RESEARCH REPORT

Evaluation of the impact of a Plano-led education program on parents' understanding of myopia and its management

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Background and rationale

The prevalence and severity of myopia are on the rise, portending a significant increase in the global burden of high myopia and its blinding complications. Myopia may be prevented, or its progression delayed, by reducing childhood exposure to its environmental risk factors, including excessive near-visual activity such as screen time, a lack of time outdoors and insufficient engagement with eye care.

Parents require adequate knowledge about myopia to better manage their children's exposure to its risk factors and thus prevent or delay its onset and progression. However, knowledge among parents is usually sub-optimal. Governments, the eyecare sector, and school administrators may increase myopia-related knowledge among parents, and thus improve their behaviour to reduce the risk of myopia among their own children, by disseminating an evidence-based digital education program about myopia and its management to parents. This report describes the design, implementation, and evaluation of a pilot parental education program about myopia and its management developed by Plano.

Objectives

The research described in this report set out to:

1. Develop an impactful parental education program about myopia and its management in children that can be readily disseminated by governments, healthcare service providers or educators as a health promotion asset to contribute to myopia control efforts.
2. Evaluate the impact of this education program by:
    a) determining the baseline level of knowledge and behaviour related to myopia and its management among parents;
    b) measuring the immediate changes in parental knowledge related to myopia and its management resulting from exposure to the program;
    c) measuring the longer-term impact (after 4 weeks) on parental knowledge and behaviour related to myopia and its management resulting from exposure to the program.

Protocol

A quasi-experimental pre-test post-test study was conducted from the 24th of May 2021 until the 29th of August 2021 to evaluate the effect of Plano's education program on parental knowledge about myopia, as well as on parental behaviours related to the management of myopia in their children. Parents residing in Singapore aged ≥21 years with at least one child aged 3-12 years were recruited to participate using a social media campaign.

At baseline (pre-test), participants completed a questionnaire divided into three sections: 1) sociodemographics and eye health status; 2) knowledge about myopia; and 3) parental behaviours regarding myopia, and then watched a 20-minute educational video on myopia directly afterwards.

Immediately after the video, participants completed a questionnaire (post-test 1) to measure immediate effects of the program on parental knowledge, following which they were emailed a PDF information booklet summarising the video for their own use.

Participants completed a questionnaire (post-test 2) four weeks later to measure longer-term knowledge retention and behaviour change resulting from Plano's educational program.

Repeated measures analysis of variance (ANOVA) was conducted to compare composite knowledge scores out of a score of 26 between pre-test, post-test 1, and post-test 2. Differences in participants' responses for each knowledge and behavioural question were analysed.

Protocol for evaluation of Plano's impact on parental knowledge and behaviour regarding myopia.

EXECUTIVE SUMMARY

Key findings

A total of 179 participants (mean ± standard deviation [SD] age = 37.3 [±5.8] years), of whom 70.4% were women with a total of 314 children (mean ± SD age = 6.6 [±4.1] years), completed all phases of the study.

Plano's educational video immediately improved mean parental knowledge scores by 18.6% (95% confidence interval [CI]: 15.0-23.3) from 51.2% (95% CI: 49.0-53.1) to 60.7% (95% CI: 58.5-63.1%) at post-test 1 ($p<0.05$).

Four weeks after completing post-test 1 and receiving the PDF booklet, the mean knowledge score of 58.5% (95% CI: 55.8-60.8) was 14.1% (95% CI: 10.5-18.0) higher than baseline ($p < 0.05$).

Large improvements were seen in the proportion of parents who gained knowledge about the prevalence (32.9% increase), age of onset (24.8% increase), and physiology (29.3% increase) of myopia, as well as the proportion who gained knowledge about safe face-to-screen viewing distances while using digital devices (67.7% increase) and the recommended daily outdoor time for children (115.2% increase).

Parents reported improvements in most of their behaviours related to managing myopia and exposure to its environmental risk factors among their children one month after receiving Plano's intervention. The proportion of children permitted to use devices daily decreased from 52.2% to 38.7%, those allowed more than 2 hours per day of screen time decreased from 11.8% to 3.8%, and those permitted more than 2 hours of uninterrupted use decreased from 9.7% to 3.3%

Interpretation of findings

Plano's digital educational program improved knowledge about myopia and motivated behavioural change to reduce childhood exposure to myopia's risk factors among parents residing in Singapore. A follow-up study will aim to further enhance the effect of the program to maximally improve knowledge and protective behaviours among parents, and dissemination of such a program to parents by clinicians, schools and governments may play an important role in public health programs that intend to address the worsening myopia crisis.

Plano's digital educational program improved knowledge about myopia and motivated behavioural change to reduce childhood exposure to myopia's risk factors among parents residing in Singapore.

BACKGROUND AND RATIONALE

Myopia as a global health challenge

Myopia is a leading cause of vision loss, affecting approximately one-third of the global population.[1] Research has shown that the prevalence of myopia is increasing around the world, with up to half of the world's population, or 5 billion people, predicted to have myopia by the year 2050.[1] Parts of Asia that have experienced economic prosperity and development in recent decades, including Singapore, South Korea and Taiwan, have been hardest hit by the myopia epidemic, with the prevalence among young adults quadrupling in the past 60 years to 80-90%.[2] Other regions such as the United States and Europe have seen somewhat less extreme but still substantial increases in the prevalence of myopia, where up to 40% of people are now affected.[3]

With the rising prevalence of myopia, there has also been a concomitant decrease in the average age at which children develop the condition, resulting in faster rates of myopic progression.[2] The result is that, by the time their myopia stabilises in teenagerhood or early adulthood, more people are experiencing myopia of greater severity.[4] Troublingly, severe myopia, known as high myopia, is associated with an increased risk of developing sight-threatening conditions such as myopic macular degeneration, retinal detachment, and glaucoma.[5-7] As many as 1 billion people are expected to have high myopia by the year 2050, placing a significant proportion of the global population at risk of irreversible vision loss.[1] Myopia and high myopia represent significant challenges to the global community in terms of personal and economic costs. Indeed, the potential lost productivity resulting from myopia already costs the global economy US$244 billion per year,[8] highlighting the pressing need to develop new interventions to reduce the burden of myopia around the world.

Singapore has been severely affected by the myopia epidemic and is often referred to as the myopia capital of the world. Research has shown that more than 10% of Singaporean infants and toddlers aged 6 to 72 months have myopia,[9] with the prevalence rising to as high as 70-80% by the time children finish secondary school.[10] People who are affected by myopia tend to have reduced quality of life, educational performance, and economic participation, and the condition costs the Singaporean healthcare system approximately US$755 million every year,[11] highlighting the need for public health interventions to manage the worsening epidemic.

Current myopia management strategies

The diagnosis, treatment and management of myopia relies on the results of timely eye examinations conducted by eye healthcare service providers such as optometrists. Children who do not undergo regular eye examinations have been found to be three times more likely to develop myopia compared to those who are examined regularly.[12] Following diagnosis of myopia, an eyecare provider may commence a variety of treatments, including correction of the child's refractive error with spectacles, contact lenses or laser surgery, or they may attempt to slow the progression of the disease through drug treatments such as atropine or pirenzepine drops,[13] or by reshaping the cornea through orthokeratology.[14]

It is now well-established that the onset of myopia may be delayed or prevented, and its progression slowed, through non-medical lifestyle interventions that reduce exposure to the disease's environmental risk factors. These include increasing outdoor activity and natural light exposure, limiting near work activity, and undergoing eye examinations once every 1-2 years during childhood.[15] Excessive use of digital smart device screens is a relatively new form of near work that has recently gained attention as an important myopia risk factor.[16-20] Children tend to engage with screens for long, uninterrupted periods, and at viewing distances that are closer than conventional near work materials such as books, likely further compounding the risk to children's eye health,[21,22] and reducing screen time has become an important component of myopia control strategies.

With the increased recognition of the key role of environmental factors in the onset and progression of myopia, reducing exposure to these factors has become a priority for clinicians and parents. In fact, as many as two-thirds of surveyed paediatric ophthalmologists have reported prescribing less digital screen time for myopia control.[23] However, clinicians are not typically equipped with comprehensive evidence-based educational materials to provide the parents of their young patients with the knowledge required to ensure that they adequately care for their children's eyes.

Myopia-related knowledge and behaviours among parents

Management of myopia - both in terms of its treatment as well as reducing exposure to its environmental risk factors - requires diligent parental supervision, particularly for young children who are not able to make informed decisions about their own behaviour. Particularly in populations where myopia onset and rapid progression occur at very young ages such as Singapore, parents must play a key role in reducing the likelihood that their children will progress to sight-threatening high myopia.

Parents require a sufficient level of knowledge about the myopia epidemic, its causes, and its management strategies to be able to implement behaviours to protect their children's eyes. Limited research has demonstrated unsatisfactory levels of knowledge and health literacy regarding myopia among parents, with one Irish study reporting that more than half of parents did not believe that myopia presented a health risk to children and that only 14% would be concerned if their child developed myopia.[24]

Research into myopia-related knowledge and behaviour among Singaporean parents has been sparse. Plano previously conducted two studies to fill this gap, both of which were published as comprehensive reports and are publicly available online. The first, titled ***What do Singaporean parents know about myopia?*** was conducted in 2018 and found that, of 326 parents surveyed, 56% correctly estimated the prevalence of myopia, 43% were aware of how many hours adolescents in Singapore spent using digital smart devices, and two-thirds were aware of the combination of protective behaviours that can be used to reduce the risk of myopia.[25] The second report, titled ***Parenting in the 21st century: Are parents well informed to manage eye health and smart device use in children?*** was conducted in collaboration with the National University of Singapore Business School and reported that up to 90% of Singaporean parents were unaware that myopia can lead to other sight-threatening eye diseases, although encouragingly, most were aware of the various management strategies that can be employed to reduce the risk of onset or progression of myopia in children.[26] About one-quarter and one-third, respectively, did not encourage their children to spend time outdoors and did not monitor their children's screen time, and three-quarters did not take their children for annual eye examinations. Together, these two surveys illustrate that a significant proportion of parents are not equipped with the requisite knowledge and do not behave optimally to mitigate the risk of myopia in their children.

The need for an evidence-based myopia education program

The lack of knowledge about myopia and implementation of its management strategies among parents demonstrates a clear need for interventions that deliver accessible, evidence-based, and authoritative education on myopia to parents. Eye health education programs, including those that target parents, teachers and children, have been shown to promote positive changes in knowledge and behaviour.[27-30] For example, after receiving a comprehensive eye health education program, the proportion of Turkish children who always wore their glasses (where required) increased from 82% to 100% (compared to 67% to 53% in controls who did not receive any program), the proportion who underwent an eye examination increased from 59% to 98% (compared to 56% to 58% in controls), and the amount of time they spent outdoors increased from 7.8 hours to 10.5 hours (compared to 8.6 hours to 7.7 hours in controls) at 6-month follow-up.[27] Among their parents who were also provided with an information booklet, the proportion who knew how frequently children should undergo eye examinations increased from 56% to 91% (compared to 57% to 63% in controls), those who knew the symptoms of visual problems increased from 55% to 96% (compared to 42% to 45%), and those who considered outdoor time very important for their children increased from 52% to 85% (compared to 65% unchanged in controls).

Similarly, a study conducted by the University of California, Los Angeles, examined whether educational pamphlets and videos for adults increased follow-up rates for eye examinations among preschool children.[29] Providing educational materials and a 3-minute video to preschool personnel and parents increased the likelihood that children would undergo a complete eye examination by 63% compared to those for whom parents and school personnel were not shown educational materials.

Despite the efficacy of educational interventions for improving knowledge and management of eye health, there has been a noteworthy lack of scaled dissemination of such programs to parents, perhaps due in part to the length and complexity of the described programs and the resource requirements for large-scale implementation. Countries with a high prevalence of myopia would benefit greatly from prioritising in their public health policies the development and distribution of an accessible and simple but comprehensive myopia education module for parents.

BACKGROUND AND RATIONALE

A myopia education program by Plano

Having identified the lack of easily accessible educational material on myopia and its management strategies for parents, Plano has drawn on its expertise and experience to design and evaluate a pilot educational program for parents. In order to ensure that it can become accessible to parents around the world, Plano's education program consists entirely of digital materials, including a short video presentation as well as a digital version of a myopia information booklet. The content of the program has been informed by the most current scientific literature on myopia.

This report describes the design, implementation, and evaluation of a pilot Plano-led parental education program about myopia and its management. It describes in detail all aspects of the project, including the objectives, significance, design, evaluation, findings, and significance.

Who will benefit from this report?

The findings presented in this report will benefit a diverse range of stakeholders for different reasons. These include:

- **The Plano Research and Analytics Team:** This study was a research and development (R&D) project that aimed to understand how effective a pilot version of Plano's parent-focused education program would be for changing knowledge and behaviour regarding myopia and its management. The findings will directly inform improvements in the development of subsequent interventions to increase their impact.

- **Eye healthcare providers:** Optometrists and ophthalmologists will note that exposure to the intervention described in this study produced significant changes in parental knowledge and behaviour regarding myopia, and they may wish to contact Plano to request access to educational materials to supplement their treatment and management of myopia among their patients.

- **General practitioners and paediatricians:** Clinicians who regularly treat children may request access to Plano's educational materials and provide them to their young patients' parents in order to help them to prevent the onset and progression of myopia in their children.

- **Schools:** Although this program has been designed for parents, teachers and school administrators may equally benefit. School teachers may access Plano's interventions to educate themselves and will likely provide their students with adequate time outdoors and eye breaks during school hours. Schools may also disseminate the materials to the parents of their students.

- **Parents:** This report contains sufficient detail to inform parents about myopia and its management, and they may use its contents to improve their own management of their children's exposure to the environmental risk factors for myopia.

- **Children:** The children of correctly informed parents will benefit as their exposure to myopia risk factors will be reduced accordingly. If children are appropriately protected, then the epidemics of both myopia and screen dependency may be controlled, ultimately benefiting society.

OBJECTIVES

The research described in this report set out to:

1. Develop an impactful parental education program about myopia and its management in children that can be readily disseminated by governments, healthcare service providers or educators as a health promotion asset to contribute to myopia control efforts.

2. Evaluate the impact of this education program by:

    a) determining the baseline level of knowledge and behaviour related to myopia and its management among parents;
    b) measuring the immediate changes in parental knowledge related to myopia and its management resulting from exposure to the program;
    c) measuring the longer-term impact (after 4 weeks) on parental knowledge and behaviour related to myopia and its management resulting from exposure to the program.

PROTOCOL

Overview and study design

This study evaluated the effect of a Plano-led education program on parental knowledge about myopia and its management, as well as on parental behaviours related to the management of myopia, through a quasi-experimental study using a pretest-posttest design **(Figure 1)**. Data collection occurred from the 24th of May 2021 until the 29th of August 2021. Parents were recruited using a social media advertising campaign. Those who participated in the study completed a baseline questionnaire on myopia-related knowledge and behaviour, following which they were required to watch a 20-minute educational video. Participants then completed the questions pertaining to knowledge about myopia again (post-test 1) to allow comparison of their knowledge before and after exposure to the program. Each participant was then sent an electronic booklet summarising the information contained in the presentation for their own use. Participants completed the knowledge and behavioural questions again four weeks after exposure to the educational video (post-test 2), and their results were compared with those at baseline and post-test 1 to ascertain whether any changes in knowledge, if any, persisted long-term, as well as to determine whether behaviours or intended behaviours related to the management of myopia and its risk factors changed following the program.

Figure 1. Overview of the study design

Setting and participant recruitment

The target population for this study was parents residing in Singapore aged 21 years or older with at least one child aged 3-12 years old. No specific exclusion criteria were applied within the target population, and parents of children both with and without myopia were eligible to participate to avoid any systematic influence of myopia status on parental knowledge and behaviour.

A sample size calculation determined that, in order to reliably detect a change in overall knowledge of at least 10% across three timepoints (pre-test, post-test immediately and post-test after 4 weeks), a total of 163 participants were required. To accommodate a loss-to-follow-up rate of 20%, the study aimed to recruit a total of 202 participants at baseline.

Recruitment was conducted through a social media advertising campaign. During the study period in 2021, the COVID-19 pandemic imposed significant restrictions on conducting in-person field-based survey research due to concerns surrounding transmission of the virus. To entirely circumvent any risk of exposure, all participants were recruited and surveyed online.

The social media recruitment campaign consisted of three adverts published on Facebook, Messenger, and Instagram **(Figure 2**). Advert 1 was a traffic advert which, when clicked, led users to the survey hosted on Qualtrics (Provo, UT), where a description of the study was displayed. Advert 2 was a lead generation advert which, when clicked, allowed the user to register their contact details and interest in participating in the survey at a later date. Advert 3 was a video that contained information about the survey which, when clicked, led users to the survey hosted on Qualtrics, where a description of the study was displayed. All three adverts contained a headline, a statement that participants will receive S$100 following the completion of all three surveys, and a “Learn more” button to direct users to participate.

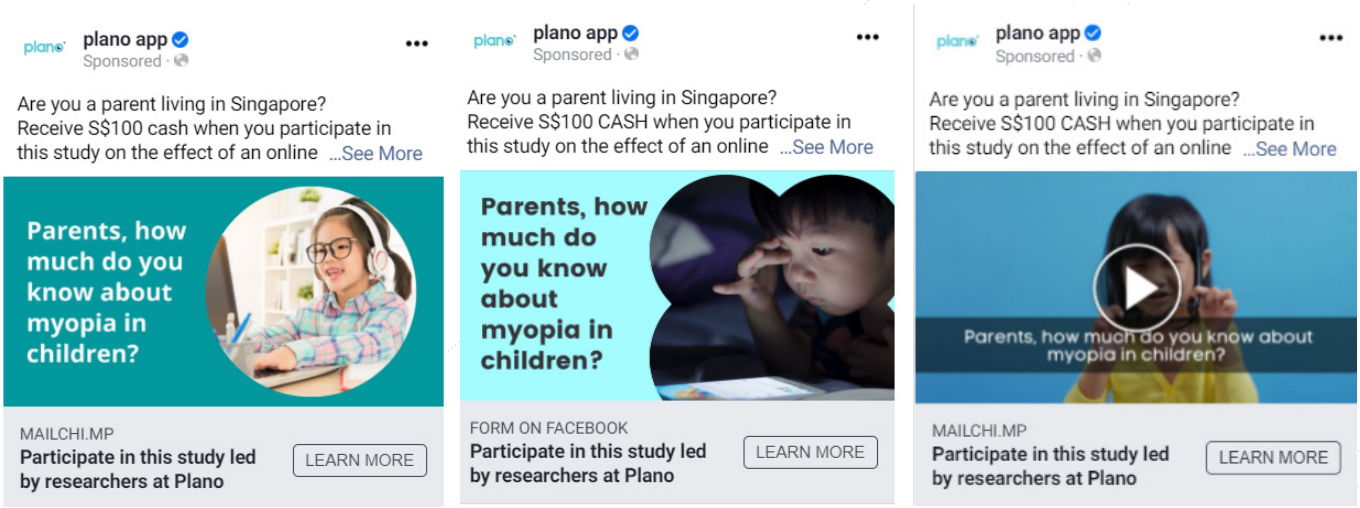
The adverts were targeted to the intended audience by specifying the required gender (men and women), age (21-65+ years), location (Singapore), demographics (parents with children aged 3-12 years), and interests (parenting, motherhood, and fatherhood). The age range of 21–65+ years was selected because 21 years is the legal adult age in Singapore and 65+ years is the maximum age option on Facebook. Detailed targeting was utilised, where the demographics specified parents with pre-school/kindergarten children (3-5 years old), primary school-age children (aged 6-8 years old) and pre-teens (aged 9-12 years old).

PROTOCOL | Setting and participant recruitment

Upon landing on the Qualtrics survey page, interested parents were presented with three questions to confirm eligibility:

1. Do you reside in Singapore?
2. Are you aged 21 years or older?
3. Do you have at least one child aged 3 years or older?

Those who responded 'No' to any of the three questions were not able to participate in the survey and were thanked for their time. Those who responded 'Yes' to all three questions were deemed eligible and were required to provide consent to their data being used for this study. After providing consent, participants were able to proceed to the survey.



Advert 1 Advert 2 Advert 3

Figure 2. The social media adverts used to recruit participants to the study

Study procedures

Baseline (pre-test) questionnaire

Participants were presented with information about the study and were instructed to complete the pre-test questionnaire. The questionnaire (summarised in **Figure 3**) consisted of three sections that included a total of 33 unique question items. The full questionnaire is provided in Appendix 1. The first section of the questionnaire included questions pertaining to the socio-demographic characteristics and eye health status of participants and their children, with parents being able to provide data for each child if they had up to seven children. In the second component, knowledge about myopia and its management was assessed with ten 4-option multiple choice questions with one correct answer, three 5-option multiple choice questions with more than one correct answer, and two 7-option multiple choice questions with more than one correct answer. The third section contained eight questions that collected information about parents' behaviour regarding the management of myopia and exposure to its environmental risk factors in their own children, with parents being able to provide data for each child if they had up to seven children.

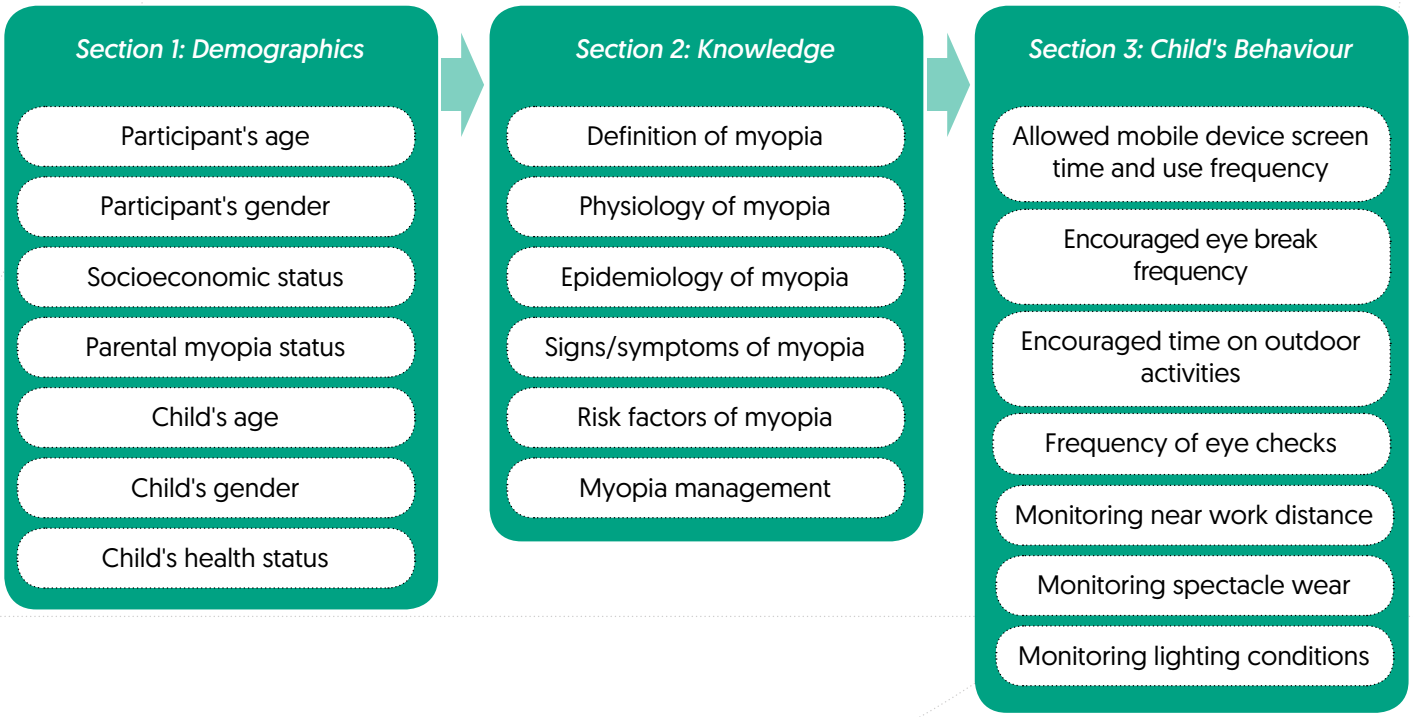


Figure 3. The three sections of the questionnaire and their respective components

PROTOCOL | Study procedures

Intervention part 1: Educational video on myopia and its management

Upon submitting their responses to the pre-test questionnaire, participants were required to watch the educational video developed by Plano. The video was hosted on YouTube and embedded as a plugin, with control functions disabled so that participants were required to watch the entire video without being able to skip or fast-forward. The 20-minute video consisted of a narrated PowerPoint presentation that contained six sections: 1) introduction, 2) the epidemiology of myopia, 3) understanding myopia, 4) risk factors for myopia, 5) myopia management, and 6) summary and recommendations. **Table 1** provides more detail of the contents of each section.

Table 1. Outline of the parental education program

Section	Topics
Introduction	Introduction to the program
Epidemiology of myopia	A. Introduction to myopia B. Prevalence of myopia in Singapore and globally C. Economic and societal impacts of myopia
Understanding myopia	A. Pathogenesis of myopia B. Signs and symptoms of myopia C. High myopia D. Common ocular complications resulting from myopia & high myopia
Risk factors for myopia	A. Genetic risk factors B. Environmental risk factors • Excessive near work • Lack of outdoor activity
Myopia management	A. Myopia correction • Regular spectacles and contact lenses • Refractive surgery: LASIK, LASEK, PRK B. Myopia control 1. Lifestyle interventions of myopia • Managing reading and device use distance • Encouraging outdoor activities • Monitoring screen time • Taking regular eye breaks • Managing lighting conditions • Going for regular and timely eye checks 2. Healthcare interventions of myopia • Myopia control spectacles and contact lenses • Orthokeratology • Pharmacologic: atropine, pirenzepine
Summary & recommendations	A. The importance of going for regular and timely eye checks B. The need to balance outdoor and near work time C. The importance of adopting healthy device use behaviours

Post-test questionnaire 1

Immediately after completion of the video, participants completed the first post-test questionnaire which contained the same knowledge questions as the pre-test questionnaire to allow comparison of the level of knowledge among parents for the same topics related to myopia before and after the intervention.

Intervention part 2: Summary information booklet

Following completion and submission of post-test 1, participants were thanked for their time and an email was sent to their provided email address containing a PDF booklet containing a summary of the information presented in the video, for personal use.

Post-test questionnaire 2

Participants were contacted via email four weeks after viewing the video presentation to complete the second post-test questionnaire. Participants were given one week to complete the questionnaire from the time they received the email. Those who failed to complete the questionnaire after one week received two follow-up emails, one week apart. Participants who still failed to complete the questionnaire were discharged from the study.

The second post-test questionnaire consisted of the same knowledge questions as the pre-test and post-test 1 to allow comparisons of the level of knowledge between the three timepoints. The behavioural questionnaire assessed the same behaviours as the pre-test questionnaire but specifically during the four weeks since exposure to Plano's intervention. A minor modification was required to accommodate the relatively short interval of four weeks compared to the recommended interval of 1 – 2 years for eye examinations, and this questionnaire assessed whether exposure to the intervention resulted in a likely change in parental motivation to change behaviour related to the prevention or management of myopia in their children. Following completion of the post-test 2 questionnaire, participants were thanked for their participation and received their reimbursement in the mail.

Statistical analysis

De-identified data were downloaded from the Qualtrics server and imported into the R statistics software (version 4.1.0) for analysis. Descriptive statistics were used to summarise the participants' sociodemographic characteristics and responses to questions. R was used to generate graphs of summary descriptive statistics. Microsoft Excel (Microsoft, United States) was used to generate graphs of the percentage of participants who selected each option for all knowledge and behavioural questions, with pre-test, post-test 1, and post-test 2 presented in parallel for knowledge questions and pre-test and post-test 2 presented in parallel for behavioural questions to facilitate comparisons between timepoints.

Participants received a score of 1 for each correct response to the knowledge questions, and a composite total knowledge score was calculated for each participant by adding the scores for each question. For questions with more than 1 correct answer, 1 point was awarded for each correct answer selected, and 1 point was deducted for each incorrect answer selected. The highest achievable composite score for answering all 15 knowledge questions correctly was 26. It was observed *post-hoc* that many participants experienced confusion between question 14 which pertained to the *correction* of myopia and question 15 which pertained to the *slowing or prevention* of myopic progression. Both of these questions had multiple correct answers, and their similar wording likely resulted in conflation of myopia correction and control. Thus, a secondary analysis was conducted in which these questions were excluded from the composite knowledge scores, wherein the highest achievable composite score was 20. Repeated measures analysis of variance (ANOVA) was used to determine whether there was a significant difference in mean composite knowledge scores between pre-test, post-test 1 and post-test 2. Bonferroni's correction was used to do post hoc pairwise comparisons of composite knowledge scores between each of the three time points.

Multiple linear regression was used to determine whether certain characteristics of participants were significantly associated with differences in mean composite knowledge scores at each of the three timepoints as well as whether these factors were associated with significant changes in knowledge after exposure to the intervention. Factors included in regression were: age, gender, ethnicity, education, salary, parental myopia status, number of children, myopia status of children, and whether participants' children had undergone an eye examination within the past two years. A p-value of 0.05 was used for statistical significance.

KEY FINDINGS

Participant characteristics

A total of 272 participants completed the baseline or pre-test questionnaire. Of these, 200 (73.5%) watched the full video presentation and completed the post-test 1 questionnaire at first follow-up, while the post-test 2 questionnaire at second follow-up was completed by 179 participants, which was 65.8% of baseline participants and 89.5%% of those who completed post-test 1.

Figure 4 shows the demographic characteristics of the 179 participants who completed all three questionnaires. The mean [± standard deviation (SD)] age of participants was 37.3 [±5.8] years, with more than one-third being 35-39 years old. The majority of the participants were women (70.4%) of Chinese ethnicity (82.7%), with either one (41.3%) or two (41.9%) children. For 77.1% of respondents, at least one parent in the family had myopia, while 42.5% had two myopic parents.

KEY FINDINGS

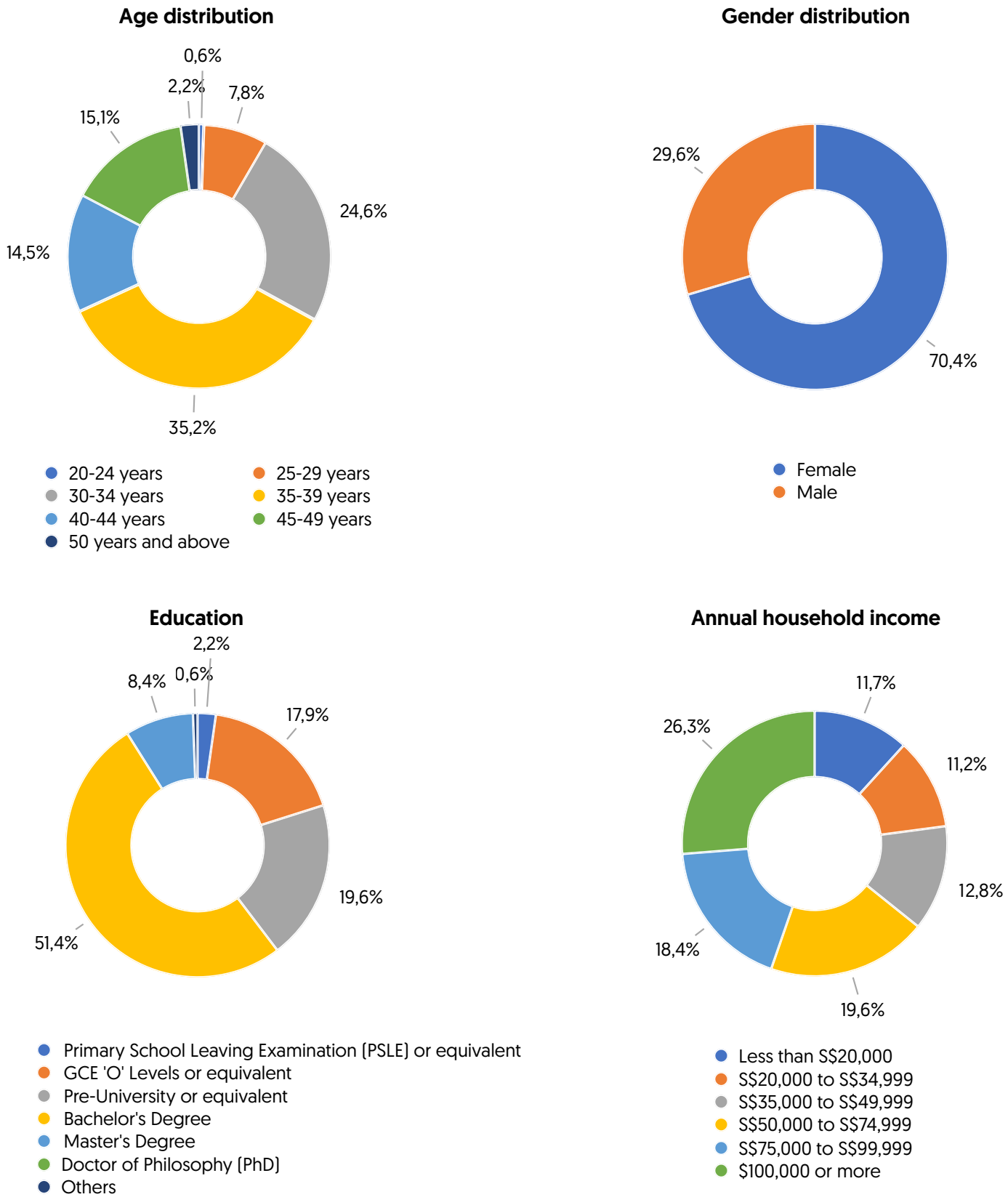


Figure 4. Participant characteristics

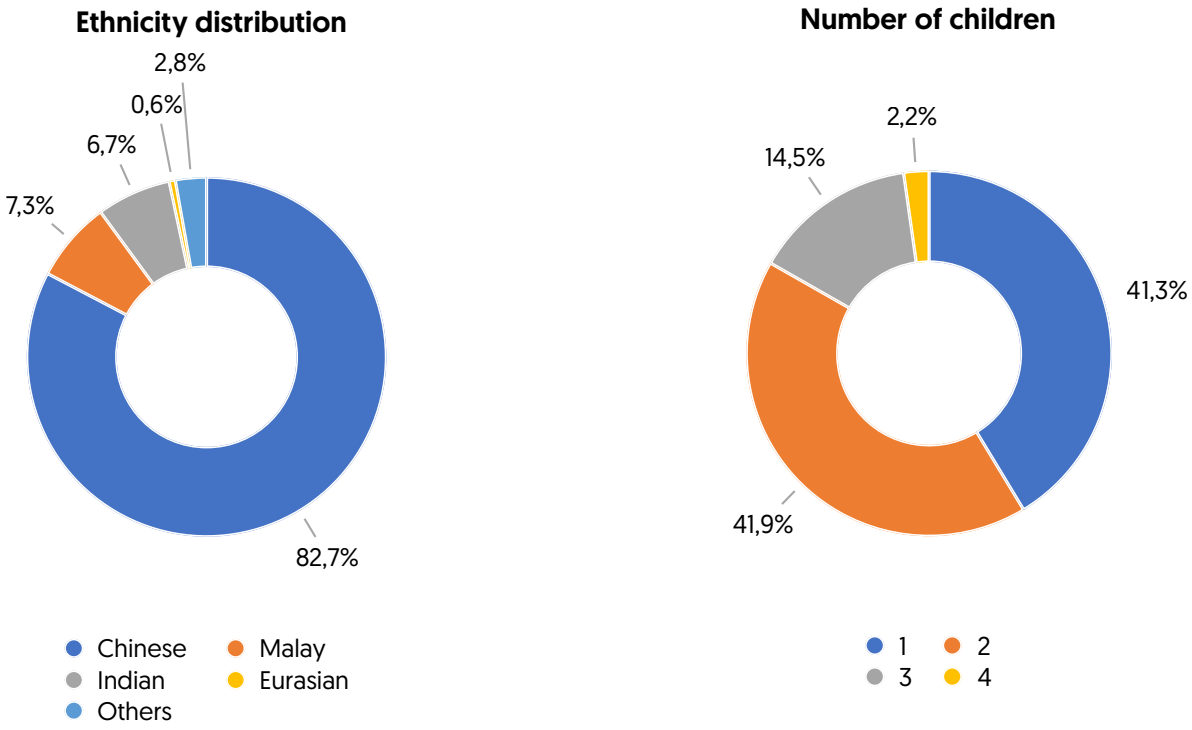


Figure 4 continued

KEY FINDINGS

Characteristics of participants' children

There were 314 children between the 179 participants. The mean [±SD] age of participants' children was 6.6 [±4.1] years, with just under half [44.5%] aged 7 years or above and thus in the high-risk age group for developing myopia **(Figure 5)**. Myopia was reported in 17.2% of children, however the eye health status of 14.3% of children was not known. Fewer than half of children had undergone an eye examination within the past year, and more than one-third had never undergone an eye examination.

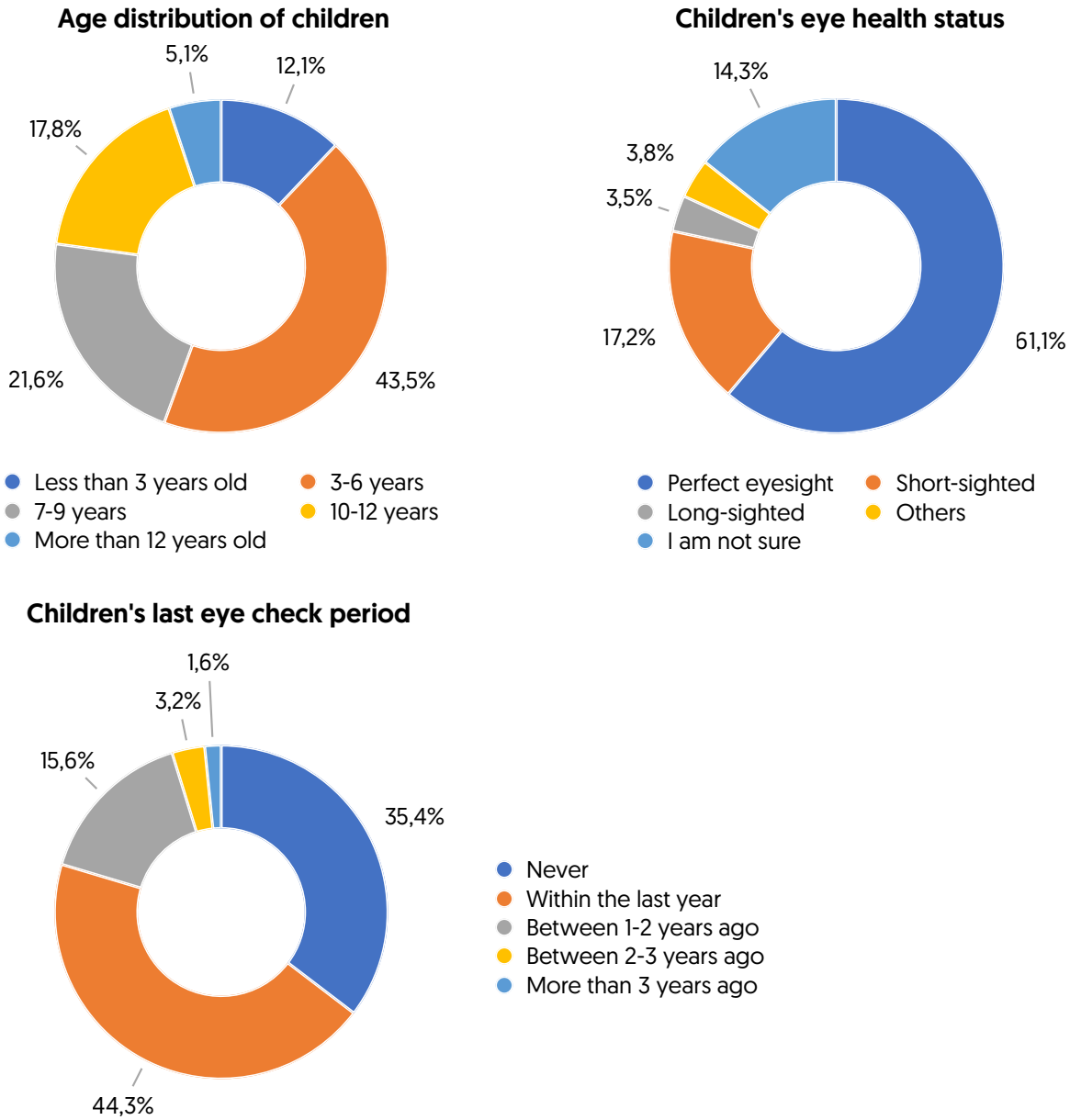


Figure 5. Characteristics of participants' children

Participants' knowledge about myopia and its management

Comparing composite knowledge scores before and after the intervention

Among all 15 knowledge questions, the mean composite knowledge score at baseline was 13.3 (95% confidence interval [CI]: 12.7-13.8) out of a possible score of 26, or 51.2% (95% CI: 49.0-53.1). Repeated measures ANOVA found that there was an overall statistically significant difference between the mean composite knowledge scores across the three testing time points ($p < 0.05$). Post hoc pairwise comparisons revealed that the video presentation was associated with an immediate and statistically significant increase of 2.5 points (relative increase of 18.6% [95% CI: 15.0-23.3]) to 15.8 (95% CI: 15.2-16.4) or 60.7% (95% CI: 58.5-63.1%) out of 26 at post-test 1 ($p<0.05$).

Most of this increased knowledge was retained 4 weeks later at post-test 2, showing a small 4.3% (95% CI: 1.1-7.6) but significant regression to a score of 15.2 (95% CI: 14.5-15.8) or 58.5% (95% CI: 55.8-60.8, $p < 0.05$), which itself remained statistically significantly higher (by 14.1%, 95% CI: 10.5-18.0) than the pre-test score ($p<0.05$).

ANOVA also showed a significant difference between the mean composite knowledge scores upon exclusion of responses to questions 14 and 15, which appeared to be a source of confusion for many participants (as seen in the low post-test knowledge in these domains). Pairwise analysis showed that the mean baseline score of 11.4 (95% CI: 10.9-11.9) out of a possible 20 or 57% (95% CI: 54.5-59.6) increased significantly by 21.1% (95% CI: 17.5-24.6) to 13.8 (95% CI: 13.3-14.3) or 69.0% (95% CI: 66.5-71.5%) at post-test 1 ($p<0.05$), and subsequently regressed by 4.2% (95% CI: 1.4-7.2) to 13.2 (95% CI: 12.7-13.8) or 66.0% (95% CI: 63.5%-69.0%, $p < 0.05$), remaining 16.0% (95%CI: 12.3-20.2) higher than baseline ($p < 0.05$).

The histograms in **Figure 6** highlight that, compared to pre-test, the distribution of participants' composite knowledge scores at post-test 1 and post-test 2 were considerably more negatively skewed, with a greater number of participants achieving scores in the higher range, whereas at pre-test, most participants' scores were more tightly clustered at a lower range. This was particularly evident when questions 14 and 15 were excluded, where 43% of participants scored 15 out of 20 or higher at post-test 1, compared to just 16% at pre-test - however, some of these higher scorers lost a portion of their knowledge at post-test 2, as seen in the leftward migration of the distribution of scores compared to post-test 1, with 30% scoring 15 or more points.

KEY FINDINGS | Participants' knowledge about myopia and its management

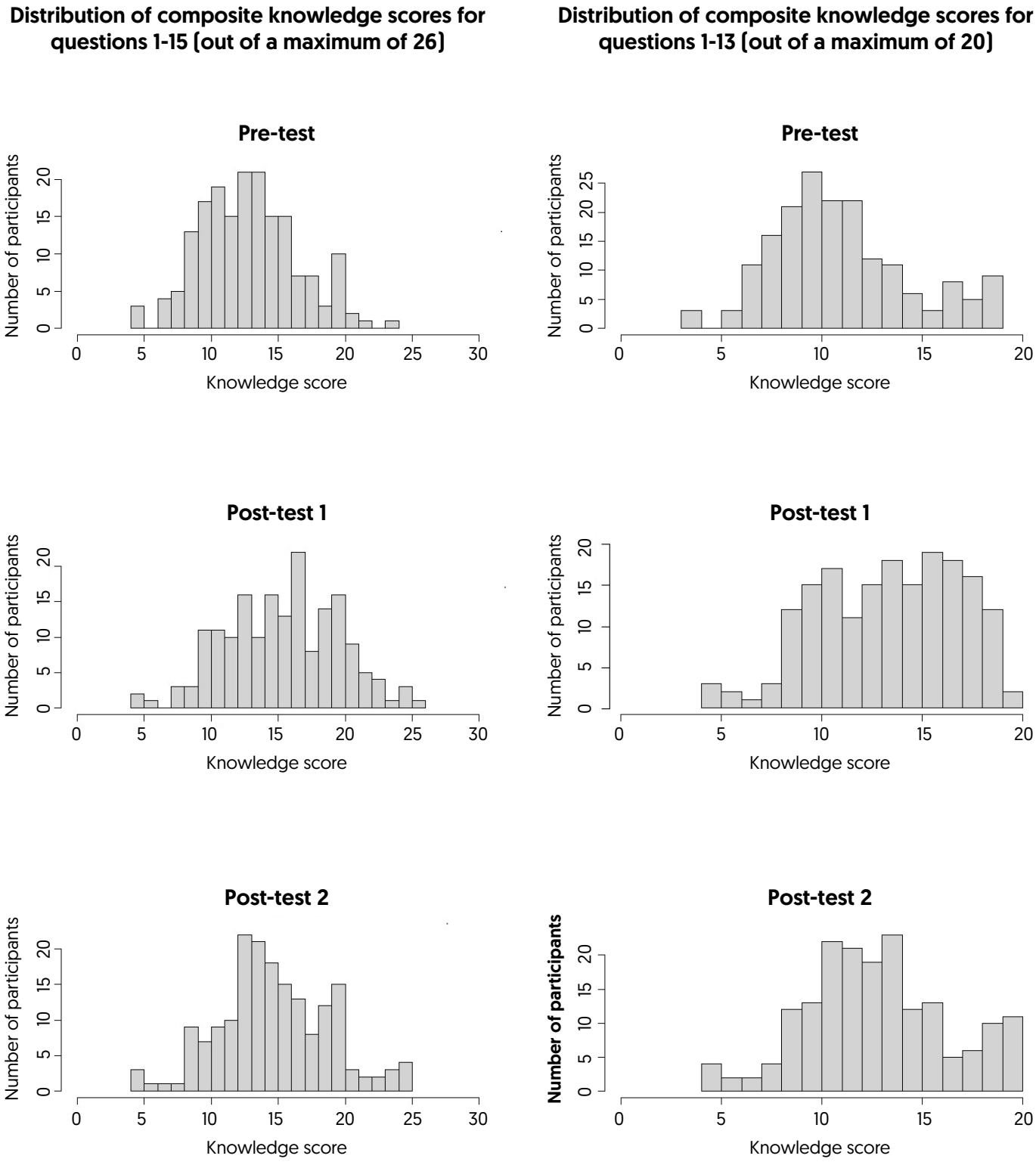


Figure 6. Histograms showing the numbers of participants achieving different composite scores for their responses to questions about myopia and its management before exposure **(pre-test)** to Plano's educational intervention, immediately after exposure to an educational video **(post-test 1)** and 4 weeks later after receiving a summary PDF booklet **(post-test 2)**

The boxplots in **Figure 7** also illustrate the upward trend in the distributions of the knowledge scores across the three timepoints. With questions 14 and 15 included, achieving the highest score of 24 out of 26 was a mathematical outlier prior to the intervention, whereas at post-test 2, the lowest scores were seen to be outlier values.

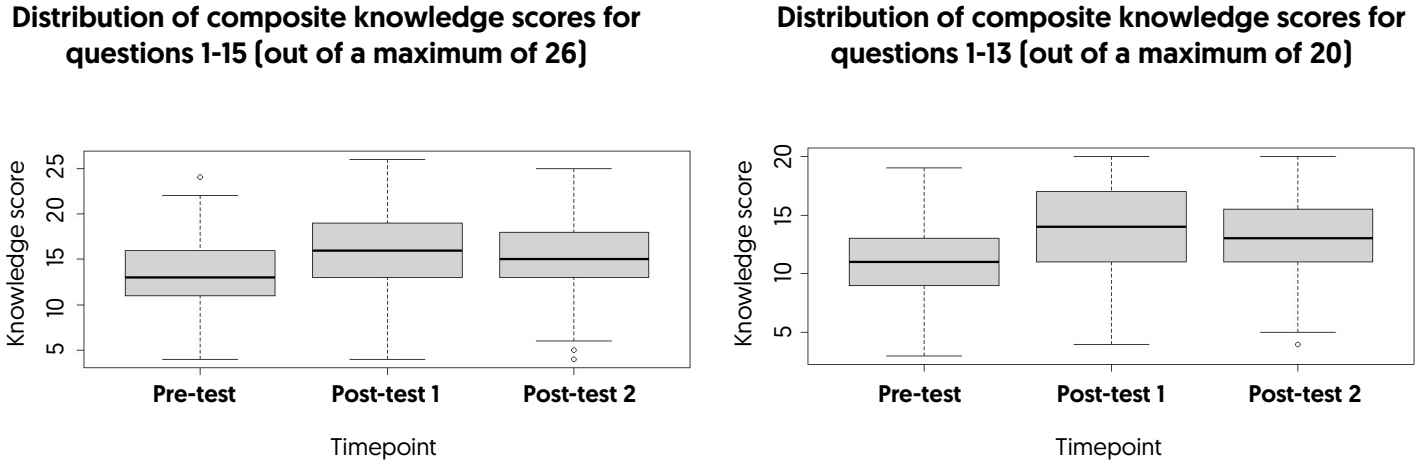


Figure 7. Boxplots showing the distribution of composite knowledge scores for participants' responses to questions about myopia and its management before exposure **(pre-test)**, immediately after exposure to an educational video **(post-test 1)** and 4 weeks later after receiving a summary PDF booklet **(post-test 2)**

Factors associated with differences in knowledge about myopia

Regression analysis revealed that knowledge scores were higher among men than women (14.7 vs 12.7, $p < 0.05$) and among those of Chinese vs non-Chinese ancestry (13.6 vs 11.7, $p < 0.05$) at baseline. At post-test 1, these differences were no longer observed, but participants with a bachelor's degree had higher absolute knowledge scores (13.6 vs 12.9, $p < 0.05$) and larger relative knowledge gains ($p < 0.05$) from pre-test to post-test 1 than those who did not have a bachelor's degree. At post-test 2, men were again seen to have higher knowledge scores (16.4 vs 15.6, $p < 0.05$) and better retention from post-test 1 to post-test 2 ($p < 0.05$) than women. Those with a bachelor's degree continued to have better mean knowledge scores (15.9 vs 14.3, $p < 0.05$), and had better retention from post-test 1 to post-test 2 ($p < 0.05$) than those who did not have a bachelor's degree, while those with 3 or more children had significantly less knowledge than those with one child (14.4 vs 15.7, $p < 0.05$).

KEY FINDINGS | Participants' knowledge about myopia and its management

Comparing responses to each knowledge question before and after the intervention

Proportions of participants who selected each response to questions pertaining to the definition, epidemiology, physiology, signs and symptoms, and risk factors of myopia are provided in **Figure 8**. Most participants (86.6%) knew the definition of myopia at baseline, with slight improvements following exposure to the video (87.2%) and again four weeks later after receiving the summary information booklet (92.2%). Slightly more than half (55.6%) were aware at baseline that myopia typically develops during primary school, with the proportion remaining virtually unchanged at post-test 1, but increasing by a relative 26% to almost 70% at post-test 2. Similarly, only half of participants knew the prevalence of myopia in Singapore prior to receiving the intervention, but this increased to 59.8% and 65.4% at post-test 1 and 2, respectively. The proportion of participants who understood that the basic physiology of myopia involves the focusing of light in front of the retina saw a relative increase of almost 30% from 55.3% before the intervention to 71.5% immediately after the video, with a slight dip to 69% at post-test 2, while the proportion of those who knew that myopia resulted from a combination of genetic and environmental factors increase from less than two-thirds to almost three-quarters from pre-test to post-test 2.

At baseline, most participants correctly responded that having problems reading from a whiteboard (88.8%), frequently holding books or mobile devices too close to the eyes (83.8%), and excessive blinking and eye rubbing (76%) were symptoms of myopia, and the proportion who selected these correct responses increased at post-test 1 (92.2%, 92.7%, 84.4%), with these improvements being largely maintained or further improved at post-test 2 (93.3%, 89.9%, 89.4%). However, selection of the incorrect responses of frequently experiencing eye pain and sensitivity to light also increased considerably, thus resulting in only a modest overall increase from a mean of 1.92 to 1.98 and 1.97 out 3 points for this multiple-option question.

Knowledge about which eye problems were associated with myopia and high myopia was poor at baseline, with one-third or less being aware that glaucoma, cataracts, and retinal detachment were associated with myopia and participants achieving a mean of 1.5 out of 4 points. This knowledge improved considerably following the video presentation with almost two-thirds selecting each of these diseases as associated conditions, and the mean score therefore increased to 2.32 out of 4.

However, some of this knowledge was lost after 4 weeks despite participants possessing a summary PDF with this information, resulting in a regression to a score of 1.85, owing in part to more participants incorrectly attributing dry eye as a condition associated with myopia. Overall knowledge about the environmental risk factors of myopia increased from 2.01 to 2.38 out of a total of 3 points following exposure to the video presentation, with a slight regression to 2.26 at post-test 2. While almost all (98.3%) participants knew that spending long hours on near work activity and a majority (78.8%) knew that a lack of outdoor time were myopia risk factors, only 31.8% correctly identified urban dwelling as a risk factor at baseline. Exposure to the intervention increased the proportion who correctly identified both a lack of outdoor time (93.3% and 93.9%) and urban dwelling (55.3% and 49.2%).

Knowledge about myopia prevention and management **(Figure 9)** was generally poor before exposure to the intervention, with two exceptions: 88.8% of participants were aware that children should take breaks from near work at least once every 30 minutes and 92.2% knew that children should undergo an eye examination every 1-2 years, with the latter further improving to 99% at post-test 1 and 98% at post-test 2. In contrast, only half knew the recommended safe viewing distance for near-vision materials (≥30 cm), and only one-quarter knew the recommended minimum time children should spend outdoors (2 hours) and the maximum time children aged ≥5 years should spend looking at digital screens (2 hours) at baseline. However, knowledge in these domains also improved considerably after the intervention, with the proportion who knew the safe viewing distance jumping to above 80% and the proportion who knew the recommended outdoor time more-than-doubling to above 50% at both post-tests, although knowledge of screen time limits saw a more modest improvement to 39.1% at post-test 1 and a regression to 29.6% at post-test 2.

As previously mentioned, question 14, which explored participants' knowledge of methods for correcting myopia, and question 15, which explored their knowledge of methods to prevent or slow the progression of myopia, appear to have been conflated in the minds of some participants. This likely resulted from very similar wording and identical answer options being used in both questions, as well as a possible lack of clarity in the video to distinguish the concepts of correction vs control of myopia. Following the video presentation, fewer participants selected the correct option of regular spectacles (82.1% to 72.6%) while more selected the incorrect options of atropine (29.1% to 43.6% and 52%) and pirenzepine (7.8% to 26.8% and 29.1%) drops as methods for myopia correction (which are agents used to slow the progression of myopia and are thus correct answers for the following question) at both post-test assessments, thus resulting in an overall lower mean score out of 3 for this question after exposure to the intervention (1.11 and 1.12 at post-tests 1 and 2 compared to 1.46 at pre-test).

KEY FINDINGS | Participants' knowledge about myopia and its management

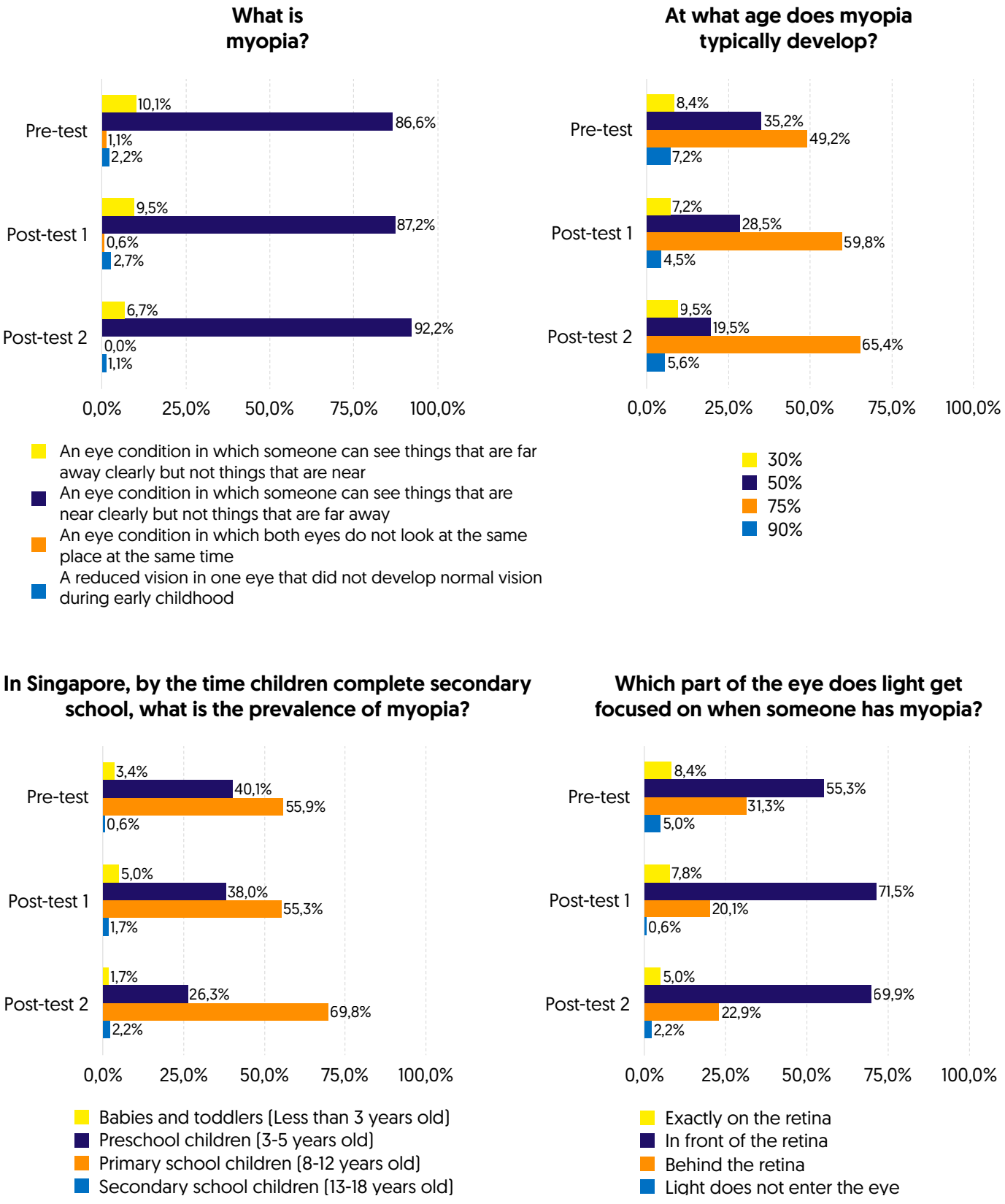
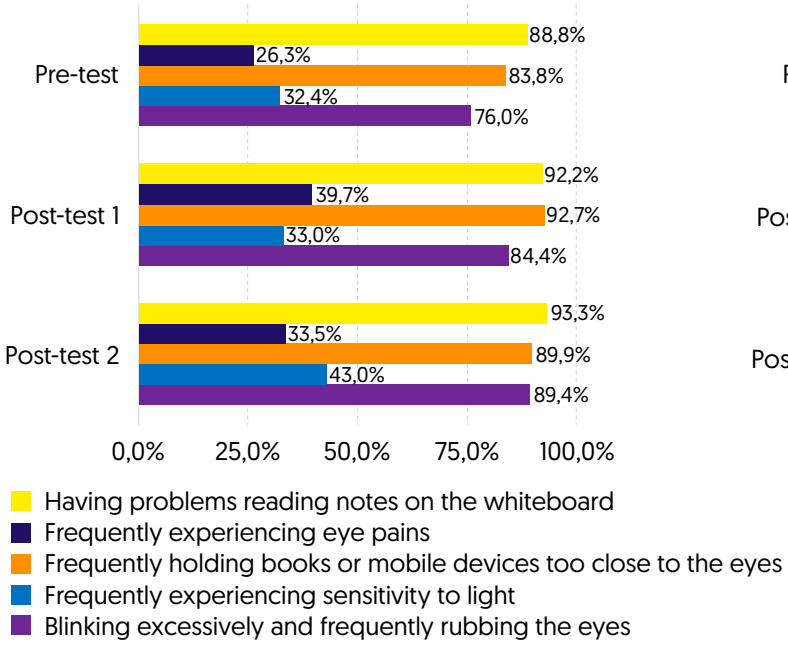
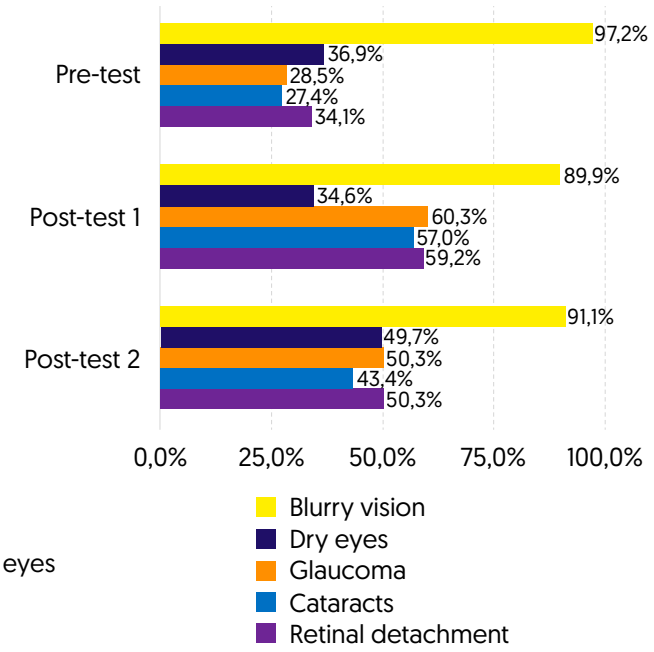


Figure 8. Participant responses to questions about the definition, physiology, epidemiology, signs & symptoms, and risk factors of myopia

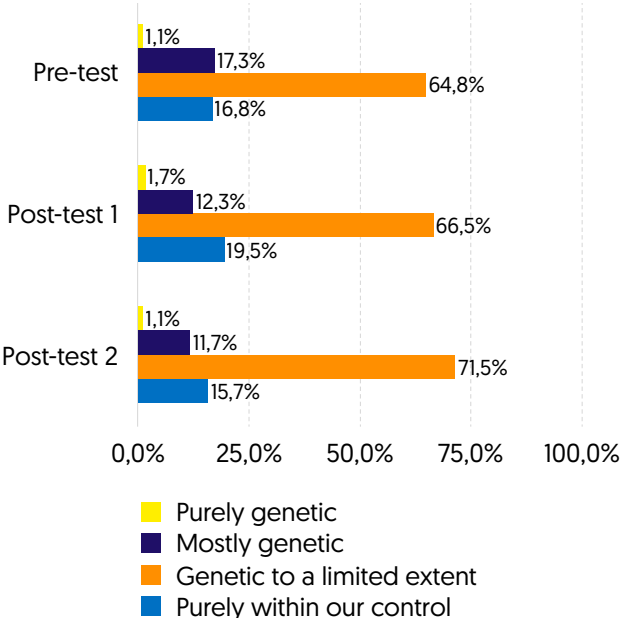
Which of the following are some of the signs and symptoms of myopia in children?
(you may select more than one option)



Which of the following eye problems are associated with myopia and high myopia?
(you may select more than one option)



To what extent is the cause of myopia due to genetic factors?



Which of the following are some of the environmental risk factors for myopia?
(you may select more than one option)

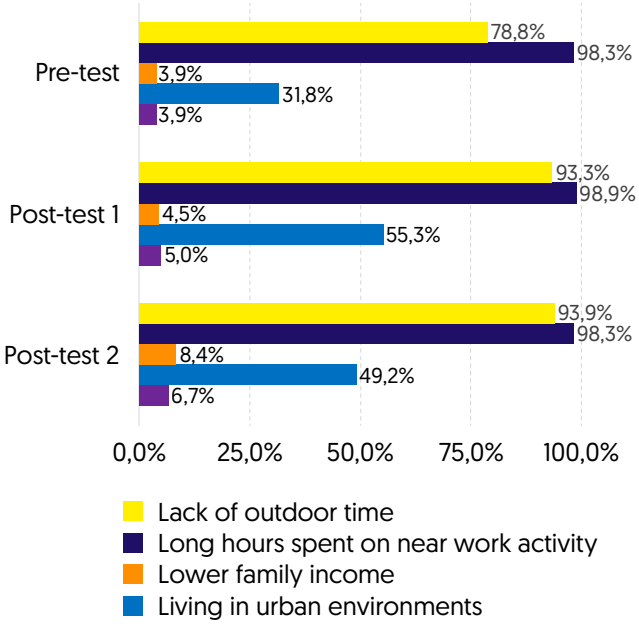


Figure 8 continued

KEY FINDINGS | Participants' knowledge about myopia and its management

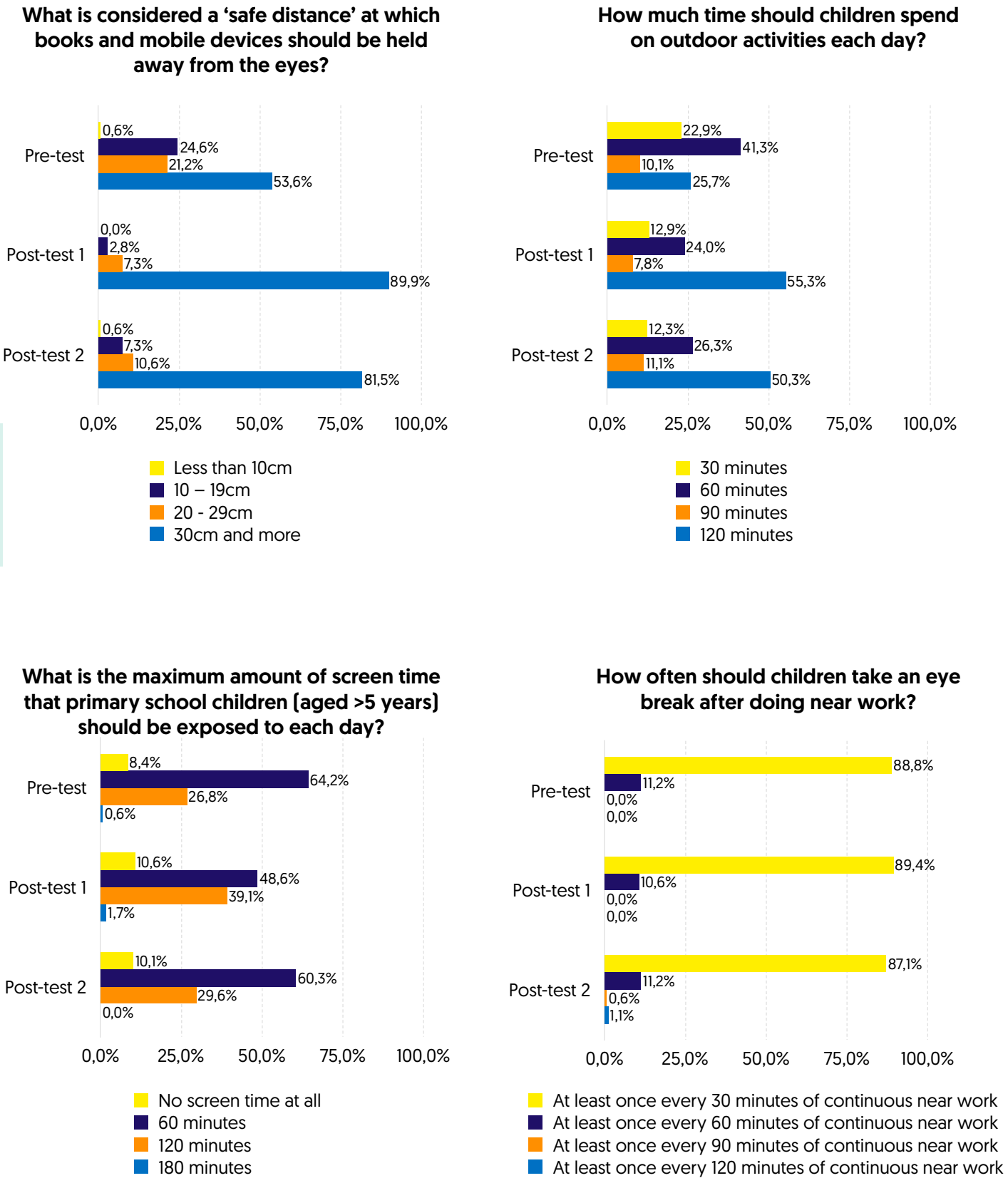
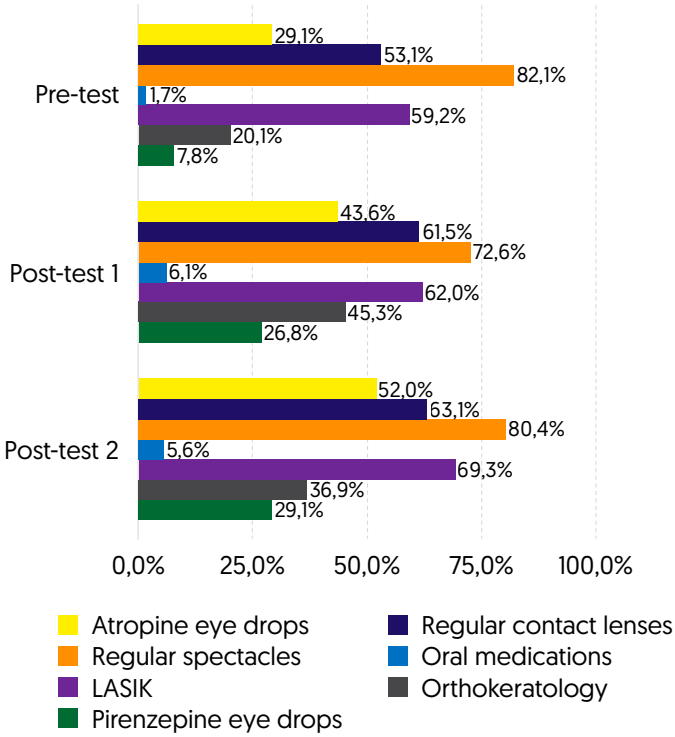
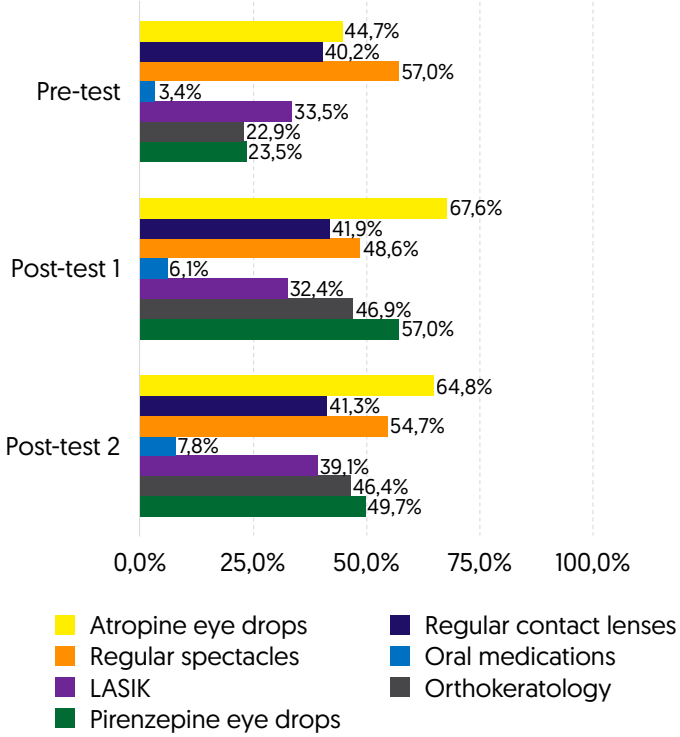


Figure 9. Participants' responses to knowledge-based questions about myopia prevention, management, and treatment

Which of the following are some of the interventions that are used to correct myopia?
(you may select more than one option)



Which of the following are some of the healthcare interventions that may slow or prevent the progression of myopia?
(you may select more than one option)



How often should you take your children for an eye check?

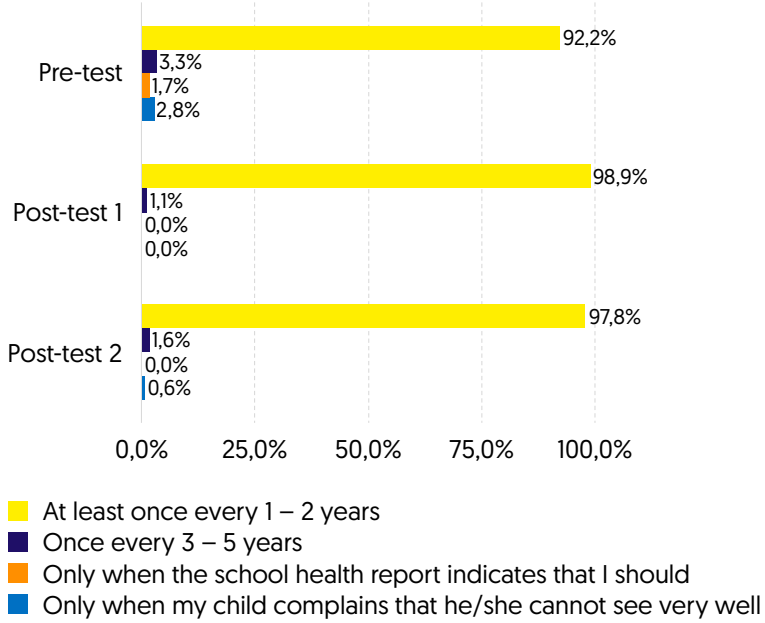


Figure 9 continued

Participants' behaviours relating to the management of myopia and exposure to its risk factors in their children

Parents reported improvements in most of their behaviours related to managing myopia and exposure to its environmental risk factors among their children one month after receiving Plano's intervention, with particularly noteworthy improvements in their management of their children's engagement with mobile smart devices and other near-vision materials **(Figure 10)**. For instance, the proportion of children who were allowed to use devices daily decreased from 52.2% to 38.7% and, on days during which children were permitted to use devices, their screen time was reduced, with the proportion using devices for more than 2 hours per day decreasing from 11.8% to 3.8%. Fewer children were allowed very long-duration episodes of more than 2 hours of continuous engagement with near-vision materials including device screens, decreasing from 9.7% to 3.3%, however, there was only a very marginal improvement from 44% to 46.5% in the proportion who complied with the recommended maximum duration of 30 minutes. Almost all parents encouraged a safe viewing distance (97.7%) and adequate ambient lighting (98.8%) while using near-vision materials such as device screens after the intervention, compared to 85.4% and 89.2%, respectively, beforehand.

While the proportion of children who were encouraged to spend 2 hours or more of time outdoors in line with recommendations remained unchanged, outdoor time was generally reported to have increased after the intervention, with 48.4% spending at least 1 hour per day outdoors compared to only 32.4% beforehand. Encouragingly, while the parents of only 56.6% of children reported taking their children for annual or biennial eye examinations at baseline, exposure to the intervention resulted in the parents of 89.6% reporting that they have taken or intend to take their children for eye examinations at the recommended frequency.

KEY FINDINGS | Participants' knowledge about myopia and its management

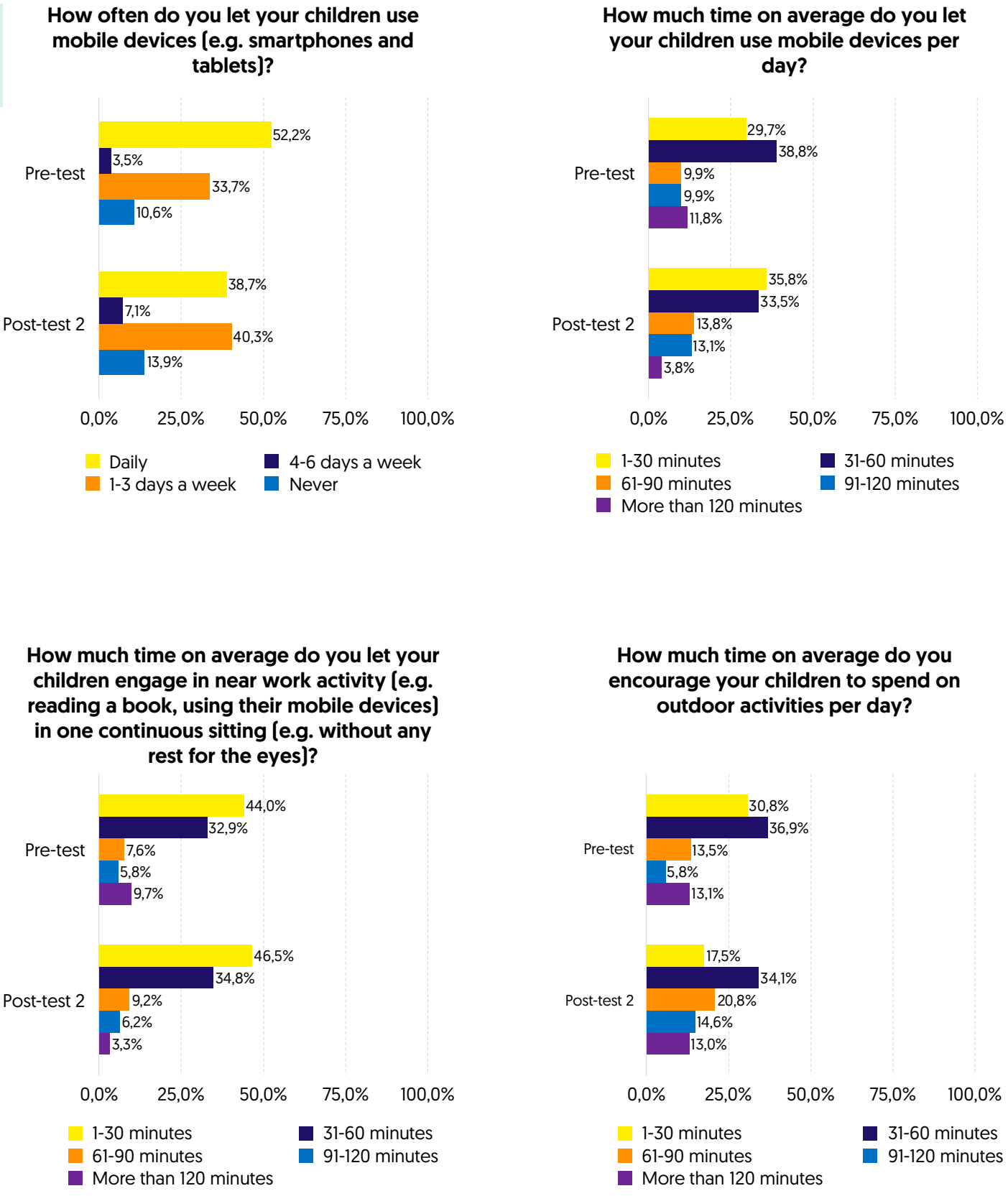
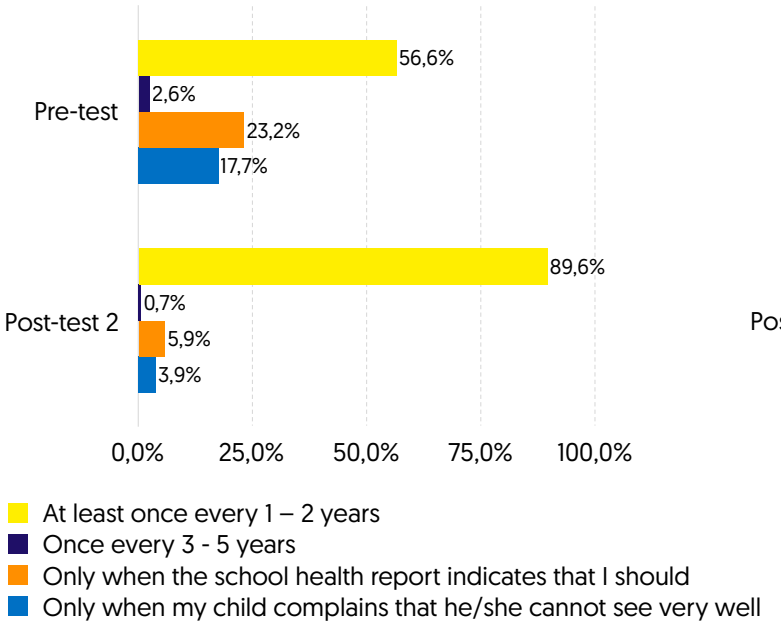
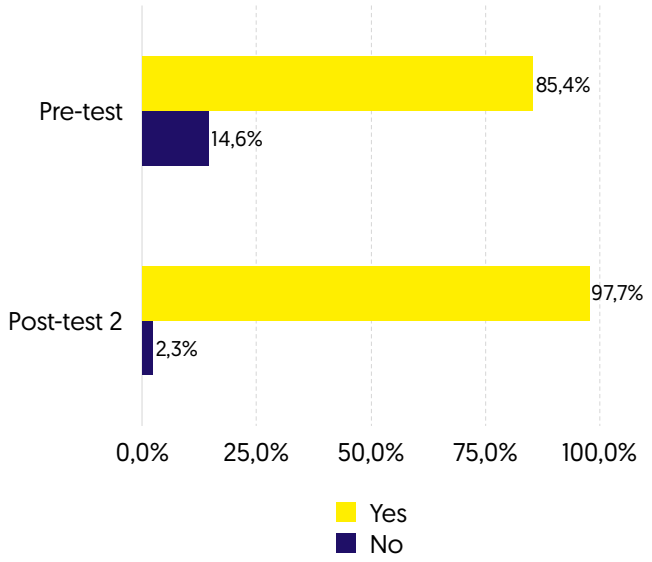


Figure 10. Participants' responses to questions about their behaviour in relation to the management of myopia and exposure to its environmental risk factors in their children

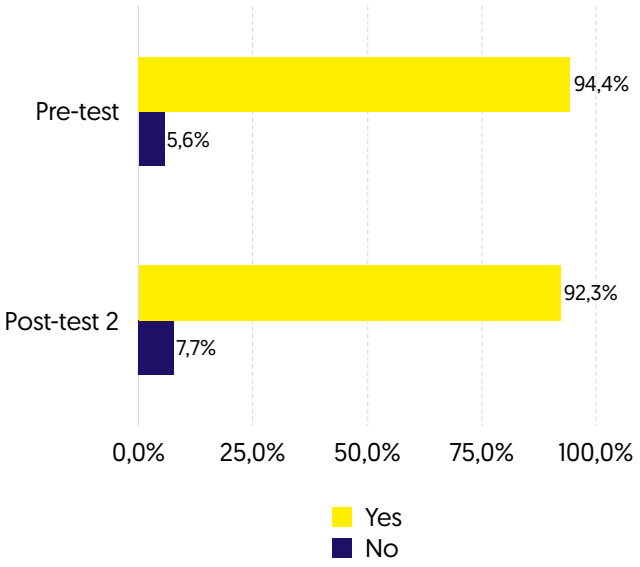
How often do you usually/do you intend to take your children for an eye check?



Do you encourage your children to hold their reading materials and mobile devices at a distance of 30cm or more from their eyes?



Do you encourage your children to wear their prescribed spectacles?



Do you encourage your children to not read their books or use their mobile devices in a dark or dim environment?

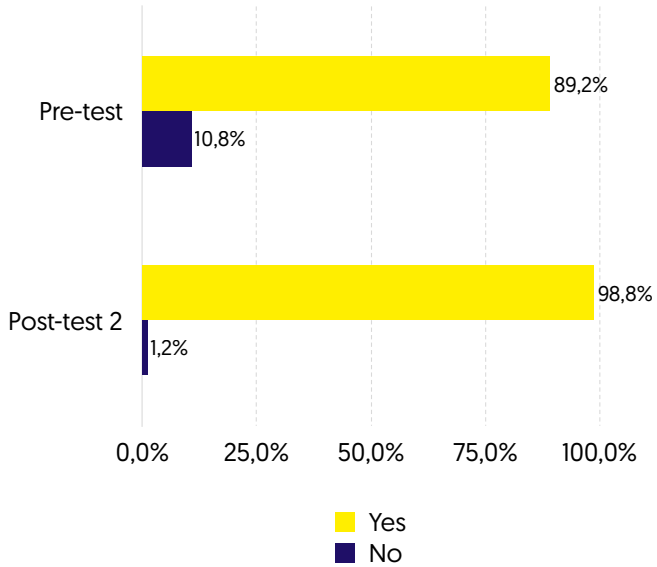


Figure 10 continued

INTERPRETATION OF FINDINGS

This study showed that exposure to an educational program developed by Plano was associated with a significant improvement in knowledge about myopia among parents and that, following the program, parents changed their behaviour to prevent or slow the progression of myopia among their own children. These findings support the large-scale distribution of a Plano-led educational program to improve parental knowledge about myopia, to inform meaningful change in parental management of myopia, and thus, to contribute to public health efforts to mitigate the public health burden of the disease and its complications.

Baseline knowledge and behaviour

The finding that baseline levels of knowledge about myopia and its management among parents residing in Singapore were low was relatively consistent with previous research conducted by Plano, where awareness of the physiology, epidemiology and management strategies for myopia was comparably insufficient.[31] Also troubling was the low percentage of parents at baseline who reported implementing certain behaviours that might protect their children from exposure to myopia's environmental risk factors, mostly notably the insufficient frequency with which they took their children for eye examinations (only 56% every 1-2 years), low levels of encouragement of their children to spend two hours outdoors daily (only 13%), and the high percentage that permitted their children to use devices for periods of longer than 30 minutes (66%). As the myopia capital of the world, Singapore has seen concerted government effort to address the problem. Despite these efforts, as well as Singapore's world-class educational, technological, and medical infrastructure, these findings suggest, firstly, that better and more widely disseminated health promotion is required, and secondly, that at least equally insufficient knowledge and protective behaviour are likely to be found in many countries outside of Singapore where the prevalence of myopia is high.

Immediate change in knowledge

We have shown that a short, yet comprehensive, digital program can immediately improve the mean level of parental knowledge of myopia by approximately 20%. Even in the absence of additional materials such as a summary information booklet, parents, and thus their children, are likely to benefit from acute exposure to myopia-related health promotion materials. Adoption and scaled dissemination of such a program by governments, schools, and clinicians would be feasible and may produce population-level knowledge gains that would result in parents taking more responsibility for reducing the risk and impact of myopia among their children.

It should be noted, however, that although the video resulted in a significant gain in knowledge, the mean composite score of 61% (or 69% when problematic questions were excluded) at post-test 1 was not optimal, and there remained significant room for further improvement. It is therefore important to conduct additional research into how best to communicate information surrounding those concepts for which the percentage of parents who provided the correct answer at post-test 1 was not very high, such as those pertaining to myopia's epidemiology,

physiology, and complications, as well as the recommended daily times that children should spend outdoors and on screens. The pilot educational video developed for this study was produced with a small budget and, as such, it is possible that the auditory and visual features of the production were not optimised to hold participants' attention and fully transfer and consolidate all the information as intended. Having demonstrated a significant effect of the program on parental knowledge, and thus establishing a proof of concept, Plano intends to allocate appropriate resources to the development of a video with better production quality based on the lessons learnt from this pilot study. It is anticipated that the effect on knowledge will be further enhanced.

Knowledge domains that did not improve with the education program

Despite an overall significant increase in knowledge, there were several specific knowledge domains that were not improved by Plano's program. As stated, Plano will meticulously re-evaluate the content of the program to determine how the information may be more effectively communicated and revisit the associated questions in the questionnaire to ascertain whether the language used in the relevant questions may benefit from some clarification.

The most salient example of areas that were resistant to knowledge improvement, and indeed in one case deteriorated, were question 14 and question 15 which referred to two related but conceptually and clinically distinct topics – those of myopia correction and myopia control, respectively. Myopia correction refers to the array of medical or optical interventions that may be used to correct the refractive error of the eyes of people who have myopia, including regular spectacles and contact lenses or laser-assisted surgery, to alter the path of light entering the eye so that it falls correctly onto the retina. These treatments are not used to slow the progression of myopia. On the other hand, pharmacological treatments such as atropine and pirenzepine and mechanical manipulation of the eye's shape through orthokeratology lenses are not used to correct myopia's refractive error, but rather to slow the disease's progression. It was clear from the increased attribution of drug treatments and the decreased attribution of regular spectacles as myopia correction strategies, as well as the overall 24% reduction in the mean score achieved for question 14, that many participants were confused. As such, Plano's next program will aim to better distinguish myopia correction and myopia control in the video and PDF materials and to delineate them in the questionnaire. It should be noted, however, that these items pertain to treatments administered by clinicians, and it

may be argued that poor improvement in these domains might be less consequential than for those where parental involvement is more direct, including preventing exposure among their children to the environmental risk factors for myopia.

Longer-term change in knowledge

There was a predictable decline in gained knowledge four weeks after the video presentation. The trajectory of semantic memory degradation over time, coined the 'forgetting curve', is well-described in the cognitive psychology literature, and occurs when information is not rehearsed or revisited frequently.[31] Therefore, irrespective of the efficacy of acute exposure to health promotion materials, it is likely necessary to reinforce the message to flatten the forgetting curve and to increase the probability that downstream health-related behaviour change will occur. With this in mind, we aimed to prevent some of this memory loss by providing all participants with a summary PDF booklet to which they could refer at any time leading up to post-test 2.

Our study design did not permit the investigation of which participants consulted the PDF booklet and how frequently, nor whether this was associated with differential knowledge retention. Nonetheless, the benefit of the booklet over and above that of the video may be inferred from the items for which post-test 2 scores were better than post-test 1 scores. For instance, knowledge from pre-test to post-test 1 remained unchanged or only marginally improved for the definition, age of onset, prevalence, and genetic causality of myopia questions, but improved at post-test 2, suggesting that gaps in knowledge acquisition upon viewing the video may have been filled when participants had the opportunity to absorb and consolidate the information later. Similarly, where knowledge might have otherwise decayed, it was largely retained with minimal forgetting in the domains of the physiology, risk factors (in particular, a lack of outdoor time) and management of exposure to risk factors (in particular face-to-screen distance and outdoor time), with the PDF possibly contributing to the recovery after the substantial pre-test to post-test 1 decline in knowledge about daily recommended screen time.

Nonetheless, the loss of some knowledge from post-test 1 to post-test 2 in the span of only 1 month should be acknowledged, and it is likely that, given more time, this decay would have been more pronounced. The relatively short duration of this pilot study precluded the investigation of the extent of knowledge retention vs loss over longer periods, but the inability to retain all of the learned information is at least suggestive of the need for ongoing myopia education programs for parents.

Behaviour change

Gains in knowledge about myopia are valuable to the extent to which they translate into real behaviour change on the part of parents to mitigate the risk and impact of myopia in their children. Calculating composite behavioural scores to compare overall changes in behaviours before and after the intervention was beyond the scope of this pilot study, but clear changes were observed at the level of specific parental behaviours. Indeed, although changes in the level of knowledge about some of the modifiable risk factors of myopia after the program were quite modest, changes in the corresponding behaviours were quite large. Substantially more children were encouraged to spend longer periods outdoors (though still below the recommended duration), behaviours surrounding screen and near work exposure were greatly improved, and the proportion of parents who had taken their children or intended to take their children for more regular eye checks increased. No inferential statistical analysis was conducted on the change in behaviour, and a future study will aim to investigate the link between changes in knowledge and changes in behaviour related to myopia with exposure to a Plano-led educational program.

Conclusion

Plano's educational program effectively improved knowledge about myopia and motivated positive behavioural change to reduce children's exposure to myopia's risk factors among parents residing in Singapore in a pilot study. A follow-up study will aim to further enhance the effect of the program to maximally improve knowledge and protective behaviours among parents, and dissemination of such a program to parents by clinicians, schools and governments may play an important role in public health programs that intend to address the worsening myopia crisis.

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APPENDIX

Questionnaire

Section 1: Socio-demographics

1. Please indicate your age (in years).

.....

2. Please indicate your gender.
   a. Female
   b. Male

3. Please indicate your ethnicity.
   a. Chinese
   b. Malay
   c. Indian
   d. Eurasian
   e. Others: .....

4. Please indicate your highest educational qualification.
   a. Primary School Leaving Examination (PSLE) or equivalent
   b. GCE 'O' Levels or equivalent
   c. Pre-University: GCE A Levels / Diploma / International Baccalaureate or equivalent
   d. Bachelor's Degree
   e. Master's Degree
   f. Doctor of Philosophy (PhD)
   g. Others: .....

5. Please indicate your total annual household income.
   a. Less than S$20,000
   b. S$20,000 to S$34,999
   c. S$35,000 to S$49,999
   d. S$50,000 to S$74,999
   e. S$75,000 to S$99,999
   f. More than S$100,000

APPENDIX | Questionnaire

6. Do you or your spouse have myopia?
   a. Yes, both of us
   b. Only me
   c. Only my spouse
   d. Neither of us

7. Please indicate the number of children in your family.

   .....

8. Please indicate your children's ages (in years) from the eldest to the youngest:

   .....

9. Which of the following options best describes your children's vision, from the eldest to the youngest?
   a. Perfect eyesight
   b. Short-sighted
   c. Long-sighted
   d. Other (please specify)
   e. I am not sure

10. Please indicate when was the last time your children had an eye check, from the eldest to the youngest:
   a. Never
   b. Within the last year
   c. Between 1 -2 years ago
   d. Between 2 – 3 years ago
   e. More than 3 years ago

Section 2: Knowledge

1. What is myopia?
   a. An eye condition in which someone can see things that are far away clearly but not things that are near
   b. An eye condition in which someone can see things that are near clearly but not things that are far away
   c. An eye condition in which both eyes do not look at the same place at the same time
   d. A reduced vision in one eye that did not develop normal vision during early childhood

2. At what age does myopia typically develop?
   a. Babies and toddlers (Less than 3 years old)
   b. Preschool children (3-5 years old)
   c. Primary school children (6-12 years old)
   d. Secondary school children (13-16 years old)

3. In Singapore, by the time children reach secondary school, what is the prevalence of myopia?
   a. 30%
   b. 50%
   c. 75%
   d. 90%

4. Which part of the eye does light get focused on when someone has myopia?
   a. Exactly on the retina
   b. In front of the retina
   c. Behind the retina
   d. Light does not enter the eye

5. Which of the following are some of the signs and symptoms of myopia in children (you may select more than one option)?
   o Having problems reading notes on the whiteboard
   o Frequently experiencing eye pains
   o Frequently holding books or mobile devices too close to the eyes
   o Frequently experiencing sensitivity to light
   o Blinking excessively and frequently rubbing the eyes

APPENDIX | Questionnaire

6. Which of the following eye problems are associated with myopia and high myopia (you may select more than one option)?
   - o Blurry vision
   - o Dry eyes
   - o Glaucoma
   - o Blindness
   - o Retinal detachment

7. To what extent is the cause of myopia due to genetic factors?
   - a. Purely genetic
   - b. Mostly genetic
   - c. Genetic to a limited extent
   - d. Purely within our control

8. Which of the following are some of the environmental risk factors for myopia (you may select more than one option)?
   - o Lack of outdoor time
   - o Long hours spent on near work activity (e.g. reading books, using mobile phones and tablets)
   - o Lower family income
   - o Living in urban environments
   - o A higher level of education

9. What is considered a 'safe distance' at which books and digital screens should be held away from the eyes?
   - a. Less than 10cm
   - b. 10 – 19cm
   - c. 20 – 29cm
   - d. 30cm and more

10. How much time should children spend on outdoor activities each day?
    - a. 30 minutes
    - b. 60 minutes
    - c. 90 minutes
    - d. 120 minutes

11. What is the maximum amount of screen time that primary school children should be exposed to each day?
    a. No screen time at all
    b. 60 minutes
    c. 120 minutes
    d. 180 minutes

12. How often should children take an eye break after doing near work?
    a. At least once every 30 minutes of continuous near work
    b. At least once every 60 minutes of continuous near work
    c. At least once every 90 minutes of continuous near work
    d. At least once every 120 minutes of continuous near work

13. How often should you take your children for an eye check?
    a. At least once every 1 – 2 years
    b. Once every 3 – 5 years
    c. Only when the school health report indicates that I should
    d. Only when my child complains that he/she cannot see very well

14. Which of the following are some of the healthcare interventions that are used to correct myopia (you may select more than one option)?
    - Atropine eye drops
    - Regular contact lenses
    - Regular spectacles
    - Oral medications
    - LASIK
    - Orthokeratology
    - Pirenzepine eye drops

APPENDIX | Questionnaire

15. Which of the following are some of the healthcare interventions that may slow or prevent the progression of myopia (you may select more than one option)?
    - o Atropine eye drops
    - o Regular contact lenses
    - o Regular spectacles
    - o Oral medications
    - o LASIK
    - o Orthokeratology
    - o Pirenzepine eye drops

Section 3a: Behaviour (pre-test)

1. How often do you let your children use mobile devices (e.g., smartphones and tablets), from the eldest to the youngest?
    - a. Daily
    - b. 4 – 6 days a week
    - c. 1 – 3 days a week
    - d. Never

2. How much time on average do you let your children use mobile devices per day, from the eldest to the youngest?
    - a. 1 – 30 minutes
    - b. 31 – 60 minutes
    - c. 61 – 90 minutes
    - d. 91 – 120 minutes
    - e. More than 120 minutes
    - f. Not applicable

3. How much time on average do you let your children engage in near work activity (e.g. reading a book, using their mobile devices) in one continuous sitting (e.g. without any rest for the eyes), from the eldest to the youngest?
    - a. 1 – 30 minutes
    - b. 31 – 60 minutes
    - c. 61 – 90 minutes
    - d. 91 – 120 minutes
    - e. More than 120 minutes
    - f. Not applicable

4. How much time on average do you encourage your children to spend on outdoor activities per day, from the eldest to the youngest?
   a. 1 – 30 minutes
   b. 31 – 60 minutes
   c. 61 – 90 minutes
   d. 91 – 120 minutes
   e. More than 120 minutes

5. How often do you usually take your children for an eye check, from the eldest to the youngest?
   a. At least once every 1 – 2 years
   b. Once every 3 – 5 years
   c. Only when the school health report indicates that I should
   d. Only when my child complains that he/she cannot see very well

6. Do you encourage your children to hold their reading materials and mobile devices at a distance of 30cm or more from their eyes?
   a. Yes
   b. No
   c. Not applicable

7. Do you encourage your children to wear their prescribed spectacles?
   a. Yes
   b. No
   c. Not applicable

8. Do you encourage your children to not read their books or use their mobile devices in a dark or dim environment?
   a. Yes
   b. No
   c. Not applicable

APPENDIX | Questionnaire

Section 3a: Behaviour (post-test 2)

1. How often have you let your children use mobile devices (e.g., smartphones and tablets) since our program 4 weeks ago, from the eldest to the youngest?
   a. Daily
   b. 4 – 6 days a week
   c. 1 – 3 days a week
   d. Never

2. How much time on average have you let your children use mobile devices per day since our program 4 weeks ago, from the eldest to the youngest
   a. 1 – 30 minutes
   b. 31 – 60 minutes
   c. 61 – 90 minutes
   d. 91 – 120 minutes
   e. More than 120 minutes
   f. Not applicable

3. How much time on average have you let your children engage in near work activity (e.g. reading a book, using their mobile devices) in one continuous sitting (e.g. without any rest for the eyes) since our program 4 weeks ago, from the eldest to the youngest?
   a. 1 – 30 minutes
   b. 31 – 60 minutes
   c. 61 – 90 minutes
   d. 91 – 120 minutes
   e. More than 120 minutes
   f. Not applicable
4. How much time on average have you encouraged your children to spend on outdoor activities per day since our program 4 weeks ago, from the eldest to the youngest?
   a. 1 – 30 minutes
   b. 31 – 60 minutes
   c. 61 – 90 minutes
   d. 91 – 120 minutes
   e. More than 120 minutes

5. How often will you take your children for an eye check, from the eldest to the youngest?
   a. At least once every 1 – 2 years
   b. Once every 3 – 5 years
   c. Only when the school health report indicates that I should
   d. Only when my child complains that he/she cannot see very well

6. Have you encouraged your children to hold their reading materials and mobile devices at a distance of 30cm or more from their eyes since our program 4 weeks ago?
   a. Yes
   b. No
   c. Not applicable

7. Have you encouraged your children to wear their prescribed spectacles since our program 4 weeks ago?
   a. Yes
   b. No
   c. Not applicable

8. Have you encouraged your children to not read their books or use their mobile devices in a dark or dim environment since our program 4 weeks ago?
   a. Yes
   b. No
   c. Not applicable

ABOUT PLANO

Plano is an award-winning Singapore-based health technology company that develops innovative ways to address the global problem of myopia (short-sightedness) and excessive screen time. Plano's mission is to empower people to achieve their best vision and eye health through education and science-driven technological solutions.

Plano has developed a holistic product ecosystem comprising education and awareness, innovative technological solutions, and big data analytics and artificial intelligence (AI). Plano's first product offering, planoApp, is the world's first science-based eye health and parental management application, and has so far been adopted by over 500,000 parents in 10 countries. planoApp runs in the background of digital smart devices and monitors device use in children. Through its suite of evidence-based functions and features, planoApp helps to modify children's behaviour to reduce their exposure to the environmental risk factors for myopia.

Since Plano's inception, the company's products and offerings have diversified and enabled the creation of an ecosystem, including 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 (planoShop), an online optometry service delivery platform (planoEyecheck), an online platform that raises awareness about the amount of time that people are spending on smart devices (planoTimeMachine), school outreach programmes (plano@school), workplace consultancy services (plano@work), a bestselling children's book series (The Plano Adventures), a growing collection of scientifically-backed educational reports and articles on healthy engagement with screens and topics related to eye health.

Plano's contract research division, the Plano Research and Analytics Team, consists of world-renowned experts in eye research, epidemiology, computer science including big data analytics and machine learning, and market research. The team holds concurrent positions at some of the world's leading research institutes, including the Duke-NUS, University of Melbourne, the University of California Berkeley, New York University, the Centre for Eye Research Australia and the Singapore National Eye Centre.

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