

ORIGINAL ARTICLE

Parental awareness of the implications of myopia and strategies to control its progression: A survey-based study

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Abstract

Purpose: Myopia has emerged as a significant public health concern. Effective methods have now been developed to delay its onset and progression. However, this information may not be reaching parents, and they are key players in terms of implementing the necessary preventive measures. This study investigated parental awareness of myopia, its implications and the strategies available for controlling it.

Methods: A self-administered online survey was distributed to parents of children 6–16 years of age. To be eligible to respond, their child had to be myopic or at risk of developing myopia due to family history.

Results: A total of 330 parents completed the survey, of which 321 were included for analysis. Sixty-seven percent of respondents had at least one myopic son/daughter, and most were between -1.00 and -1.75 D. Among parents of myopic children, 20.9% thought that their child's myopia progressed moderately. Sixty-seven percent of parents had a significant level of concern about the progression of the myopia and felt that it was caused mainly by the use of electronic devices and genetics. A generalised linear model showed that parental concern was significantly predicted by the perception of evolution ($p < 0.001$) and the number of known health-related consequences ($p < 0.001$). Almost 40% of parents were unaware of the existence of myopia control strategies. Relatives and eye care practitioners are the main sources of information. The most well-known myopia control strategy was myopia control soft contact lenses (29.2%), although the option that most parents would opt for was spectacles with peripheral defocus lenses (47.1%). The selection of a contact-lens-based myopia control method correlated significantly with the age of the children ($p < 0.001$).

Conclusions: Society in general and parents in particular need more information about myopia, its consequences and the options available for its control. Eye care practitioners play an important role in this issue.

KEYWORDS

myopia, myopia control strategies, myopia implications, parental awareness, questionnaire

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INTRODUCTION

Myopia has emerged as a public health concern of our time. Estimates suggest that myopia will affect 52% (almost 5000 million) of the world's population by 2050. Additionally, 10% (925 million) will suffer from high myopia.¹ According to these data, by that time, there will be more than twice as many myopic people as there were at the beginning of the century. The problem is most evident in East Asia, where the prevalence of myopia could reach 84% by 2050,² while in America or Europe, it is estimated that it will reach 30%.³ In Spain, the trend seems to be similar to that in Europe or America, with a significant increase in the last decades. A study carried out in 2000 found a prevalence of 2.5% in children aged 3–8 years.⁴ However, a more recent study in children aged 5–7 years found that myopia increased significantly in the 2016–2020 period, rising from 16.8% to 20.1%.⁵ Uncorrected refractive error is the leading cause of severe visual impairment (42%) and high or pathological myopia is an important cause of blindness (3%).⁶ High myopia is linked to potentially disabling eye health consequences, including glaucoma, myopic macular degeneration, choroidal neovascularisation, retinal detachment and cataract development.^{7,8} Thus, the risk of visual loss is sufficiently important to warrant measures to prevent high/pathological myopia.⁹ If estimates hold true, then the number of people with high myopia could lead to productivity losses costing billions of dollars, as well as a significant increase in the cost of care.^{3,10,11} In addition, the impact of myopia on quality of life and personal development must be taken into account.¹²

These circumstances have significantly increased interest in interventions to slow the progression of myopia in children and teenagers, with the aim of avoiding ocular complications later in life. In general, research on strategies to slow myopia progression focuses on preventing axial elongation.¹³ Various methods of myopia control have been proposed and implemented, including environmental, pharmacological and optical treatments. Environmental interventions include increasing the time spent outdoors and reducing near work, both of which have been shown to have a significant effect on reducing myopia progression.^{7,14–16} Clinical trials for myopia control using pharmacological methods usually apply atropine at different concentrations (1%, 0.5%, 0.025% and 0.01%). The results demonstrate that there is a relationship between dose and effect, but lower concentrations seem to be a safer option due to fewer side effects and rebound.¹⁴ For instance, 0.01% atropine has been shown to have a control effect of about 45% with fewer side effects and a reduced rebound effect compared with higher concentrations.¹⁷ Several optical methods have been applied to date. Orthokeratology is the optical method with the most promising results, retaining axial elongation between 30% and 60%.^{14,18} Peripheral defocus soft contact lenses have shown moderate (38%) efficacy.^{14,17,19} For spectacle lenses, the under-correction strategy was traditionally used, but there is no scientific evidence to support a clinically significant effect on myopia

Key points

- Sixty-seven percent of parents were concerned about myopia and its progression. They believe that the main causes for the onset and progression of myopia are genetics and the use of electronic devices.
- Parental concern was significantly predicted by the perceived speed of myopia progression and the number of known health-related consequences.
- Almost 40% of parents were unaware of the existence of myopia control techniques. The preferred myopia control method was spectacles with peripheral defocus lenses.

control.¹⁷ Bifocals and progressive addition lenses appear to reduce progression by between 6% and 51%, but the high variability found in the results of the various studies has raised questions as to whether these are clinically significant.^{17,20,21} More recently, spectacle lenses that induce peripheral defocus have been developed. Early research has shown a control efficacy of more than 60%.^{22,23}

In this context, it seems that eye care professionals are concerned about myopia. Martínez-Pérez et al.²⁴ investigated strategies and attitudes in the management of myopia in clinical practice worldwide. They used a survey completed by 173 Spanish optometrists. While this group was concerned about myopia, the implementation of myopia control interventions among Spanish optometrists remained low. The main reasons for not applying these methods were cost, lack of predictability of results and a shortage of information. Despite the scientific community's elevated interest in controlling myopia, the results and information obtained must still be effectively transferred, not only to eye care professionals but also to society in general and parents in particular. Since the ideal age to implement myopia control strategies is during childhood, parents are key players in terms of achieving their beneficial effects. For this reason, the objective of this study was to investigate parental knowledge of myopia and its possible consequences for ocular health. Another aim was to ascertain whether myopia is a cause of concern among parents and which factors might determine this. Knowledge and attitudes towards myopia control interventions were also studied.

METHODS

Participants

A total of 330 parents completed an online survey. To participate in the study, participants had to be the parents of at least one myopic child or adolescent between 3 and

16 years of age. If one of the parents was myopic, but they had children who had not yet developed this refractive error, they were still allowed to participate. Only one parent could take part and, if they had several myopic children, they had to answer considering the child who first developed myopia. In the case of children without myopia, they had to answer for the eldest child. Before analysing the data, some responses were removed: eight respondents had children older than 16 years and one respondent left several questions unanswered. A total of 321 responses were suitable for further analysis.

This study was in line with the Declaration of Helsinki and was prospectively approved by the University of Granada Human Research Ethics Committee (2610/CEIH/2022). Consent was obtained from each participant before completing the survey.

Questionnaire

The design of the initial draft was developed by two researchers. A third researcher revised the draft to optimise comprehension of items and responses. Then, the questionnaire was administered to 15 parents by one member of the research team. In this way, it was ensured that there were no difficulties in comprehension, and we could determine the opinion of the parents. Then the questionnaire was distributed, and once the first 50 responses were obtained, the internal consistency of items was measured, using Cronbach α criteria of 0.7 or higher as acceptable.

The final survey was self-administered online via Google Forms ([google.com](https://www.google.com)), from January to August 2022, and distributed through social media, schools, mailing lists and optometry centres. Parents were asked to participate in the survey if they had at least one child between 3 and 16 years of age that was myopic or at risk of developing myopia due to family history. If they had more than one child with myopia or at risk, they were asked to answer only for the first child who developed myopia or the older one if they did not have myopia at that time. Only one parent was allowed to answer, thus obtaining only one response from each household unit.

The entire survey consisted of 24 items divided into three sections. In the first section, we collected **demographic and visual data**: the age of the child, province of residence and information about the refractive error and compensation methods (children and parents). We also asked about the frequency of eye or visual examinations and information on habits and daily tasks.

The second section investigated the **knowledge or awareness of the consequences of myopia**. We asked parents whether they were concerned about myopia and its progression in their children. They had to rate their concern from 1 ('I am not concerned at all') to 10 ('I am extremely concerned'). They could then choose from several reasons for their concern (ocular health, personal image, economic disbursement and dependency on correction methods), but they were also free to indicate other reasons.

In addition, parents were asked about visual-related task habits and whether they thought that these could affect the onset and progression of myopia.

The third section of the questionnaire involved **knowledge about myopia control strategies**. We asked parents whether they were aware of the possibility of applying interventions to control the progression of myopia. In this sense, we asked whether their children have ever been deliberately under-corrected. We also asked them whether they were aware of any control strategies such as spectacle lenses, drugs, hydrophilic contact lenses or orthokeratology. If they were aware of these, we investigated where they had obtained this information (from their optician, ophthalmologist, television, internet or social media). After a brief description of all the methods, we also asked whether they would apply any of these methods to their children and which one they would choose.

The questionnaire included questions in different formats. Thus, five questions were closed-ended, and one was a rating (parent's concern about myopia). Eighteen were tick-box questions and 12 allowed for multiple responses, with this instruction indicated in the wording of the question. In addition, six of the tick-box questions also included an open-ended response. When parents indicated open-ended responses, they were analysed as another response category or included within the established response categories where possible. For more details, the questionnaire is included in the Appendix A.

Statistical analysis

All statistical procedures were performed using SPSS 28.0 software (SPSS Inc., [ibm.com/es-es/products/spss-statistics](https://www.ibm.com/es-es/products/spss-statistics)). Means and standard deviations (SD) were obtained for continuous variables, and absolute values (n) or frequencies (%) for categorical data. Where participants could choose different response options to a question, these were considered independently so that percentages were calculated for each category of response in relation to the total sample. The chi-squared and Mann-Whitney U -tests were applied to assess differences between groups for categorical and continuous variables, respectively. Spearman's correlations were employed to study associations between variables. Finally, to investigate which characteristics or circumstances could predict the level of parental concern about myopia, a generalised linear model (GLM) was fitted. Statistical significance was set at $p < 0.05$.

RESULTS

Demographic and visual data

The final sample for the analysis included 321 responses to the questionnaire. Although no territorial restrictions were established, most of the responses came from the

autonomous community of Andalusia (92%). Thirty-three responses (10.3%) came from rural areas, defined as locations with a population of less than 4000 inhabitants.²⁵ The mean age of the children was 11.9 ± 3.6 years (range 3–16 years). Table 1 shows data on the refractive error of both the parents and children. Eighty-one percent of mothers, 69% of fathers and 80.7% of children had a refractive error. Of the entire sample, 48.9% of mothers and 33.2% of fathers had myopia. It is important to mention that an additional 5.7% of mothers and 3.1% of fathers had undergone refractive surgery, so they could be included in the group of myopic parents. The percentage of myopic children was higher (67.3%). There were significant differences in the number of myopic children according to whether the mother was myopic or not ($\chi^2 = 9.058$; $p = 0.003$), but this was not the case with fathers ($\chi^2 = 0.988$; $p = 0.32$). Of the 216 myopic children, 161 had at least one myopic parent (74.5%) and 55 (25.5%) had no myopic parents. A significant negative correlation was found between myopic parents (none, one or two) and the age of onset of myopia ($\rho = -0.215$; $p = 0.002$), indicating that children with myopic parents become myopic at an earlier age.

With regard to the employed methods for refractive correction, the most common was spectacles (64.8% and 45.8% for mothers and fathers, respectively). The use of soft contact lenses was more widespread among mothers than fathers (20.8% vs. 9.0%), and this was also one of the correction methods used by the children (16.8% of cases). Gas-permeable contact lenses were a less frequent correction method.

Data on the frequency of eye examinations and/or optometric evaluations are summarised in Table 2. Six percent of respondents declared that their child had never visited an

eye care practitioner. Among those who did have their children's vision checked, the highest percentage were those who did so annually (43%), while 23.1% only did so when the child complained. The chi-square test did not show significant differences in the frequency of eye examinations and/or optometric evaluations between responses from rural and urban areas ($\chi^2 = 2.079$; $p = 0.15$). As stated above, 67.3% of the participants had a son/daughter with myopia ($N = 216$), and the mean age of onset was 8.8 ± 3.2 years (range 2–16 years). Figure 1 shows the distribution between different ranges of myopia, with the predominant group being those with 1–1.75 D myopia.

Among parents of myopic children, 20.9% thought that their child's myopia progressed 'moderately'. For the categories 'very slowly' (15%), 'slowly' (14.6%) and 'fast' (15%), similar percentages were found. Only 4.7% thought that the myopia was increasing 'very fast'. Over the preceding year, the increase in myopia for respondents whose child had this form of refractive error was 0 D in 49 participants (22.7%), 0.25 D in 53 participants (24.5%), 0.50 D in 30 participants (13.9%), 0.75 D in 17 participants (7.9%) and 1 D or more in 28 participants (13%). Thirty-nine parents (18.1%) declared that they did not know whether their children's myopia had increased in the preceding year.

With regard to habits that could influence the onset and progression of myopia, we asked participants about the frequency their child spent doing outdoor activities in a normal week and the time spent each day performing near-vision activities (Figure 2). More than half of the sample (56.1%) indicated that their children spend time doing outdoor activities at least three times a week. On the other hand, the daily time spent on near-vision activities was generally prolonged, with more than a third (36.8%) of the

TABLE 1 Analysis of the frequency of refractive error and the method of correction used by the parents and children.

	Mother		Father		Child	
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)
Refractive error						
Emmetropia	60	19	99	31	62	19.3
Myopia	154	48.9	106	33.2	216	67.3
Hyperopia	24	7.6	7	2.1	8	2.5
Astigmatism	105	33.3	72	22.5	87	27.1
Presbyopia	78	24.9	82	25.6	–	–
Undergone refractive surgery	18	5.7	10	3.1	–	–
Not known	14	4.4	31	9.7	32	10
Correction method						
None	103	32.1	157	48.9	85	26.5
Spectacles	208	64.8	147	45.8	219	68.2
Soft contact lenses	67	20.8	29	9.0	54	16.8
Gas-permeable contact lenses	2	0.6	0	0	4	1.2
No answer	1	0.3	9	2.8	7	2.2

sample indicating that their children spent more than 6 h a day on near-vision activities. A correlation analysis showed significant associations between greater myopia and both the perception of a more rapid evolution of this ametropia ($\rho=0.779$; $p<0.001$) and more time spent doing near-vision activities ($\rho=0.224$; $p<0.001$). We also found that the parents who indicated that their child spent longer periods of time doing outdoor activities felt that the myopia was progressing more slowly ($\rho=-0.174$; $p=0.002$). Finally, a

significant correlation was also found between the perception of a more rapid evolution of myopia and greater increase in myopia in the preceding year ($\rho=0.403$; $p<0.001$).

Knowledge of the causes and consequences of myopia progression

With the objective of obtaining information about the awareness of or concern regarding the consequences of myopia for ocular health, we asked the respondents to rate their concern about myopia and its progression from 1 ('not at all') to 10 ('extremely concerned'). The mean rating \pm SD was 7.08 ± 2.60 points, showing that myopia is an issue of concern among parents. Most indicated a considerable level of concern about the progress of their child's myopia, with almost 75% scoring more than 5 points, and 21% scoring the maximum (10 points). These results are summarised in Figure 3. Comparison about the level of concern of parents from rural and urban areas showed no significant differences between these groups ($Z=-0.733$; $p=0.46$).

We asked about the causes for this concern, providing several possible reasons as well as a section for others. Only a small proportion of the parents manifested that they were not worried (8.5%). The most typical reason for the concern was the children's ocular health (80.2%), followed by dependence on spectacles or contact lenses (37.1%) and the economic cost of spectacles or contact lenses (13.7%). Aesthetics or personal image (4%), and the discomfort of wearing spectacles or contact lenses (0.3%) were lesser reasons for concern.

Among the eye health consequences that myopia can trigger, some were better known than others among parents. Firstly, it is worth noting that a very large proportion of respondents (56.5%) did not know that having high myopia could have consequences for eye/visual health. However, among those who did know about this, the most well-known consequences were retinal detachment (26.7%), followed by cataract (18.8%) and glaucoma (14.6%).

Parents were asked for their opinion on the causes or habits that could influence the onset or progression of myopia in children (Table 3). The vast majority of parents believed that genetics (91.3%) and the use of electronic

TABLE 2 Frequency of eye examinations/optometric evaluations.

	Frequency (n)	Percentage (%)
Never	20	6.2
Only undergone one visual examination	3	0.9
Annually	138	43
Every 6 months	53	16.5
Every 2 years	31	9.7
More often than every 6 months	2	0.6
When the child complains that they cannot see well	74	23.1

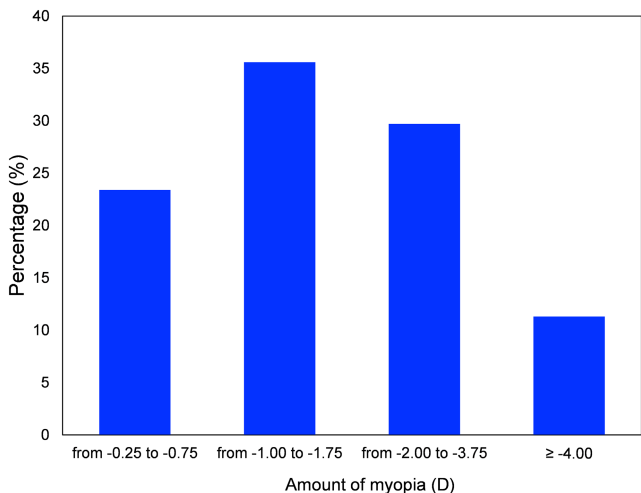


FIGURE 1 The amount of myopia present in the children.

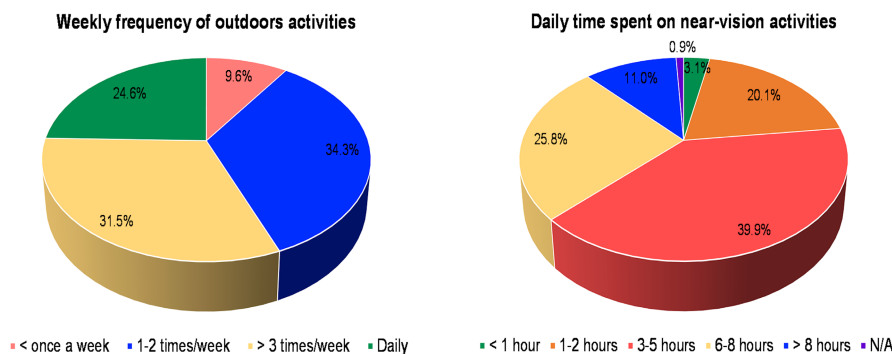


FIGURE 2 Time spent on activities that could influence the onset and progression of myopia.

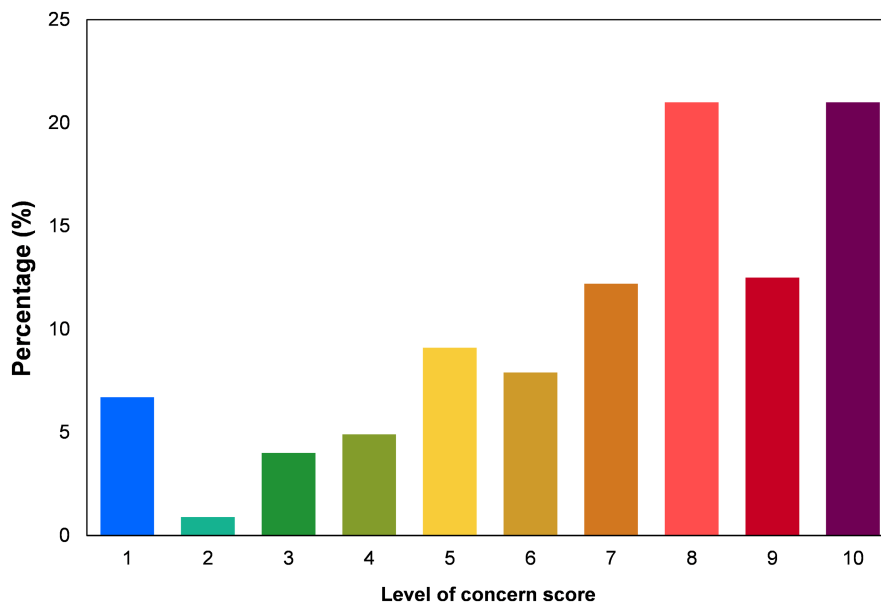


FIGURE 3 Level of concern about myopia and its progression rating from 1 ('not at all') to 10 ('extremely concerned').

TABLE 3 Opinion on causes or habits influencing myopia onset and progression.

Cause/habit	Frequency (n)	Percentage (%)
I don't think it can be affected	1	0.3
Use of electronic devices (mobile phones, tablets, video-game consoles, etc.)	273	85
Sedentary lifestyles and little time spent outdoors	66	20.6
Family genetics	293	91.3
Nutrition	105	32.7
Lack of visual assessments	21	6.5
Lack of renewing spectacle prescription	20	6.2
Studies or education	2	0.6
Other	2	0.6
I do not know	2	0.6

devices (85%) play a major role in this issue. Other causes that stood out were nutrition (32.7%), sedentary lifestyles and little time spent outdoors (20.6%).

Variables determining the level of parental concern about myopia

The results of the GLM demonstrated that the level of concern manifested by the parents was predicted by two independent variables (Table 4): the parent's perception of how fast the myopia was increasing, with those who

perceived a faster increase indicating greater concern, and the number of health consequences of myopia on ocular health. Parents who were aware of more of the health consequences related to myopia were more concerned. Other parameters such as whether the child or the parents have myopia, the age of myopia onset, the level of myopia and its increase over the preceding year were not significant predictors of parental concern.

To investigate which reasons manifested by parents were more associated with this concern, a correlation analysis was performed. We found only one significant correlation, namely between the level of concern and ocular health ($\rho=0.242$; $p<0.001$). Other reasons, such as dependency on correction, economic costs of the correction, evolution, discomfort related to correction and aesthetic and personal image showed no significant correlations. The most important reason for parents to be concerned about myopia was to preserve the ocular health of their children.

To ascertain which ocular health problems might be of the greatest concern to parents, we conducted a secondary analysis of correlations between the level of concern and the various consequences mentioned in the responses to the questionnaire. In this case, each of the consequences included in the analysis showed significant correlations with concern (Table 5). Not knowing that myopia progression may lead to an increased risk of ocular pathologies was significantly associated with a lower score for the level of concern. The ocular health consequence most strongly correlated with parental concern was retinal detachment.

Knowledge of myopia control strategies

While 60.2% of parents indicated having heard about the possibility of different interventions for controlling the

TABLE 4 Generalised linear model: predictors of parental concern about myopia and its progression.

	B	SE	Wald χ^2	p-Value	95% CI
Intercept	8.750	2.9083	9.052	0.003	[3.050, 14.450]
Urban or rural area	Ns.	Ns.	Ns.	Ns.	Ns.
Myopic child	Ns.	Ns.	Ns.	Ns.	Ns.
Myopic parents	Ns.	Ns.	Ns.	Ns.	Ns.
Age of myopia onset	Ns.	Ns.	Ns.	Ns.	Ns.
Level of myopia	Ns.	Ns.	Ns.	Ns.	Ns.
Perception of myopia evolution					
0=No evolution	-2.260	1.3342	2.686	0.090	[-4.875, 0.355]
1=Very slow	-2.664	0.8034	10.999	<0.001	[-4.239, -1.090]
2=Slow	-2.614	0.7900	10.952	<0.001	[-4.163, -1.066]
3=Moderate	-2.520	0.7585	11.041	<0.001	[-4.007, -1.034]
4=Fast	-2.366	0.7435	10.128	0.001	[-3.823, -0.909]
5=Very fast	RC	RC	RC	RC	RC
Evolution over the preceding year	Ns.	Ns.	Ns.	Ns.	Ns.
Number of consequences known	0.738	0.1559	22.422	<0.001	[0.433, 1.044]
Number of observations	321				
AIC	1506.4				
BIC	1600.7				

Note: Bold indicates significant *p*-values.

Abbreviations: AIC, Akaike's Information Criterion; BIC, Schwarz's Bayesian Criterion; Ns, not significant; RC, reference category.

TABLE 5 Spearman's correlation between the level of parental concern about myopia and possible consequences for ocular health.

	Do not know	Retinal detachment	Cataract	Glaucoma
Concern (0–10)				
ρ	-0.272	0.212	0.154	0.205
<i>p</i> -Value	<0.001	<0.001	0.006	<0.001

Note: The correlation coefficient and associated *p*-values are included.

increase in myopia, an important proportion did not know about these (39.2%). The chi-squared test did not show significant differences between the responses of parents from rural and urban areas ($\chi^2 = 2.079$; $p = 0.15$). Those parents who were familiar with these interventions had heard about them from relatives (33.7%), optometrists (26.1%), ophthalmologists (12.5%) and the media (internet 6.4%; press or TV 7.9%).

Forty-three parents (15.2%) indicated that at some point, their children's myopia had been under-corrected to prevent its progression. Although 51.7% of parents were not aware of any particular method or treatment for controlling myopia, the most well-known myopia control strategy was the use of myopia control soft contact lenses (29.2%), followed by orthokeratology (22.2%), atropine (17%), peripheral defocus spectacle lenses (13.4%), bifocal lenses (0.3%) and visual training (0.3%). Interestingly, some of the parents indicated refractive surgery as a method for controlling myopia (0.9%). Of the available strategies and treatments,

we asked which they would opt for if they were to apply a myopia control method to their children (they could choose several techniques). The results showed that 22 parents (6.7%) would not be willing to apply any treatment. The methods that most parents would opt for were spectacle lenses with peripheral defocus for myopia control (47.1%) and myopia control soft contact lenses (36.5%), followed by atropine (23.7%) and orthokeratology (17.9%). Other parents indicated that in this case, they would choose the option recommended by the ophthalmologist (1.2%) or the least invasive or risky treatment (0.3%), showing concern for safety. It is important to mention that 30 respondents (9.1%) said they did not know which one they would choose.

Figure 4 shows a comparison between the strategies that the parents were previously aware of and which of them they would choose. As can be seen, although peripheral defocus spectacle lenses were the least-known method, this was the most popular option chosen by parents to control their children's myopia. The second most well-known strategy was myopia control soft contact lenses, and this method would be chosen by a similar number of parents. Atropine was not very popular among the sample and was only just better known than peripheral defocus spectacle lenses, the latter being a much newer technique. Finally, orthokeratology is the only treatment for which the number of parents who would choose it was lower than the number of parents who were aware of its existence. With regard to contact lens strategies, we found a significant correlation between the child's age and the probability of choosing a contact-lens-based myopia

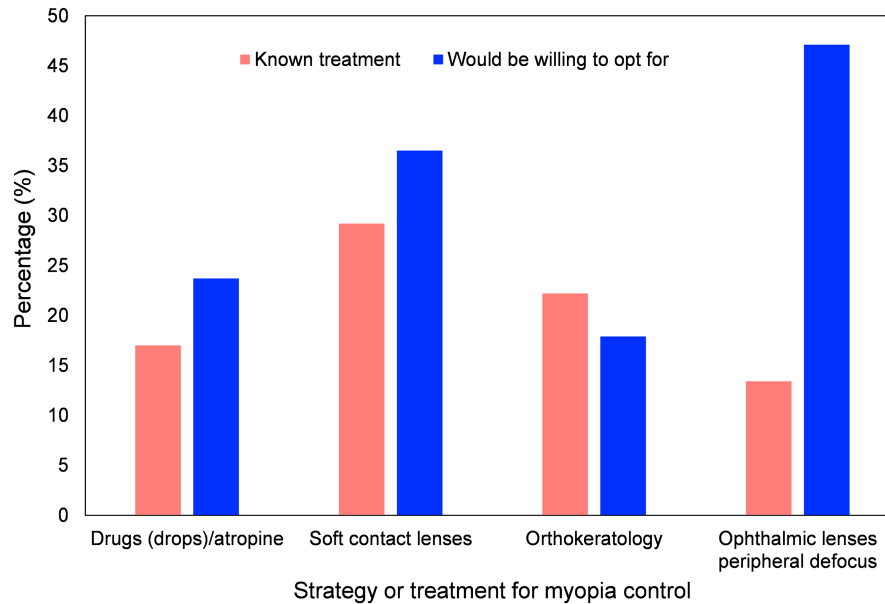


FIGURE 4 Comparison of knowledge of different methods of myopia control and the number of parents who would choose each method for their children.

control method ($\rho=0.309$; $p<0.001$), so that the older the child, the more likely the parent would be to opt for contact lenses.

DISCUSSION

This study investigated parental knowledge of the implications of and control strategies for myopia. A further aim was to study which factors determine parental concern with regard to myopia. The results demonstrated that 67% of respondents had at least one myopic son/daughter, and the largest group indicated their children's myopia was progressing moderately (20.9%). Myopia is an issue of concern among parents, and they highlighted the use of electronic devices and genetics as significant factors that could influence its progression. Parental concern is a function of two of the independent variables studied: perception of evolution and the number of known health-related consequences. Thus, all health-related consequences correlated significantly with the level of concern, with retinal detachment having the strongest association ($\rho=0.212$; $p<0.001$). Almost 40% of parents were unaware of the possibility of applying myopia control strategies to their children; the most well-known being myopia control soft contact lenses. However, the most reliable method, or the one that most parents would opt for, would be spectacle lenses with peripheral defocus.

An important segment of the youngest generations is myopic, with estimations suggesting a continuous increase in its prevalence.¹ Seven out of 10 parents that completed this survey had at least one myopic child. However, the percentage of myopic children among the parents surveyed in this study is not a reflection of the prevalence of myopia in

our setting. The questionnaire was targeted towards parents of myopic children or children at risk of developing myopia due to family history and not to the general population, so these data describe the sample but do not indicate the prevalence of this ametropia. In this regard, several studies conducted in Europe have reported a prevalence ranging from 2% to 19% of children under 9 years of age and 18%–43% in children 9–19 years of age.²⁶ In Spain, the reported prevalence in children aged 5–7 was 20.1% in 2020.⁵ In our survey, we asked parents if they had at least one myopic child, and it is probable that parents who were more familiar with myopia would have been more likely to participate in a survey on this topic. We found a greater prevalence of myopia among mothers, which agrees with some previous studies indicating a higher prevalence in women.^{14,27}

A significant correlation was found between greater levels of myopia and time spent on near-vision activities. This is consistent with the study of Alvarez-Peregrina et al.,²⁸ who found that children who spent more time doing near-vision activities showed spherical equivalents with a tendency towards myopia. They also demonstrated an association between excessive electronic device use and an increased prevalence of myopia (OR: 1.10; CI: 1.07–1.13; $p<0.001$). On the other hand, time spent outdoors could prevent or delay the onset of myopia and its progression, with a recent meta-analysis suggesting a 2% reduction in the odds of developing myopia per hour spent outdoors each week.²⁹ We found no significant associations between the amount of myopia and time spent outdoors, in contrast to other studies conducted in Spain²⁸ and other parts of the world,^{7,14,16} which supported this association. This result may be due to the way this question was formulated, as we asked about the weekly frequency and not about the time spent doing outdoor activities.

We did find a significant negative correlation between a lack of awareness of the ocular health consequences of myopia and the level of concern. Eighty-two percent of the 321 parents indicated ocular health as being a myopia-related reason for concern. McCrann et al.²⁵ surveyed 329 parents in Ireland, finding that 46% of them were concerned about their children's eye health in terms of myopia, while another 46% declared that myopia was only an optical inconvenience. This last percentage is higher than the number of parents concerned about correction dependence in the present study (37.1%). Our results showed that parents were less concerned about other reasons, such as economic cost (13.7% vs. 31%) and aesthetic reasons (4% vs. 14%) than in the aforementioned study.²⁵

Although a large percentage of parents indicated ocular health as a reason for myopia-related concern, 56.5% of parents were not aware of the relationship between myopia and the possible associated pathological complications. This result is more in line with McCrann et al.,²⁵ and reflects the need for information about myopia and its implications to be publicised more widely. Among the examples we provided in the survey, the most well known was retinal detachment, but less than a third of the sample was aware of any of the complications listed. According to the GLM, the level of concern indicated by parents was a function of how they perceived the speed at which the myopia was evolving and their awareness of possible consequences for ocular health. This result agrees with the high percentage of parents who indicated ocular health as a reason for their concern.

In the opinion of the parents, genetics and the use of electronic devices were two major causes for myopia onset and progression. Previous studies have highlighted the same finding.^{25,30} In fact, McCrann et al.²⁵ demonstrated that parents who regarded myopia as a health risk limited the screen time of their children. All these factors influenced the level of concern that parents demonstrated about myopia.

Almost 40% of the parents did not know about the possibility of applying strategies to control myopia, and half of the sample did not know of any specific interventions. The most well-known control methods were myopia control soft contact lenses followed by orthokeratology. A study conducted in 2014 in Hong Kong reported orthokeratology as being the most well-known method for myopia control among parents.³¹ These authors studied two groups depending on the intervention that parents would choose from two options: that is, orthokeratology or myopia control soft contact lenses. They showed that parents selected a strategy in line with their previous knowledge. In the present study, prior knowledge does not seem to have such an influence because the number of parents who would opt for a specific method was higher than the number who knew about it, with the exception of orthokeratology. This result could be due to the fact that

parents perceived orthokeratology as being a more invasive, unfamiliar method, considering that only two parents and four children reported using gas-permeable contact lenses. Conversely, Cheung et al.³¹ found orthokeratology to be the parents' preferred method (86%), followed by progressive ophthalmic lenses or spectacles (35%), myopia control soft contact lenses (29%) and spectacles with under-correction (21%). The parents in that study could have been more open to orthokeratology due to a greater awareness of its efficacy for controlling myopia. That study was conducted in Hong Kong, and East Asian countries have high prevalence of myopia in children. For this reason, it is possible that eye practitioners make greater efforts in terms of prevention and advising the population, and this technique has been much more widely used than in other countries for several years.³²

The method of myopia control that parents trusted the most was peripheral defocusing spectacle lenses, perhaps because it was the most familiar and least invasive corrective method. According to parents, the two more valuable aspects when it comes to choosing a myopia control strategy were safety and comfort in daily life.³¹ Opting for contact lenses also seems to be linked to the child being of a certain age, at which time they begin to prefer the independence of the contact lens for their activities.³³ Spectacle lenses with peripheral defocusing technology are a relatively new alternative for myopia control, with recent research showing promising results in terms of both efficacy^{22,23,34} and safety.^{23,34} In Spain, this type of myopia control strategy has been on the market since April 2021, so they are currently relatively unknown among parents, with only 13% of our sample indicating that they had heard about them.

The findings of this study indicate a lack of information among the parents of children with myopia or at risk of developing myopia. Among those parents with certain knowledge about possible myopia control strategies, the main source of information was relatives (33.7%) and various eye care practitioners (optometrists, 26.1%; ophthalmologists, 12.5%). A lower percentage obtained information from the media (14.3%). These results show that eye care practitioners are key when it comes to providing information, raising awareness and giving advice on myopia and the benefits of myopia control. Some parents surveyed in our study indicated that they would only choose the myopia control method suggested by their ophthalmologist. Adequate outreach by these professionals, coupled with communication between parents and relatives, could greatly increase public awareness. Indeed, the study by Yang et al.,³⁵ conducted in Singapore, showed that despite having a significant influence on the choice of vision correction method, more than two-thirds of eye care practitioners did not prescribe myopia control intervention at the first visit. Practitioners indicated that more training would increase the number of prescriptions but saw the cost of myopia control products as a drawback.

Finally, some limitations need to be considered when interpreting the results presented here. To facilitate the survey for parents, different options were offered for most of the questions. In opinion-related questions, such as the one concerning those habits that parents believe may influence the development and progression of myopia, providing response options may have biased the results. However, in this case, the results are in line with those obtained by McCrann et al.,²⁵ who asked parents an open-ended question with a free-text box. In addition, the categories provided for the question of perception of the speed of myopia evolution could contain some ambiguity, as it leaves it up to the parent to judge what is a rapid or slow development. Correlations have shown that the responses were related to the amount of myopia in the child and the increase in the previous year, suggesting that parents were answering with appropriate criteria. On the other hand, in the question regarding outdoor activities, parents were asked to indicate the weekly frequency rather than duration, as in the question on the duration of near-vision activities. This may have been the reason why we did not find a correlation with myopia progression, as we did for time spent on near-vision activities.

In conclusion, increasing education about myopia is paramount, and parents should be aware of predisposing environmental factors in addition to the interventions available for controlling myopia. Parents should be involved in such interventions, playing an important role together with eye care professionals. To raise awareness and disseminate information about myopia, public institutions and the healthcare system should also promote informational campaigns. Myopia is a public health issue whose complications can have an important quality-of-life implications and place a significant burden on society.

AUTHOR CONTRIBUTIONS

Sonia Ortiz-Peregrina: Conceptualization (equal); data curation (equal); formal analysis (equal); investigation (equal); methodology (equal); supervision (equal); writing – original draft (equal); writing – review and editing (equal). **Salvador Solano-Molina:** Conceptualization (equal); formal analysis (equal); investigation (equal); methodology (equal); resources (equal); writing – original draft (equal); writing – review and editing (equal). **Francesco Martino:** Data curation (equal); formal analysis (equal); writing – review and editing (equal). **José J. Castro-Torres:** Conceptualization (equal); funding acquisition (equal); project administration (equal); resources (equal); writing – review and editing (equal). **José R. Jiménez:** Conceptualization (equal); investigation (equal); methodology (equal); resources (equal); supervision (equal); validation (equal); writing – review and editing (equal).

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CONFLICT OF INTEREST STATEMENT

The authors report no conflicts of interest and have no proprietary interest in any of the materials mentioned in this article.

DATA AVAILABILITY STATEMENT

The datasets generated during the current study are available from the corresponding author on reasonable request.

PATIENT CONSENT

Consent was obtained from each participant before completing the survey.

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APPENDIX A

Questionnaire

SURVEY ABOUT MYOPIA

Myopia has emerged as a global pandemic. For this reason, the University of Granada is conducting research into different interventions to control the development and progression of myopia. First of all, we would like to know the level of concern and information that parents have about myopia, its implications and its control methods. This questionnaire is intended for **parents of myopic children and adolescents (between 3-16 years)**, or parents of those children and adolescent (3-16 years) **at risk of developing myopia** due to family history. If you have more than one child with myopia or at risk, please answer considering the child in whom myopia appeared first or the older if they have no myopia yet. The questionnaire should only be completed once, by one parent. Answering this questionnaire only take a few minutes. Please read the questions carefully and answer as truthfully as possible. Your cooperation will help us in our research. Thank you very much.

Demographic data

1. Child's age: _____
2. City of residence: _____

Visual data

3. The mother has (you can choose several options if appropriate):

- Myopia
- Hyperopia
- Astigmatism
- Presbyopia
- None of them
- She undergone surgery to take off spectacles
- I do not know

4. The mother wears (you can choose several options):

- Spectacles
- Soft contact lenses
- Rigid gas permeable contact lenses
- Nothing

5. The father has (you can choose several options if appropriate):

- Myopia
- Hyperopia
- Astigmatism
- Presbyopia
- None of them
- He undergone surgery to take off spectacles
- I do not know

6. The father wears (you can choose several options):

- Spectacles
- Soft contact lenses
- Rigid gas permeable contact lenses
- Nothing

7. Our child usually attends eye exams or optometric evaluations with this frequency:
- Has not yet attended
 - Every six months
 - Annually
 - Every two years
 - When the child complains about his/her vision
 - Other (please, specify): _____
8. At the present, my son/daughter has (you can choose several options if appropriate):
- Myopia
- Hyperopia
 - Astigmatism
 - None of them
 - I do not know
9. In case your child currently has myopia, please indicate the age of onset: _____ years.
10. My son/daughter wears (you can choose several options):
- Spectacles
 - Soft contact lenses
 - Rigid Gas Permeable contact lenses
 - Nothing
11. If you have indicated that your child has myopia, how many dioptres of myopia does he/she have?
- Between 0.25 and 0.75 dioptres
 - Between 1 and 1.75 dioptres
 - Between 2 and 3.75 dioptres
 - More than 4 dioptres
12. You would say that your child's myopia is progressing:
- Very slowly
 - Slowly
 - Moderately
 - Fast
 - Very fast
 - My son/daughter does not currently have myopia.
13. During the last year, my son's/daughter's myopia has increased:
- Nothing
 - 0.25 D
 - 0.50 D
 - 0.75 D
 - 1D or more
 - I do not know
14. My son/daughter engages in outdoor activities (going to the park, playing sports, walking, etc.):
- Daily
 - More than three times a week
 - 1-2 times a week
 - Less than once a week



15. My son/daughter performs near vision activities (studying, reading, video games consoles, smartphone, tablet, etc.) an average daily of :

- Less than one hour
- 1-2 hours
- 3-5 hours
- 6-8 hours
- More than eight hours

Knowledge of the causes and consequences of myopia progression

16. From 1 to 10, rate your level of concern about your child's myopia (or its possible appearance), and about the progressive increase of myopia:

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 9 ___ 10

1 = Not at all _____ 10 = Extremely concerned

17. Indicate the reason(s) you are concerned that your child has myopia (or may developed myopia), and that it is progressing (you can choose several reasons).

- I am not concerned at all
- Aesthetics or personal image
- Economical disbursement for spectacles or contact lenses
- Dependence on spectacles or contact lenses
- Ocular health
- Others (indicate if possible): _____

18. I have heard of or know the following possible consequences of having high myopia (you can choose several reasons):

- I have never heard that having myopia can lead to visual health consequences.
- Cataract development
- Retinal detachment
- Glaucoma development
- Others (indicate if possible): _____

19. Do you think that your child's habits influence the appearance and/or increase of myopia? If yes, please indicate what you think may have an influence (you can choose several options):

- Use of electronic devices (mobiles, tablets, video game consoles, etc.)
- Sedentary lifestyles and little time spent outdoors
- Family genetics
- Lack of visual assessments
- Lack of renewing spectacle prescription
- Feeding
- Others (indicate if possible): _____

Knowledge about myopia control

20. Do you know or have you heard about the possibility of applying different interventions to control the increase in myopia?

Yes _____ No _____

21. If yes, please indicate where this information comes from (you can choose several options).

- Press or TV
- Optometrist
- Ophthalmologist
- Internet or social media
- Relatives: friends/known people/family

22. Has your optometrist or ophthalmologist ever fitted your child with less myopia than he/she has in the glasses or indicated to use an older prescription glasses to prevent myopia increment?

Yes: _____ No: _____

23. Do you know any of these myopia control methods? Please indicate the ones you are familiar with below (you can choose several options if appropriate):

- Drugs (eye drops).
- Soft contact lenses for myopia control
- Nocturnal (rigid) contact lenses, orthokeratology or ortho-k (these contact lenses are used when sleeping, they temporarily correct myopia and it is not necessary to wear glasses or contact lenses during the day).
- Spectacles to control myopia (they generate peripheral defocus but look like normal glasses)
- Progressive addition spectacles
- Others (indicate): _____
- I did not know any method of myopia control

24. If you were to apply a myopia control method to your child, which one(s) would you be willing to choose? (you can choose several options):

- Drugs (eye drops).
- Soft contact lenses for myopia control
- Nocturnal (rigid) contact lenses, orthokeratology or ortho-k.
- Spectacles to control myopia (they generate peripheral defocus but look like normal glasses)
- Progressive addition spectacles
- Others (indicate): _____
- I would not be willing to apply any method of myopia control to my child.

The Department of Optics (University of Granada) is conducting a study on myopia control methods. If you would like to obtain more information on this subject and/or would be interested in having your child receive one of the treatments applied to prevent the progression of myopia, please contact us.