BMJ Open

Knowledge, attitude and practice among parents of children and teenagers towards myopia prevention and control during the COVID-19 epidemic

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To cite: Fu T, Yang Z, Zhang P, *et al*. Knowledge, attitude and practice among parents of children and teenagers towards myopia prevention and control during the COVID-19 epidemic. *BMJ Open* 2025;**15**:e089431. doi:10.1136/bmjopen-2024-089431

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (https://doi.org/10.1136/bmjopen-2024-089431).

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Received 30 May 2024
Accepted 17 March 2025

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ABSTRACT

Objectives This cross-sectional study aimed to assess parents' knowledge, attitude and practice (KAP) towards myopia amidst increased children's online course participation during the COVID-19 pandemic, potentially impacting visual health.

Design The study adopted a cross-sectional design to analyse parent KAP regarding myopia.

Setting and participants Conducted from 19 August 2022 to 19 October 2022, in the Jinan High-tech District, the study included 3261 participants, comprising 800 males (24.5%).

Interventions A self-administered questionnaire assessed KAP, with a good KAP defined as a score >75% of the total.

Primary and secondary outcome measures The KAP scores were the primary outcome measures. The factors associated with a practice score >75% were also investigated.

Results Parents had mean KAP scores of 10.2±2.4 (10.2/14=72.9%), 41.8±4.9 (41.8/50=83.6%) and 54.3±7.1 (54.3/65=83.5%), respectively. The knowledge scores (OR 1.11, 95% CI 1.06 to 1.16, p<0.001), attitude scores (OR 1.15, 95% CI 1.12 to 1.17, p<0.001), daily outdoor activities time (30–60 min: OR 1.46, 95% CI 1.16 to 1.84, p=0.001; 1–2 hours: OR 1.92, 95% CI 1.48 to 2.49, p<0.001; >2 hours: OR 1.91, 95% CI 1.34 to 2.74, p<0.001, respectively), and parents whose children did not have myopia progression during the online class (OR 1.43, 95% CI 1.05 to 1.96, p=0.024) were independently associated with a practice score >75%, while a child in fourth grade of primary school (OR 0.76, 95% CI 0.58 to 0.99, p=0.042), unaware of child's myopia (OR 0.52, 95% CI 0.43 to 0.64, p=0.002) and daily electronics usage time >2 hours (OR 0.53, 95% CI 0.43 to 0.64, p<0.001) were independently associated with practice scores ≤75%.

Conclusions The study found that parents showed suboptimal knowledge, positive attitude and proactive practice concerning myopia prevention during the pandemic. Areas requiring improvement include better education for parents of grade 4 students, increased awareness for parents unaware of their child's myopia status and addressing excessive electronic device use among children.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The adoption of a cross-sectional design and a sizeable participant sample from a specific district offered valuable insights into parental knowledge, attitude and practice (KAP) regarding myopia within that community.
⇒ The study's limited scope, focusing on a specific district, may not fully represent the diverse viewpoints of parents from various locations.
⇒ Reliance on self-reported data may introduce a bias towards socially desirable responses, suggesting a need for methods like triangulation for result accuracy.
⇒ The potential discrepancy between reported KAP scores and actual behaviours highlights a limitation in solely relying on respondents' statements for insights into myopia prevention practices.

INTRODUCTION

The COVID-19 pandemic quickly spread from Wuhan to all of China in December 2019 and was declared a Public Health Emergency of International Concern by the WHO in 2020. Governments reacted by impeding travels and establishing lockdowns, strict hazard controls in offices and other workplaces, and closure of institutions and facilities. These measures also impacted preschools, schools and universities, which were closed at different scales in 172 countries. As a result, nearly 98.5% of the students were affected worldwide.[1]

In early February 2020, the Chinese Ministry of Education stopped in-person classes as an emergency response to the rising pandemic.[2] As an alternative, internet platforms were implemented for online learning, including for children. However, long screen use can cause digital eye strain (DES),[3 4] which typically displays dry eyes, itching, heated sensations, tearing, blurred vision and headaches.[5] DES is a risk factor for new-onset myopia or myopia progression.[6] Although school closures were temporary,

Table 1 Demographic characteristics and KAP scores

Variables	N=3261	Knowledge score		Attitude score		Practice score	
		Mean±SD	P value	Mean±SD	P value	Mean±SD	P value
Total		10.18±2.35		41.8±4.9		54.3±7.1	
Gender			0.268		<0.001		0.025
Male	800 (24.5)	10.1±2.5		41.2±5.4		53.8±7.3	
Female	2461 (75.5)	10.2±2.3		42.0±4.7		54.4±7.0	
Age, years (mean±SD)	37.7±4.6		<0.001		0.010		0.421
≤30	74 (2.3)	9.9±2.3		41.4±4.7		53.7±6.0	
31–35	1027 (31.5)	10.0±2.3		41.7±4.8		54.0±7.5	
36–40	1478 (45.3)	10.4±2.3		42.1±4.9		54.5±6.8	
≥41	682 (20.9)	9.9±2.4		41.3±5.0		54.2±7.0	
Residence			<0.001		<0.001		<0.001
Non-urban	245 (7.5)	9.1±2.5		40.5±4.6		51.8±7.2	
City	3016 (92.5)	10.3±2.3		41.9±4.9		54.5±7.0	
Education			<0.001		<0.001		<0.001
Middle school and below	240 (7.4)	8.5±2.7		39.8±4.5		51.1±8.3	
High school/technical secondary school	734 (22.5)	9.4±2.4		41.1±4.2		53.1±7.1	
Junior college/university	2042 (62.6)	10.5±2.2		42.1±5.0		54.9±6.8	
Graduate and above	245 (7.5)	11.5±1.6		43.6±5.1		55.6±6.9	
Occupation			<0.001		<0.001		0.001
Employed	2269 (69.6)	10.5±2.2		42.1±5.0		54.5±6.9	
Unemployed	164 (5.0)	9.8±2.2		41.6±4.5		53.8±7.4	
Freelancer	591 (18.1)	9.5±2.6		41.0±4.4		54.0±7.2	
Others (housewives, disabled, retirees or those unwilling to disclose)	237 (7.3)	9.0±2.7		40.7±5.1		52.7±8.0	
Child's grade (primary school)			0.008		0.001		<0.001
1	693 (21.3)	10.2±2.3		42.4±4.9		55.6±6.8	
2	627 (19.2)	10.2±2.3		41.8±4.7		55.0±6.5	
3	459 (14.1)	9.9±2.5		41.5±4.9		53.5±7.1	
4	623 (19.1)	10.5±2.2		41.8±5.1		54.1±7.1	
5	517 (15.9)	10.1±2.3		41.6±4.9		53.6±7.2	
6	342 (10.5)	10.0±2.4		41.2±4.7		52.4±7.4	
Is your child myopic? (ie, does the child have a diagnosis of myopia?)			<0.001		<0.001		<0.001
Yes	448 (13.7)	11.2±2.1		42.9±4.9		54.7±6.9	
No	2465 (75.6)	10.1±2.3		41.7±4.9		54.5±7.0	
Unclear	348 (10.7)	9.4±2.4		41.1±4.5		51.8±7.1	
Daily electronics usage time (mean±SD)	2.3±1.7		0.072		0.035		<0.001
≤2 hours	2140 (65.62)	10.2±2.4		41.9±5.0		55.3±6.8	
>2 hours	1121 (34.38)	10.1±2.3		41.5±4.7		52.2±7.1	
Daily reading and homework time (mean±SD)	2.0±1.2		0.013		0.010		0.060
≤2 hours	2447 (75.04)	10.2±2.3		41.9±4.9		54.4±7.1	
>2 hours	814 (24.96)	10.0±2.4		41.4±4.8		53.9±7.1	

Continued

Table 1 Continued

Variables	N=3261	Knowledge score		Attitude score		Practice score	
		Mean±SD	P value	Mean±SD	P value	Mean±SD	P value
Is your child learning online at home?			0.116		0.070		0.249
Yes	2959 (90.7)	10.2±2.3		41.7±4.9		54.2±7.0	
No	302 (9.3)	10.0±2.5		42.3±5.1		54.7±7.4	
Number of days learning online at home							
Less than 1 week	249 (8.4)	10.1±2.3		41.2±6.3		54.9±7.4	
Within 1 week to 1 month	1367 (46.2)	10.1±2.3		41.6±4.6		54.1±7.0	
Within 1 month to 3 months	1240 (41.9)	10.4±2.3		42.0±4.8		54.3±6.9	
More than 3 months	103 (3.5)	9.6±3.0		41.5±4.9		53.3±6.9	
Daily outdoor activities time			<0.001		0.001		<0.001
<30 min	810 (24.8)	9.9±2.5		41.4±5.2		52.3±7.4	
30 min to 1 hour	1548 (47.5)	10.3±2.3		41.7±4.8		54.5±6.7	
1 hour to 2 hours	680 (20.9)	10.4±2.3		42.4±4.8		55.7±6.9	
≥2 hours	223 (6.8)	10.1±2.5		42.2±4.6		55.6±7.4	
During COVID-19, has the vision of your child worsened (eg, a decrease of visual acuity)?			<0.001		<0.001		<0.001
Yes	503 (15.4)	10.9±2.3		41.9±5.4		53.3±7.2	
No	1859 (57.0)	10.3±2.3		42.0±4.8		55.4±6.8	
Unclear	899 (27.6)	9.7±2.4		41.2±4.6		52.4±7.1	
Magnitude of myopia progression							
<−0.5D	194 (38.6)	11.1±2.0		41.4±5.4		53.6±7.7	
−0.5D to −1D	176 (35.0)	11.4±1.9		43.2±5.5		54.7±6.2	
−1D to −1.5D	20 (4.0)	11.3±2.1		41.8±4.6		51.8±8.6	
−1.5D to −2D	9 (1.8)	9.2±3.4		42.1±5.4		52.4±9.7	
≥−2D	7 (1.4)	10.3±3.1		44.9±5.2		51.4±3.8	
Unclear	97 (19.3)	9.6±2.6		40.5±4.8		50.8±7.1	

KAP, knowledge, attitude and practice.

the steady development of such educational online platforms and their growing adoption contributed to their general acceptance in the longer term.[7] The increase in electronic device use for education also supported the growing dependence of children on computers and smartphones during the lockdown, as this was their sole contact with the external world.

There is substantial evidence that DES, near work (including studying) and little time spent outdoors cause myopia. A meta-analysis covering 12 cohort studies, 15 cross-sectional investigations and a population of 25 025 children aged 6–18 reached an evidence rating of II for encouraging decreased screen time to prevent myopia.[8] These results are further supported by other studies in different populations.[9 10] Only a few studies evaluated the knowledge, attitude and practice (KAP) towards myopia among parents of school-aged children.[11–13] The parents' KAP towards their children's visual health has been associated with myopia risk in school-aged children.[13]

Given the essential role of parents in the ocular health education of their children and the implementation of healthy screen habits at home, improving ocular health awareness among these adults seems indispensable to prevent the aggravation of myopia incidence rates. A KAP survey is a structured quantitative method that helps expose misconceptions that may prevent the effective implementation of activities or desired behaviours.[14] Therefore, a KAP questionnaire was used to conduct the present study to better understand parental behaviours and perspectives on myopia prevention and control during the COVID-19 epidemic.

METHODS

Study design and participants

This cross-sectional study was conducted among parents between 19 August 2022 and 19 October 2022, in the Jinan High-Tech District. The primary schools in this

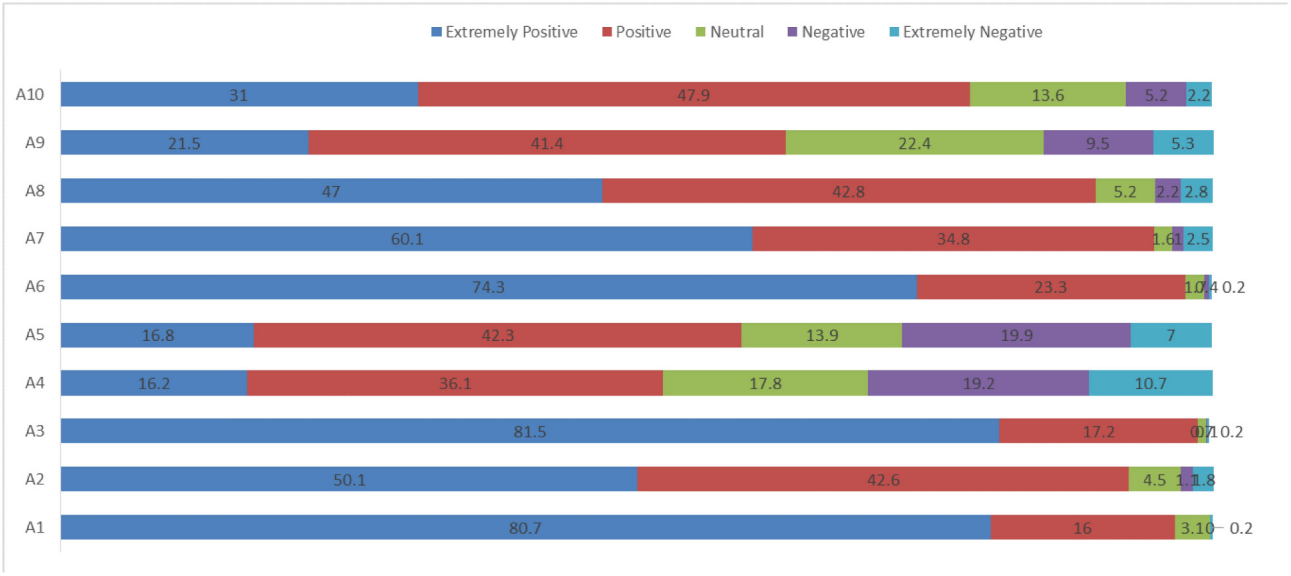

Figure 1 The score distribution of the 'attitude' dimension. The x-axis is the distribution of options (in percentages), and the y-axis is the specific entries. Details of the questions could be found in the KAP questionnaire (online supplemental material). KAP, knowledge, attitude and practice.

district were closed from 1 January 2022 to 27 February 2022, and from 4 March 2022 to June 2022 (the exact date differed among schools).

The inclusion criteria were (1) parents of children attending grades 1–6 (in China, children typically start first grade of primary school at 6 years) and (2) voluntarily agreeing to participate. Incomplete or irregular questionnaires were excluded.

Procedures

According to the Guidelines on Appropriate Technology for the Prevention and Control of Myopia in Children and Teenagers (updated version),[15] a KAP questionnaire (online supplemental material) was self-designed and revised according to the comments from six experts (four ophthalmologists, one special examination ophthalmologist and one elementary school teacher). The four dimensions included the following. The demographic characteristics of the participants were collected. The knowledge dimension consisted of 14 questions about myopia (eg, Children and teenagers are at high risk for myopia, especially those aged 8–14. True or False?). Correct answers were scored 1, and incorrect or unclear answers were scored 0. The total knowledge score ranged from 0 to 14 points, with higher scores indicating better knowledge. The attitude dimension comprised 10 questions (eg, I am very concerned about myopia in my child). All attitude items were scored using a 5-point Likert scale, ranging from very positive (5 points) to very negative (1 point), resulting in a total attitude score of 10–50 points; higher scores indicated more favourable attitudes. The practice dimension included 13 questions (eg, after the online class, my child will not turn off the electronic device in time and will continue to play games, social software or browse the web) was also scored using a 5-point Likert scale, ranging from always (5 points) to never (1 point) for positive questions and from 1 point to 5 points for negative statements. The final practice score ranged 13–65 points, with higher scores indicating more active practice. A final score exceeding 75% of the total score of each dimension indicated adequate knowledge (knowledge score >10.5), a positive attitude (attitude score >35) and proactive practice (practice score >48.75).[16]

After designing the questionnaire and conducting a small-scale test (30 copies to 30 parents; the eligibility criteria for the pilot test were the same as for the formal study). The 37 questions showed high internal consistency (Cronbach's α=0.860). During the pilot study, none of the parents had difficulty in responding to the questionnaire.

The final questionnaire was in Chinese. The participants were enrolled through convenience sampling. The electronic questionnaires were distributed through school WeChat and QQ groups, while the paper questionnaires were handed out when parents visited the clinic for medical consultation. Those who visited the clinic were also given the option to complete the electronic questionnaire instead. The electronic questionnaire was constructed using the WeChat-based Questionnaire Star applet and generated Quick Response (QR) codes. The participants logged in and filled out the questionnaire by

Table 2 Pearson correlation analysis

	Knowledge	Attitude	Practice
Knowledge	1		
Attitude	0.35 (p<0.001)	1	
Practice	0.29 (p<0.001)	0.39 (p<0.001)	1

Data are shown as r (p value).

Table 3 Univariable and multivariable logistic regression analyses for knowledge scores (75% cut-off)

Factors	Univariable logistic regression		Multivariable logistic regression	
	OR (95% CI)	P value	OR (95% CI)	P value
Gender				
Male	Ref			
Female	0.999 (0.852 to 1.172)	0.991		
Age, years				
≤30	Ref			
31–35	1.004 (0.626 to 1.613)	0.985		
36–40	1.423 (0.890 to 2.273)	0.140		
≥41	1.028 (0.635 to 1.663)	0.911		
Residence				
Non-urban	Ref		Ref	
City	2.282 (1.728 to 3.013)	<0.001	1.393 (1.032 to 1.879)	0.030
Education				
Middle school and below	Ref		Ref	
High school/technical secondary school	1.802 (1.289 to 2.520)	<0.001	1.696 (1.200 to 2.398)	0.003
Junior college/university	4.031 (2.952 to 5.505)	<0.001	3.089 (2.211 to 4.315)	<0.001
Graduate and above	12.195 (7.948 to 18.711)	<0.001	8.196 (5.202 to 12.915)	<0.001
Occupation				
Employed	Ref		Ref	
Unemployed	0.469 (0.338 to 0.651)	<0.001	0.686 (0.483 to 0.974)	0.035
Freelancer	0.512 (0.426 to 0.616)	<0.001	0.737 (0.601 to 0.902)	0.003
Others (housewives, disabled, retirees, or those unwilling to disclose)	0.367 (0.276 to 0.488)	<0.001	0.571 (0.421 to 0.775)	<0.001
Child's grade				
1	Ref		Ref	
2	0.987 (0.795 to 1.225)	0.903	1.065 (0.846 to 1.340)	0.591
3	0.764 (0.603 to 0.968)	0.026	0.904 (0.702 to 1.164)	0.434
4	1.175 (0.945 to 1.460)	0.146	1.073 (0.847 to 1.358)	0.561
5	0.840 (0.668 to 1.055)	0.133	0.820 (0.635 to 1.059)	0.128
6	0.882 (0.681 to 1.144)	0.344	0.978 (0.729 to 1.312)	0.881
Is your child myopic? (ie, does the child have a diagnosis of myopia?)				
Yes	Ref		Ref	
No	0.434 (0.350 to 0.538)	<0.001	0.502 (0.385 to 0.656)	<0.001
Unclear	0.245 (0.182 to 0.330)	<0.001	0.341 (0.247 to 0.471)	<0.001
Daily electronics usage time				
≤2 hours	Ref		Ref	
>2 hours	0.860 (0.744 to 0.994)	0.041	0.907 (0.772 to 1.065)	0.232
Daily reading and homework time				
≤2 hours	Ref		Ref	
>2 hours	0.828 (0.706 to 0.970)	0.020	0.865 (0.729 to 1.028)	0.099
Is your child taking online courses at home?				
Yes	1.163 (0.917 to 1.474)	0.213		
No	Ref			
Daily outdoor activities time				
≤1 hour	Ref		Ref	

Continued

Table 3 Continued

Factors	Univariable logistic regression OR (95% CI)	P value	Multivariable logistic regression OR (95% CI)	P value
>1 hour	1.221 (1.047 to 1.424)	0.011	1.145 (0.970 to 1.351)	0.109
During COVID-19, has the vision of your child worsened (eg, a decrease of visual acuity)?				
Yes	Ref		Ref	
No	0.599 (0.489 to 0.734)	<0.001	0.727 (0.561 to 0.943)	0.016
Unclear	0.400 (0.319 to 0.501)	<0.001	0.515 (0.396 to 0.670)	<0.001

scanning the QR code sent by the researchers. In order to ensure the quality and completeness of the questionnaire results, each IP address could be used for submission only once, and all items were compulsory. Every questionnaire was checked for completeness, consistency and validity by research team members.

Statistical analysis

All data were analysed in 2022. SPSS V.26.0 (IBM) was used for statistical analysis. Continuous data were tested for normal distribution using the Kolmogorov-Smirnov test. Continuous data were expressed as mean±SD and compared by t-test (eg, between sexes) or one-way analysis of variance (eg, among age groups). The categorical data were presented as n (%) and compared with the χ^2 test. Pearson correlations were used to analyse KAP scores. Univariable and multivariable analyses of practice were performed by logistic regression. The dependent variable was a practice score >75% of the total practice score (ie, 60 points and above vs 59 points and below). The 75% distribution of the data was used as the cut-off value because the data distribution was too skewed (2591 out of 3261 with sufficient knowledge). An analysis of the factors associated with practice scores >75% (dependent variable) was performed; variables with p<0.05 in the univariable logistic regression analyses were included as independent variables in the multivariable logistic regression analysis (not stepwise). For the comparison of KAP according to myopia, a propensity score matching (PSM) was performed based on gender, age, residence, education, occupation and child's school grade. All statistical tests were performed using two-sided tests, and a p<0.05 was considered statistically significant.

Patient and public involvement

No patients were involved.

Results

A total of 3261 parents were enrolled, of which 800 were male (24.5%) and 2461 (75.5%) were female. Their mean age was 37.7 years (range 30–41), and most lived in the city (92.5%). Most children did not have myopia (75.6%), while 13.7% did, and 10.7% had no diagnosis. During the study period, most children experienced online learning at home (90.7%) for 1 week to 1 month (46.2%), for 1–3 months (41.9%), for <1 week (8.4%) or >3 months (3.5%). The daily time that children spent outdoors was mainly 0.5 to 1 hour (47.5% of the children), followed by <0.5 hour (24.8%), 1–2 hours (20.9%) and >2 hours (6.8%). Since the pandemic outbreak, worsening of visual acuity was reported in 15.4% of the children (table 1). The parents' KAP scores were 10.2±2.4 (10.2/14=72.9%), 41.8±4.9 (41.8/50=83.6%) and 54.3±7.1 (54.3/65=83.5%), respectively (table 1).

In the knowledge dimension, the statement with the best percentage of right answers was 'There are many causes of myopia in children, including genetics, nutritional diet and poor habits of eye use', while the poorest percentage of right answers was found at 'Long time use of electronic devices (tablet computers, cell phones, computers, etc) can cause myopia in children' (online supplemental table S1).

The results of the attitude dimension showed that parents had a more positive attitude towards "I am very concerned about myopia in my child. (A1)" and a less positive attitude towards "Even if the doctor recommends prescribing a pair of glasses for my child, I'm still reluctant to let him/her wear it. (A4)" (figure 1). The practice dimension results suggest that parents were more positive (always+often) about "I will try to provide a good indoor lighting environment in the home. (P5)" and less positive (always+often) about "After the online class, my child will not turn off the electronic device in time and will continue to play games, social software or browse the web. (P1)" (online supplemental figure S1).

Pearson correlation analysis revealed significant differences between each KAP dimension after pairwise comparisons (p<0.001) (table 2).

Multivariable logistic regression showed that urban resident (OR 1.39, 95% CI 1.03 to 1.88, p=0.030), high school education (OR 1.70, 95% CI 1.20 to 2.40, p=0.003), undergraduate studies (OR 3.09, 95% CI 2.21 to 4.32, p<0.001) and graduate studies (OR 8.20, 95% CI 5.20 to 12.92, p<0.001) were independently associated with knowledge >75%, while being unemployed (OR 0.69, 95% CI 0.48 to 0.97, p=0.035), freelancer (OR 0.74, 95% CI 0.60 to 0.90, p=0.003), other occupations (OR 0.57, 95% CI 0.42 to 0.78, p<0.001), no diagnosis of myopia in the child (OR 0.502, 95% CI 0.39 to 0.66, p<0.001), unclear myopia status in the child (OR 0.34, 95% CI 0.25 to 0.47, p<0.001), no change in vision during the pandemic (OR 0.73, 95% CI 0.56 to 0.94, p=0.016) and unclear change in vision during the pandemic (OR 0.52, 95% CI 0.40 to

Table 4 Univariable and multivariable logistic regression analyses for attitude scores

Factors	Univariable logistic regression		Multivariable logistic regression	
	OR (95% CI)	P value	OR (95% CI)	P value
Knowledge score	1.333 (1.281 to 1.386)	<0.001	1.304 (1.250 to 1.360)	<0.001
Gender				
Male	Ref		Ref	
Female	1.408 (1.148 to 1.727)	0.001	1.405 (1.129 to 1.748)	0.002
Age, years				
≤30	Ref			
31–35	0.899 (0.464 to 1.742)	0.753		
36–40	0.962 (0.499 to 1.854)	0.908		
≥41	0.721 (0.370 to 1.406)	0.337		
Residence				
Non-urban	Ref		Ref	
City	1.941 (1.438 to 2.621)	<0.001	1.301 (0.937 to 1.807)	0.116
Education				
Middle school and below	Ref		Ref	
High school/technical secondary school	1.842 (1.325 to 2.561)	<0.001	1.518 (1.067 to 2.162)	0.020
Junior college/university	2.589 (1.917 to 3.494)	<0.001	1.428 (1.005 to 2.027)	0.047
Graduate and above	4.755 (2.814 to 8.034)	<0.001	1.842 (1.032 to 3.290)	0.039
Occupation				
Employed	Ref		Ref	
Unemployed	0.730 (0.486 to 1.098)	0.131	0.899 (0.580 to 1.395)	0.636
Freelancer	0.634 (0.504 to 0.798)	<0.001	0.885 (0.683 to 1.147)	0.357
Others (housewives, disabled, retirees or those unwilling to disclose)	0.605 (0.436 to 0.841)	0.003	0.995 (0.690 to 1.436)	0.979
Child's grade				
1	Ref		Ref	
2	0.771 (0.571 to 1.043)	0.091	0.777 (0.566 to 1.066)	0.118
3	0.755 (0.545 to 1.045)	0.090	0.861 (0.610 to 1.214)	0.393
4	0.851 (0.626 to 1.157)	0.303	0.792 (0.572 to 1.095)	0.158
5	0.697 (0.511 to 0.952)	0.023	0.719 (0.515 to 1.005)	0.053
6	0.644 (0.456 to 0.909)	0.012	0.703 (0.483 to 1.023)	0.066
Is your child myopic? (ie, does the child have a diagnosis of myopia?)				
Yes	Ref		Ref	
No	0.685 (0.506 to 0.928)	0.015	0.824 (0.592 to 1.147)	0.251
Unclear	0.516 (0.352 to 0.758)	<0.001	0.797 (0.528 to 1.205)	0.282
Daily electronics usage time				
≤2 hours	Ref			
>2 hours	0.906 (0.747 to 1.099)	0.318		
Daily reading and homework time				
≤2 hours	Ref			
>2 hours	0.893 (0.724 to 1.101)	0.290		
Is your child taking online courses at home?				
Yes	0.978 (0.710 to 1.348)	0.893		
No	Ref			
Daily outdoor activities time				

Continued

Table 4 Continued

Factors	Univariable logistic regression		Multivariable logistic regression	
	OR (95% CI)	P value	OR (95% CI)	P value
≤1 hour	Ref		Ref	
>1 hour	1.537 (1.229 to 1.922)	<0.001	1.468 (1.159 to 1.858)	0.001
During COVID-19, has the vision of your child worsened (eg, a decrease of visual acuity)?				
Yes	Ref			
No	1.069 (0.819 to 1.396)	0.623		
Unclear	0.879 (0.658 to 1.175)	0.383		

0.67, p<0.001) were independently associated with knowledge <75% (table 3).

The knowledge scores (OR 1.30, 95% CI 1.25 to 1.36, p<0.001), female gender (OR 1.41, 95% CI 1.13 to 1.75, p=0.002), high school education (OR 1.52, 95% CI 1.07 to 2.16, p=0.020), undergraduate studies (OR 1.43, 95% CI 1.01 to 2.03, p=0.047), graduate studies (OR 1.84, 95% CI 1.03 to 3.29, p=0.039) and >1 hour of daily outdoor activities (OR 1.47, 95% CI 1.16 to 1.86, p=0.001) were independently associated with the attitude scores >75% (table 4).

The knowledge scores (OR 1.11, 95% CI 1.06 to 1.16, p<0.001), attitude scores (OR 1.15, 95% CI 1.12 to 1.17, p<0.001), daily outdoor activities time (30–60 min: OR 1.46, 95% CI 1.16 to 1.84, p=0.001; 1–2 hours: OR 1.92, 95% CI 1.48 to 2.49, p<0.001; >2 hours: OR 1.91, 95% CI 1.34 to 2.74, p<0.001, respectively) and parents whose children did not have myopia progression during the online class (OR 1.43, 95% CI 1.05 to 1.96, p=0.024) were independently associated with a practice score >75%, while a child in grade 4 (OR 0.76, 95% CI 0.58 to 0.99, p=0.042), unaware of child's myopia (OR 0.52, 95% CI 0.43 to 0.64, p=0.002) and daily electronics usage time >2 hours (OR 0.53, 95% CI 0.43 to 0.64, p<0.001) were independently associated with practice scores <75% (table 5).

After PSM, there were 445 participants in the groups of children with versus without myopia. The myopia group showed higher total knowledge, myopia knowledge (K1–K4), myopia correction (K10–K14), total attitude, A4, A8, A10 and P12–P13 scores than the non-myopia group (all p<0.05) (table 6). The characteristics of the participants after PSM are shown in online supplemental table S2.

DISCUSSION

In the present study, parents demonstrated suboptimal knowledge, positive attitude and proactive practice towards myopia prevention and control during the COVID-19 pandemic. Parents with good knowledge and attitudes had better practice scores. In addition, the parents of children who participated in outdoor activities for >30 min/day and parents whose children did not have myopia progression during the online class also had better practice. In contrast, parents whose child was in grade 4, unaware of whether their child had myopia and whose child used electronic devices >2 hours per day had poor practice scores. These findings may contribute to elucidating ocular health habits from different populations and improve ocular health awareness among parents.

A previous study surveyed the views and attitudes of 3275 Chinese parents regarding young children's online learning during the COVID-19 lockdown.[17] Researchers found that most Chinese parents were seriously concerned about potential eye pathologies caused by online learning, decreased physical activity and possible digital addiction. Many parents practised diverse strategies to limit their children's screen use and promote off-screen activities. Studies also reported the worries of Chinese parents about online education damaging their children's eye health, among other numerous concerns.[18 19] All these results align with the good KAP scores registered by the parents from the present study. In East Asia, public strategies for preventing myopia are included in the educational curricula and emphasise incorporating outdoor activities during school time.[20] The comprehensive myopia prevention plan that was launched in 2018 with the participation of the Chinese Ministry of Education and the National Health Commission features three major points: (1) increase outdoor classroom time to 1–2 hours per day, (2) eliminate written homework in the first 2 years of school and limit it to 60 min for grades 3–6 and 90 min for higher grades and (3) improve national infrastructure to deliver high-quality refractive services.[21] As school closure was prolonged, the application and perennity of these programmes were endangered. Even though children could still leave screens if willing to, medium-to-long-term social distancing could impair outdoor activities and exacerbate the behaviour of long hours spent in front of screens, even for recreation. Nevertheless, in 2021, the Chinese Ministry of Education initiated a 5-year campaign to prevent and reduce myopia among younger generations, and a work plan was developed. The effects will probably be noticed in the future years.

An encouraging level of eye care awareness was observed in the study population. A common misconception in East Asia is that myopia can be eradicated with eyeglasses or laser surgery.[20] Surprisingly, in this study, the attitude 'myopia in my child is not a big deal, and he/she can have myopia surgery in the future' represented only 3% of the

Table 5 Univariable and multivariable logistic regression analyses for practice scores (75% cut-off)

Factors	Univariable logistic regression		Multivariable logistic regression	
	OR (95% CI)	P value	OR (95% CI)	P value
Knowledge score	1.25 (1.20 to 1.30)	<0.001	1.11 (1.06 to 1.16)	<0.001
Attitude score	1.18 (1.15 to 1.20)	<0.001	1.15 (1.12 to 1.17)	<0.001
Gender				
Male	Ref	–		
Female	1.20 (1.00 to 1.44)	0.056		
Age, years				
≤30	Ref	–		
31–35	1.54 (0.86 to 2.76)	0.146		
36–40	1.45 (0.81 to 2.58)	0.213		
≥41	1.40 (0.77 to 2.53)	0.265		
Residence				
Non-urban	Ref	–	Ref	–
City	2.11 (1.48 to 3.01)	<0.001	1.38 (0.93 to 2.03)	0.110
Education				
Middle school and below	Ref	–	Ref	–
High school/technical secondary school	1.28 (0.87 to 1.89)	0.213	0.93 (0.61 to 1.41)	0.719
Junior college/university	2.21 (1.55 to 3.16)	<0.001	1.18 (0.79 to 1.74)	0.423
Graduate and above	2.59 (1.68 to 4.00)	<0.001	0.93 (0.57 to 1.51)	0.766
Occupation				
Employed	Ref	–		
Unemployed	0.83 (0.57 to 1.19)	0.304		
Freelancer	0.86 (0.70 to 1.06)	0.159		
Others (housewives, disabled, retirees or those unwilling to disclose)	0.74 (0.54 to 1.01)	0.060		
Child's grade				
1	ref	–	ref	–
2	0.80 (0.63 to 1.00)	0.054	0.996 (0.77 to 1.29)	0.977
3	0.58 (0.45 to 0.76)	<0.001	0.78 (0.58 to 1.05)	0.099
4	0.63 (0.49 to 0.79)	<0.001	0.76 (0.58 to 0.99)	0.042
5	0.60 (0.46 to 0.77)	<0.001	0.84 (0.62 to 1.12)	0.225
6	0.46 (0.34 to 0.63)	<0.001	0.76 (0.53 to 1.08)	0.119
Is your child myopic? (ie, does the child have a diagnosis of myopia?)				
Yes	Ref	–	Ref	–
No	0.96 (0.77 to 1.19)	0.684	0.88 (0.65 to 1.19)	0.397
Unclear	0.36 (0.25 to 0.52)	<0.001	0.519 (0.43 to 0.64)	0.002
Daily electronics usage time				
≤2 hours	Ref	–	Ref	–
>2 hours	0.44 (0.37 to 0.53)	<0.001	0.53 (0.43 to 0.64)	< 0.001
Daily reading and homework time				
≤2 hours	Ref	–		
>2 hours	0.85 (0.72 to 1.02)	0.073		
Is your child taking online courses at home?				
Yes	0.81 (0.63 to 1.05)	0.118		
No	Ref	–		

Continued

Table 5 Continued

Factors	Univariable logistic regression OR (95% CI)	P value	Multivariable logistic regression OR (95% CI)	P value
Daily outdoor activities time				
<30 min	Ref	–	Ref	–
30 min to 1 hour	1.71 (1.38 to 2.12)	<0.001	1.46 (1.16 to 1.84)	0.001
1 hour to 2 hours	2.54 (2.0 to 3.23)	<0.001	1.92 (1.48 to 2.49)	<0.001
>2 hours	2.44 (1.75 to 3.39)	<0.001	1.91 (1.34 to 2.74)	<0.001
During COVID-19, has the vision of your child worsened (eg, a decrease of visual acuity)?				
Yes	ref	–	ref	–
No	1.65 (1.31 to 2.07)	<0.001	1.43 (1.05 to 1.96)	0.024
Unclear	0.74 (0.57 to 0.98)	0.032	0.90 (0.64 to 1.25)	0.510

affirmative responses. Furthermore, after analysing the distribution of each KAP dimension, healthy or at least not harmful responses appeared in most cases.

Increased time spent outdoors has been proven to reduce myopia onset, including incident and prevalent myopia.[22 23] Nevertheless, initiatives to increase outdoor time are not welcome in many East Asian countries. Parents frequently worry about their children getting less time for their studies, and educators do not usually support open-air learning and playing.[20] In the study population, on the other hand, 75.2% of the children spent more than 30 min outdoors every day, according to their parents, who, in turn, scored higher KAP values (vs the remaining 24.8%). Moreover, 72.7% of the parents claimed to control their child's use of electronics and to try to replace them with daytime outdoor activities. As stated earlier, these beneficial results could be related to an overall acceptable level of eye care awareness in this population. It should also be considered that most children in this sample did not have myopia (75.6%), which could be positively influenced by their off-screen time.

The present work identified some misconceptions about ocular health and myopia control among Chinese parents. Poor education on how myopia is associated with

Table 6 KAP comparison between different myopia progression and daily outdoor activities

Factor or statement	Participants* Myopic	Not myopic	p_1
Knowledge			
Total	11.17±2.12	10.40±2.21	<0.001
Myopia Knowledge (K1–K4)	3.32±0.77	3.10±0.71	<0.001
Myopia Protection (K5–K9)	4.68±0.63	4.68±0.65	0.902
Myopia Correction (K10–K14)	3.18±1.34	2.62±1.48	<0.001
Attitude			
Total	42.89±4.91	41.40±5.00	<0.001
Even if the doctor recommends prescribing a pair of glasses for my child, I'm still reluctant to let him/her wear them (A4)	3.63±1.23	3.21±1.22	<0.001
I think taking online courses at home every day will not affect the vision (A8)	4.40±0.90	4.18±0.97	<0.001
I prefer to take my child to the nearest eyeglass store than to the hospital (A10)	4.13±0.89	4.00±0.92	0.015
Practice			
Total	54.71±6.92	54.28±6.96	0.356
Use of electronic products (P1–P4)	14.98±2.81	15.16±2.62	0.406
Lighting and electronic product selection (P5–P8)	17.91±2.44	17.61±2.61	0.094
Visual habits (P9–P11)	12.91±2.17	12.93±2.17	0.782
Compliance with medical advice and timely consultation (P12–P13)	8.92±1.39	8.58±1.67	0.005

p1: p value for myopic versus non-myopic.
*Indicates that the participants in this section are after PSM matching.
PSM, propensity score matching.

a greater risk of visual impairment highlights the importance of professional eye care and control to prevent further vision deterioration. Children with no certain myopia diagnosis or follow-up had parents with the lowest scores in every knowledge variable. A lack of myopia diagnosis also resulted in the lowest overall scores in the attitude and practice dimensions. One of the most serious misconceptions was that 'Most myopia in children is pseudomyopia, which can fully recover'. These findings are coincidental with previous reports by authoritative international health institutions, such as the WHO Regional Office for the Western Pacific, the International Agency for the Prevention of Blindness (IAPB) and the Brien Holden Vision Institute (BHVI).[20] In the 2018 WHO/IAPB/BHVI Meeting on Myopia, it was stated that <50% of Chinese parents complied with medical prescriptions for infantile spectacles,[20] supporting the need to reinforce parental education on myopia diagnosis, correction and progression. Moreover, in the COVID-19 context, as students dedicate more time to online learning, parental negligence regarding the ocular health of their children is a major concern, especially since prolonged near work is associated with myopia onset.[4 8 9]

In order to moderate the harmful effects of myopia mentioned above, eye researchers have proposed several ways to take action.[4] First, public policies should help parents be more conscious of the consequences of limited physical activity and outdoor time on myopia. Parents need to be aware of the importance of eye care when using screens, especially for long hours, including taking frequent breaks and reducing screen entertainment. Second, health institutions and eye care professionals should continue working with schools to promote creative learning, reading at home and indoor physical activities, such as cleaning, decorating, cooking and many others. The importance of taking breaks should be emphasised as well. Third, when legal and safe, outdoor physical exercises should be encouraged for all children. Parents, as role models, are requested to diminish their use of screens and familiarise their children with non-digital creative and enriching activities, including music and crafts, for instance.[24]

The child's grade was taken into consideration. Generally, the child's age and school grade will be strongly covariant, and they cannot be considered simultaneously. The exact reason why that particular grade was independently associated with KAP towards myopia cannot be determined based on the available data. Still, the typical age at myopia onset is 8–12,[25] while grade 4 children are about 10. Hence, grade 4 is around the peak age of myopia diagnosis, possibly related to the lower KAP.

This work has some limitations. First, a larger-scale study that enrols families from various locations could offer more representative and diversified information. An in-depth comprehension of individualised realities and problems is not feasible. Mixed methods that combine interviews and statistics could help better understand Chinese parents' opinions, concerns and hardships. The participants were enrolled through convenience sampling, which could lead to bias. Second, our survey collected self-reported data, which could have a bias towards socially acceptable answers. Additionally, some potential factors associated with KAP were not fully captured. Further studies that include triangulation methods (eg, teacher-self-peer interaction) could improve the accuracy of the results. In the future, the parents' KAP scores may be connected with hard data such as the children's refraction, which may be determined during a medical or optometry test. Such hard data would also allow for correlations between parental KAP towards myopia and actual myopia in their children. In the meantime, the associations and correlations should be interpreted with caution. In addition, as the questionnaire was self-designed and differed from the questionnaires used in similar studies, there are no recognised minimal clinically important differences. Third, the KAP method principally registers an answer based on the respondent's statements. This way, the results show the declarations, but there can be a distance between what is said and what is actually done. The prevalence of myopia is high in Shandong (China), at 71% among adolescents.[26] The low prevalence reported by the parents (13.7%) is probably due to underreporting. This also calls for more thorough myopia screening programmes to cover primary school students. Fourth, the parents of children with amblyopia, strabismus and systemic disorders such as congenital anomalies or neurologic disorders were not excluded from acquiring a study sample representative of the general population. Still, such parents could have a higher health literacy and KAP than the parents of children without such disorders. In the same way, parental myopia was not taken into account. Fifth, the determination of the change in myopia was self-reported by the parents and was mainly based on their judgement of their child's comportment, squinting, blinking, etc. Sixth, since the information was self-reported, precise ophthalmological information (eg, axial length) was not collected because of a high risk of unreliable or missing data.

The KAP framework allows the identification of gaps, misunderstandings and misconceptions that constitute barriers to the correct implementation of a given set of actions in a specific population. The present KAP study indeed allowed the identification of such gaps and issues, which can be targeted in future interventions to promote health and prevent myopia.

In conclusion, parents demonstrated suboptimal knowledge, positive attitude and proactive practice towards myopia prevention and control during the COVID-19 epidemic. Parents whose child is in grade 4, who are unaware of their child's myopia, and whose child uses electronic devices >2 hours per day may need the education to improve practice. Public health policies and school norms that promote healthy visual habits and increased outdoor activities are also strongly recommended.

Contributors TF and LG carried out the studies, participated in collecting data and drafted the manuscript. ZY and PZ performed the statistical analysis and participated in its design. JY helped to draft the manuscript. All authors read and approved the final manuscript. LG is the guarantor.

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

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study was ethically approved by the Institutional Review Board of Jinan 2nd People's Hospital (JNEYE20230602). All participants were informed about the study protocol and provided written informed consent to participate in the study. I confirm that all methods were performed in accordance with the relevant guidelines. All procedures were performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article or uploaded as supplementary information. All data generated or analysed during this study are included in this published article.

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