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Parental Perspectives On Myopia In An Urban Chinese Population

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Parental Perspectives on Myopia in an Urban Chinese Population

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PARENTAL PERSPECTIVES ON MYOPIA IN AN URBAN CHINESE POPULATION

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In this study, we aimed to understand how Chinese parents view myopia, including causes, progression, and treatment. We performed a cross-sectional study from July 2016 to August 2016 at Peking University 3rd Hospital in Beijing, China. Parents of myopic children completed a questionnaire including sociodemographics and Likert-style questions assessing perspectives on myopia. We employed logistic regression models to analyze relationships between responses and demographic data/degree of myopia. 109 parents completed the survey. Of these, 97 responses were included in the analysis. Almost all parents surveyed (97.9%) found their child's myopia concerning and believe myopia is dangerous to their child's vision. Lifestyle modifications rather than medical treatments were thought to be most effective for preventing and slowing progression of myopia. 93 (95.9%) parents reported restricting electronic screen use and 64 (61.0%) reported restricting studying/reading. All respondents were willing to use at least one treatment listed on the survey to treat their child's myopia. Of the 97 children, only 27 were currently using any of the treatment methods. Parents were more likely to agree to a greater number of treatments if the child was a boy (OR=2.33, $p<0.05$). Parental age/sex/education level did not affect number of methods chosen.

Almost all Chinese parents in this study found their children's myopia concerning and hoped to prevent myopia progression. However, only 27 of the 97 children were currently using methods in attempt to slow progression. Having a male child increased willingness to use treatment methods. An understanding of parental perspectives on myopia may help guide future research and patient care.

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INTRODUCTION

BACKGROUND

Myopia, or nearsightedness, results when the eye is too long for light to properly focus on the retina. Light focuses in front of the retina rather than on it, which leads to blurry images when viewing objects from far away, though patients can see clearly up close.

Worldwide, myopia has become an increasingly common ophthalmic disease. A recent systematic review and meta-analysis estimates that the percentage of the world's population with myopia will increase from 22.9% in 2000 to 49.8% in 2050.[1] Additionally, by 2050, almost 1 billion people, or 9.8% of the world's population, will have high myopia.[1] Despite the increasing rates of myopia, it is rarely viewed as a serious problem in Western societies. Instead, myopia is viewed as an inconvenience that can be easily corrected with glasses, contact lenses, or surgery.[2] Most patients with myopia are seen by optometrists rather than ophthalmologists. However, a recent study estimates that the lifetime risk of developing visual impairment from myopia and high myopia is 4% and 39%, respectively.[3] These data suggest that myopia is a serious medical and public health problem.

Myopia is already a disease of epidemic proportions in many East Asian countries such as China. Rates of myopia in urban Chinese teenagers and young adults have been estimated to be on the order of 80% to 90%.[4-6] These rates are higher than those in other ethnic groups, even when comparing Chinese children to children of other ethnic groups growing up in the same geographic area.[4,7,8]

Among myopic children in China, about 24% are categorized as high myopes by adulthood, placing them at higher risk for blindness and visual impairment due to diseases such myopic maculopathy, myopic choroidal neovascularization, and retinal detachment.[9] These complications result from mechanical stress placed on the retina due to the eye being too long. Myopic maculopathy has already become a leading cause of untreatable visual impairment in the Chinese population, causing 7.7-12.5% of blindness in studies of people over the age of 40, second only to cataract.[10,11] Thus, significant time has been dedicated to preventing and slowing the progression of myopia in China.

CAUSES

Many large-scale studies in the last two decades have examined risk factors such as time spent on near work, time spent on outdoor activities, high population density, and urban residence as possible causes of myopia.[12-23] Below is a summary of the current literature on risk factors for myopia.

Near-work habits

The association between near-work habits and development of myopia is of great interest to researchers. Near-work habits include amount of time spent on near-work activities (i.e. studying, reading, and playing videogames) and working distance.

A longitudinal questionnaire-based study of eighth graders in Orinda, California found that participants with myopia spent significantly more time reading and studying than participants without myopia.[13] Another questionnaire-based study of over 16,000 second-graders in Taipei, Taiwan found that students with a

shorter working distance for near-work activities were at higher risk for myopia. In this study, participants with working distance of <30 cm were considered to have short working distance.[14] In a longitudinal, questionnaire-based study in Beijing, China of about 5,000 elementary school students, the authors stratified participants based on whether there was significant progression of myopia between enrollment and follow-up one year later. They then compared baseline characteristics of participants with progression to those without progression and found that students with a shorter working distance (< 33 cm) were at higher risker for developing myopia.[15]

It has long been hypothesized that accommodation from near-work activities and the accompanying change in lens shape increases vitreous chamber pressure, leading to axial elongation. During accommodation, the ciliary muscle tightens around the lens to increase the thickness of the lens. At the same time, the tightening of the ciliary muscle increases tension on the choroid. Because the eye is filled with non-compressible vitreous fluid, the increased tension on the choroid results in increased vitreous chamber pressure. It is thought that chronic elevations in vitreous chamber pressure from accommodation lead to axial elongation and myopia.[24]

Although increased amount of time spent on near-work and shorter working distance have both been associated with myopia development, it is difficult to ascertain if this is a causal relationship. It is possible that children who are predisposed to development of myopia are more likely to rely on shorter working distances. Similarly, it is possible that children predisposed to development of

myopia more greatly enjoy activities that utilize close vision such as reading and studying.

Time spent on outdoor activities

One of the most well-studied modifiable risk factors for prevention of myopia is increased time spent outdoors. In a study by Rose et al., prevalence and risk factors for myopia in 6- and 7- year old children of Chinese ethnicity in Sydney and Singapore were compared. The authors found that the children in Sydney had a lower prevalence of myopia, which was associated with increased time spent on outdoors activities (13.75 hours per week vs. 3.05 hours per week).[12]

A 15-year longitudinal study of children born between April 1991 and December 1992 in England assessed time spent outdoors by the children between eight and nine years of age. Children who reported three or more hours spent outside per day were significantly less likely to become myopic, even after correcting for confounders such as myopic parents, time spent reading, and sex.[19] Of note, this study found that time spent outdoors was a predictor of myopia incidence independently of physical activity, suggesting that time spent outdoors rather than physical activity is the modifiable factor linked to prevention of myopia.

The mechanism by which time spent outdoors prevents development of myopia is unclear, but a few hypotheses exist. The first hypothesis stems from the idea that increased near-work and accommodation can cause myopia. Thus, it is thought that spending time outdoors, where children can look into the distance, can prevent myopia development.[17] However, the paradigm has recently shifted to also examine the potential effects of ambient light in preventing myopia

development. Studies in animal models suggest that visible light could stimulate dopamine release by the retina. Dopamine is thought to inhibit axial elongation of the eye.[9,19]

Population density/urban residence

The effects of population density and urban residence on myopia development have recently become of greater interest. A study by Zhang et al. examined 2480 students in secondary schools in Liangying Township, Guandong, China.[18] Liangying Township is composed of a mix of rural and urban neighborhoods, and the authors calculated population density of 32 villages and urban zones in this township. The authors then correlated population density with prevalence of myopia and found that students with refractive error less than or equal to -2.0 D lived in significantly more densely populated areas than students with refractive error greater than -2.0 D.[18] Additional studies comparing prevalence of myopia in urban vs. rural residents found significantly higher rates of myopia in urban populations. While rates of myopia in urban Chinese teenagers are about 80%, rates of myopia in rural Chinese teenagers are about 55%.[4,9]

Residence in densely populated areas and urban residence are hypothesized to be associated with myopia because these places provide children with less opportunity for outdoor play. Additionally, even if children spend time outside in highly populated areas, their line of sight may be limited by tall buildings and lack of open space.[18] Urban areas also likely offer more educational opportunities and pressure for students to succeed from an early age, resulting in greater time spent on near-work activities.[12]

In summary, most myopia studies to date have found that increased time spent on near work increases risk for myopia, while increased time outdoors decreases risk for myopia.[12-16,18-22] Initial studies have also suggested a positive correlation between urban residence and high population density with risk for developing myopia.[18,23] Higher educational levels and parental history of myopia have also been linked to increased risk of developing myopia.[4]

Despite the results of these studies, it can be difficult to discern which factors are independently associated with myopia given the multifactorial nature of the disease and presence of confounding variables. For example, residents of urban areas may have higher educational levels than residents of rural areas, as people with higher education tend to cluster in urbanized areas where greater job opportunities are available. People with higher education are likely to have spent greater time studying or reading during their developmental years, which may then explain higher rates of myopia in urban populations. Although some of the previously mentioned studies correct for confounding variables, it is also difficult to correct for any genetic contributions that may result from highly educated parents clustering in urbanized areas. Additionally, most studies that assess time spent outdoors and time spent on near work activities rely on parental reporting of these values, which could lead to significant recall bias. To address concerns about confounding variables and recall bias, more randomized controlled trials to study myopia risk factors are needed.

TREATMENTS

Several treatments exist to prevent progression of myopia. This section will not cover devices or methods that merely correct the refractive error from myopia such as glasses, contact lenses, or refractive surgery. Methods that serve to correct refractive error do not prevent the eyeball from growing in length. Thus, the retina is still subject to increased mechanical stress and subsequent eye elongation. This section will focus on discussing current methods available to prevent eyeball growth and myopia progression.

A 2016 network meta-analysis included thirty randomized controlled trials (RCTs) that studied interventions to control myopia progression.[25] The interventions studied in the RCTs included multifocal spectacle lenses, rigid contact lenses, and pharmaceutical agents. The effectiveness of each intervention for preventing myopia progression was categorized as strong, moderate, or weak based on diopters change per year and axial length change per year compared to single vision spectacle lenses/placebo.

Bifocal and multifocal spectacle and contact lenses

Bifocal and multifocal lenses include bifocal lenses, progressive addition lenses (also known as no-line bifocals), prismatic bifocal lenses, and peripheral defocusing multifocal lenses. Bifocal and multifocal lenses have been hypothesized to decrease the rate of myopia progression by decreasing the accommodative effort for near work.[26] The 2016 network meta-analysis by Huang et al. found that each of the bifocal and multifocal lenses studied in RCTs had weak or moderate effects on preventing myopia progression.[25] However, only peripheral

defocus modifying contact lenses and progressive addition spectacle lenses had a statistically significant effect on preventing myopia progression.[25]

Rigid contact lenses

Rigid contact lenses include rigid gas permeable lenses and orthokeratology, a type of rigid contact lens worn overnight that corrects myopia by reshaping the cornea. Rigid contact lenses are thought to prevent myopia progression by flattening the central cornea and steepening the midperipheral cornea, which reduces relative peripheral hyperopia and may slow elongation of the eyeball.[25] The 2016 network meta-analysis found that rigid gas permeable lenses have no effect on preventing myopia progression.[25] However, the analysis also showed that orthokeratology had moderate effectiveness in preventing myopia progression.[25] Despite evidence that orthokeratology is moderately effective for preventing myopia progression, the major disadvantages are cost, discomfort from overnight wear, difficulty educating children on proper usage, and infection risk.[25]

Pharmaceutical agents

Pharmaceutical agents that have been found to be effective in preventing myopia progression include antimuscarinic agents such as atropine and pirenzapine. It is unknown exactly how these agents prevent myopia progression. Initially, it was thought that atropine prevents myopia progression because it prevents accommodation. However, it has been found that atropine prevents myopia progression even in animals that cannot accommodate. It is now thought that atropine exerts its effects on biochemical pathways in the retina or sclera by

binding muscarinic receptors. Additional theories hypothesize that pupillary dilation following atropine administration increases exposure to ultraviolet A, limiting axial elongation, or that atropine downregulates chronic inflammation that may be present at baseline in myopic eyes.[27]

The most notable studies examining the effectiveness of pharmaceutical agents are the Atropine for the Treatment of Childhood Myopia (ATOM) studies. In the original ATOM study, a parallel-group, placebo-controlled, randomized, double-masked study, the authors found that eyes treated with 1% atropine over 2 years had significantly less myopia progression and axial elongation compared to eyes treated with placebo drops.[28] In a 5-year follow-up study (ATOM2), the authors compared the efficacy and safety of high-dose (1% and 0.5%), moderate-dose (0.1%), and low-dose (0.01%) atropine. They found no clinically significant difference between the effectiveness of each dose for preventing myopia progression or axial elongation.[29] However, the low-dose atropine was found to have the least side effects, with negligible effects on pupil size, accommodation, and near visual acuity.[29] Huang et al. found in their meta-analysis that all three doses of atropine were strongly effective in preventing myopia progression.[25] Pirenzapine had moderate effects in preventing progression.[25] Given that all three atropine doses are effective for myopia progression, low-dose atropine is clinically preferred as it does not have the side effects associated with high-dose atropine use such as increased photophobia and glare.

In summary, the most effective method currently available to prevent myopia progression is atropine. Orthokeratology is also thought to be effective, but

has the major disadvantages of cost, infection risk, and adherence difficulties in children.

SOCIETAL IMPACT

In the United States, the direct cost of correcting vision impairment due to myopia is between 3.9 billion and 7.2 billion USD per year.[4] Another study estimated that the annual cost to treat myopia in the urban Asian population is 328 billion USD, costing more than other chronic medical problems such as Parkinson's disease and chronic obstructive pulmonary disease.[30] Beyond the economic impacts of myopia, it has been documented that many patients with myopia suffer from compromised quality of life due to psychological, cosmetic, functional, and financial factors.[31,32]

An article published in 2001 about myopia in Singapore raised concerns about the health, social, and economic repercussions of increasing rates of myopia and high myopia.[33] For example, concerns have been raised about the use of eyeglasses in the military as they cause interface problems with equipment such as binoculars, protective masks, and head-mounted instruments. Almost 20% of pilot applicants to the Republic of Singapore Air Force are rejected due to refractive status.[33] As myopia becomes increasingly more prevalent, its effects on career choice, productivity, and economies will likely become more apparent.

Of particular concern are the increasing rates of myopia in school-age children. One study of Taiwanese school children found that the prevalence of myopia in 7-year-olds increased from 5.8% in 1983 to 21% in 2000. The

prevalence of myopia in 12-year-olds increased from 36.7% in 1983 to 61% in 2000.[34] Another review of myopia prevalence in the United States found that the prevalence of myopia in children aged 12 to 17-years-old increased from 12.0% to 31.2% between 1971 and 2004.[35] Increased use and reliance on electronic devices that use near-vision such as computers, tablets, cell phones, and televisions are thought to play a major role in the increasing prevalence of myopia in school-age children.[12,36] The increasing rates of myopia in school-age children is concerning as studies indicate that myopia progresses significantly faster in children who develop myopia at a younger age.[37,38] With the rates of high myopia also increasing, greater ocular complications leading to irreversible visual impairment, handicap, and socioeconomic burden are expected to follow.[14]

PURPOSE

Despite the significant number of articles about myopia prevalence, causes, treatments, and societal impact, few studies have sought to understand parental perceptions and perspectives on the causes, treatment methods, and lifestyle impact of myopia. As ophthalmologists, optometrists, public health experts, and public policy officials move towards interventions to decrease rates of myopia and myopia progression, ultimately patient and parental preference will be pivotal in determining outcomes and effectiveness of interventions. We thus sought to understand how Chinese parents view myopia, including causes, progression, and treatment. A greater understanding of parental perspectives on myopia may help provide effective treatment and guide future research and patient care.

METHODS

STUDY PARTICIPANTS

The author of this thesis approached participants in the waiting area of the Peking University 3rd Hospital pediatric ophthalmology/optometry clinic. Participants verbally gave informed consent to participate. Parents of children with concurrent diagnoses such as strabismus or amblyopia were excluded. Of 126 people approached, 109 agreed to participate and completed the survey (86.5% participation rate). Four participants were excluded, as they were neither the father nor mother of the patients (i.e. were the aunt or grandmother). Three participants resided in a rural area and were excluded. An additional five participants were excluded as their children were greater than or equal to 18 years in age. This study was reviewed and deemed exempt by the Yale University Institutional Review Board and was conducted in accordance with the tenets of the Declaration of Helsinki. Additional approval was granted by Peking University 3rd Hospital. All data were de-identified.

QUESTIONNAIRE DESIGN

In this study, a two-part questionnaire was administered. The questionnaire was first developed in English by Wendy F. Li with assistance from Juan Bu and Christopher C. Teng. The questionnaire was then translated into Chinese by Wendy F. Li with assistance from Juan Bu. Part 1 of the questionnaire contained questions assessing demographics of the parents and their children. Part 2 of the questionnaire contained 24 Likert-style questions assessing parents' views on myopia and its causes, progression, and treatment. We utilized a 4-point Likert

scale as previous studies demonstrated greater construct validity with a 4-point scale in Chinese populations.[39]

OUTCOMES

Likert-style questions were divided into four categories (A through D below). Wendy F. Li tabulated parental responses to the Likert-style questions. She then performed data analyses with assistance and guidance from Joshua L. Warren. We first reported data from each category as descriptive data. We then determined association between parental age/sex/education level and child's age/sex/degree of myopia with responses to each category.

Categories based on questions assessing:

A. Perspectives on causes of myopia and myopia progression

We asked parents how strongly they agreed or disagreed with statements citing specific causes of myopia and myopia progression. These possible causes included: electronic screen use, studying or reading, eye fatigue, heredity, eating sweets, and wearing glasses.

B. Methods to prevent myopia progression

We asked parents about how effective they thought specific lifestyle modifications and treatment methods are for preventing myopia progression (on a scale from not effective to very effective). Lifestyle modifications included: restricting electronic screen use, increasing outdoor activity, and restricting time spent studying or reading. Treatment methods included: acupuncture, periocular massage at acupoints (such as on the nasal or brow ridge), ocular exercises, orthokeratology, and traditional Chinese medicine.

C. Willingness to use treatment methods and currently used treatment methods

We queried parents on willingness to use each of five treatments (acupuncture, periocular massage at acupoints, ocular exercises, orthokeratology, and traditional Chinese medicine) to prevent myopia progression in their children. A score from 0 to 5 was assigned to each respondent based on number of methods they were willing to use.

Of the five methods in this category, respondents could also indicate if their child was already using each method. A score from 0 to 5 was assigned to each respondent based on number of methods already currently used by their child.

D. Currently used lifestyle modifications

The final category of questions contained two questions that asked parents to quantify how much they restrict their child's electronic screen use and studying/reading (on a scale from no restriction to always restricted).

Questionnaire (English):

This questionnaire asks you about your views on nearsightedness. There are no right or wrong answers. The information you provide will be kept strictly confidential.

Instructions:

1. Please try to answer every question. If a question does not apply to you or your child, mark the “not applicable” choice.
2. Please ask the staff if you have any questions.

A. What is your relationship to the child?

Mother Father Other: _____

B. What is your current age? _____

C. What does each parent do for work?

Mother:_____

Father:_____

D. How many total years of school has each parent completed?

Mother: <12 years 12-16 years >16 years

Father: <12 years 12-16 years >16 years

E. How far is your home from this hospital (km)? _____

F. Do you live in an urban or rural environment? Urban Rural

Questionnaire (English) cont.

G. Is your child nearsighted? Yes No

If Yes:

How old was your child when he/she was diagnosed? _____

How severe is your child's nearsightedness?

Mild Moderate Severe Don't know

H. Which people at home are nearsighted?

Child's mom Child's dad Child's grandparent(s) Child's sibling(s)

I. Do you believe that nearsightedness is associated with heredity? Yes No

The questions below ask you to describe your feelings. While you may not find an answer that exactly states your feelings, please mark the answer that comes closest to describing how you feel. Your first reaction to each question should be your answer.

1. My child being nearsighted worries me.	Not at all	A little	Moderately	Very much
2. There are effective methods to prevent nearsightedness or prevent progression of nearsightedness.	Strongly Disagree	Disagree	Agree	Strongly Agree

3. Too much TV, computer, or cell phone use can cause nearsightedness.	Strongly Disagree	Disagree	Agree	Strongly Agree
4. How effective is limiting TV, computer, or cell phone use in preventing progression of nearsightedness?	Not Effective	Mildly Effective	Moderately Effective	Very Effective
5. How effective is acupuncture in preventing progression of nearsightedness?	Not Effective	Mildly Effective	Moderately Effective	Very Effective
6. Wearing glasses has made my child's nearsightedness progress.	Strongly Disagree	Disagree	Agree	Strongly Agree
7. Spending too much time outside can cause nearsightedness.	Strongly Disagree	Disagree	Agree	Strongly Agree

8. How effective is time spent outdoors in preventing progression of nearsightedness?	Not Effective	Mildly Effective	Moderately Effective	Very Effective
9. How effective are periocular massages in preventing progression of nearsightedness?	Not Effective	Mildly Effective	Moderately Effective	Very Effective
10. Studying or reading too much can cause nearsightedness.	Strongly Disagree	Disagree	Agree	Strongly Agree
11. How effective is limiting studying or reading in preventing progression of nearsightedness?	Not Effective	Mildly Effective	Moderately Effective	Very Effective
12. Children with nearsighted parents are more likely to be nearsighted.	Strongly Disagree	Disagree	Agree	Strongly Agree

13. How effective are ocular exercises in preventing progression of nearsightedness?	Not Effective	Mildly Effective	Moderately Effective	Very Effective
14. Eating too many sweets can cause nearsightedness or make nearsightedness worse.	Strongly Disagree	Disagree	Agree	Strongly Agree
15. How effective is Ortho-K in preventing progression of nearsightedness?	Not Effective	Mildly Effective	Moderately Effective	Very Effective
16. Eye fatigue can lead to development of nearsightedness.	Strongly Disagree	Disagree	Agree	Strongly Agree
17. Nearsightedness is dangerous to my child's vision.	Strongly Disagree	Disagree	Agree	Strongly Agree

18. I restrict my child's TV, computer, or cell phone use to prevent progression of nearsightedness.	No Restriction	Mild Restriction	Moderate Restriction	Always Restricted
19. I restrict my child's studying and reading to prevent progression of nearsightedness.	No Restriction	Mild Restriction	Moderate Restriction	Always Restricted
20. I would use acupuncture on my child to prevent progression of nearsightedness.	Strongly Disagree	Disagree	Agree	Strongly Agree
		Already Using		
21. I would use periocular massages on my child to prevent progression of nearsightedness.	Strongly Disagree	Disagree	Agree	Strongly Agree
		Already Using		
22. I would use ocular exercises on my child to prevent progression of nearsightedness.	Strongly Disagree	Disagree	Agree	Strongly Agree
		Already Using		

23. I would use ortho-K on my child to prevent progression of nearsightedness.	Strongly Disagree Disagree Agree Strongly Agree Already Using
24. I would use Traditional Chinese Medicine on my child to prevent progression of nearsightedness.	Strongly Disagree Disagree Agree Strongly Agree Already Using

Questionnaire (Chinese):

这是一份询问您对于您孩子近视和近视治疗反馈问卷。**没有正确或错误答案**。您的回答会严格保密。

说明：

1. 请尝试回答所有问题。
2. 不清楚的地方请您询问工作人员。

A. 您和小孩是什么关系？

母亲　　父亲　　其他：_____

B. 您现在有多大年龄？_____

C. 孩子父母从事什么工作？如果不工作，请写“不工作”或“居家”。

母亲：_____　　父亲：_____

D. 孩子父亲和母亲各接受过多少年的教育？

母亲：少于 10 年　　10-12 年　　13-16 年　　多于 16 年

父亲：少于 10 年　　10-12 年　　13-16 年　　多于 16 年

E. 您家距离这个医院多少公里？_____

F. 您住在农村还是城镇市区？

农村　　城镇市区

G. 您孩子有近视吗？　　有　　没有

a) 您的孩子在多大年纪的时候被诊断出有近视？_____

b) 请问您孩子近视程度？

轻度　　重度　　严重度　　不清楚

H. 在您的家庭谁有近视？

孩子的爸爸　　孩子的妈妈　　孩子的兄弟姐妹　　孩子的外祖父母或祖父母

I. 您认为近视与遗传有关吗？　　是　　否

以下的问题请您描述您的感觉。您可能找不到准确的答案描述，请标记最接近你感觉的答案。您对问题的第一反应就是答案。

1.	我孩子因为有近视让我担心。	不担心	有点担心	适度担心	很担心
2.	医疗之中有方法防止近视或控制近视进展。	非常不同意	不同意	同意	非常同意
3.	电视，电脑，和手机看多了可以造成近视。	非常不同意	不同意	同意	非常同意
4.	限制看电视，电脑，或手机的使用对控制近视进展有多大的效果？	没效	稍微有效	适度有效	非常有效
5.	针灸对控制近视进展有多大的效果？	没效	稍微有效	适度有效	非常有效
6.	戴眼镜使我孩子的近视变的更严重。	非常不同意	不同意	同意	非常同意
7.	户外运动可以造成近视。	非常不同意	不同意	同意	非常同意
8.	户外运动对控制近视进展有多大的效果？	没效	稍微有效	适度有效	非常有效
9.	眼保健操（按摩）对控制近视进展有多大的效果？	没效	稍微有效	适度有效	非常有效
10.	学习看书太多可以造成近视。	非常不同意	不同意	同意	非常同意
11.	限制学习读书的时间对控制近视进展有多大的效果？	没效	稍微有效	适度有效	非常有效
12.	如果孩子的父母有近视，孩子有更大可能近视。	非常不同意	不同意	同意	非常同意
13.	眼睛训练对控制近视进展有多大的效果？	没效	稍微有效	适度有效	非常有效
14.	吃太多甜点可以造成近视或使近视变的更严重。	非常不同意	不同意	同意	非常同意
15.	OK 镜 (角膜塑形镜)对控制近视进展有多大的效果？	没效	稍微有效	适度有效	非常有效

16.	如果眼睛疲劳更容易近视。	非常不同意	不同意	同意	非常同意	
17.	近视对孩子的视力没有危险。	非常不同意	不同意	同意	非常同意	
18.	您为了控制孩子的近视进展有没有限制孩子看电视，电脑，或手机的时间？	没有限制	一些限制	多数限制	一直限制	
19.	您为了控制孩子的近视进展有没有限制孩子学习读书的时间？	没有限制	一些限制	多数限制	一直限制	
20.	我愿意用针灸控制孩子的近视进展。	非常不愿意	不愿意	愿意	非常愿意	已经在用
21.	我愿意用眼保健操（按摩）控制孩子的近视进展。	非常不愿意	不愿意	愿意	非常愿意	已经在用
22.	我愿意用眼睛训练控制孩子的近视进展。	非常不愿意	不愿意	愿意	非常愿意	已经在用
23.	我愿意用 OK 镜(角膜塑形镜)控制孩子的近视进展。	非常不愿意	不愿意	愿意	非常愿意	已经在用
24.	我愿意用中药控制孩子的近视进展。	非常不愿意	不愿意	愿意	非常愿意	已经在用

STATISTICAL ANALYSIS

Continuous variables are expressed as median (range), categorical ones as numbers (percent). Small cell sample sizes in the extreme categories (i.e. strongly disagree, strongly agree) led us to collapse the Likert-scale responses to binary values (i.e. agree vs. disagree) for question categories A, B, and D (Supplemental Material, Table 5). Following collapse of the responses, Wendy F. Li employed logistic regression to calculate the odds ratio (OR) and 95% confidence interval (CI) for association of demographic data with responses to questions from categories A, B, and D. She employed ordinal logistic regression to calculate OR and 95% CI for association of demographic data with scores from category C.

For responses to questions about causes of myopia and effectiveness of lifestyle modifications/treatment methods, the demographic data of interest included respondents' age, sex, and education level. For responses to questions assessing willingness to use treatment methods and currently used treatment methods/lifestyle modifications, the demographic data of interest included respondents' age, sex, and education level and children's sex and degree of myopia. Because of small sample sizes, each demographic was converted to a categorical variable. Median ages were used to divide parents and children into two groups (age < 40 and ≥ 40 for parents and age <13 and ≥ 13 for children). Parents with a graduate education were compared to all others and children with high myopia (≤ -6.0 D) were compared to all others. Respondent's sex, child's sex, and child's degree of myopia were also used to control for covariates. RStudio

statistical software (version 0.99.903; RStudio, Inc., Boston, Massachusetts) was used to complete analysis with the following packages: foreign, MASS, Hmisc, reshape2.

RESULTS

97 respondents of median age 42 years (range 31 to 58 years, 85 female and 12 male) completed the survey. Median age of the respondents' children was 12 years (range 5-25 years). The respondents' children consisted of 43 males and 54 females. Median age of diagnosis with myopia was nine years (range two to 16 years) and median time since diagnosis with myopia was three years (range zero to 12 years). Eight out of 97 children (8.25%) in our study had high myopia (≤-6.0 D in at least one eye). Distance residing from the hospital was up to 1500 kilometers. Additional demographic data of the 97 respondents is shown in Table 1 and demographic and clinical data of the respondents' children is shown in Table 2. Of the 97 participants, 95 (97.9%) find their child's myopia concerning. 45 (46.4%) find their child's myopia very concerning. Additionally, 84 (88.4%) believe myopia is dangerous to their child's vision.

Table 1: Respondent Demographics

N	97
Age (years)	
Median	42
Range	31-58
Sex/Relationship to child	
Male (father)	12
Female (mother)	85
Education (years)	
< 10	1
10-12	11
13-16	46
> 16	38
Unanswered	1
Distance from Hospital (km)	
≤ 5	28
6-10	28
11-20	19
21-30	8
31-50	4
200-800	4
≥1000	1
Unanswered	5

Table 2: Demographics of Respondents' Children

N	97
Age (years)	
Median	12
Range	5-17
Sex	
Male	43
Female	54
Refractive error	
Mean diopters spherical	-3.13 OD, -2.95 OS
Number of high myopes[A] (%)	8 (8.25%)
Age of diagnosis (years)	
Median	9
Range	2-16
Years since diagnosis	
Median	3
Range	0-12

[A]Defined as patients with myopia of -6.0 D or greater in at least one eye

A. Perspectives on causes of myopia and myopia progression

Among causes of myopia (Table 3), electronic screens, eye fatigue, and heredity were most commonly believed to cause myopia, with over 90% of respondents agreeing with each cause. Logistic regression was not performed on these three causes as such a large majority agreed with each cause.

Logistic regression suggested no statistically significant association between parental sex/age and the remainder causes (Supplemental Material, Table 6). Odds of parents greater than or equal to 40 years of age agreeing that studying/reading cause myopia was 2.67 times larger than parents less than 40 years of age (95% CI, 1.03-6.90; p=0.04). Odds of parents with a graduate degree agreeing that studying/reading cause myopia was 4.23 times larger than parents without a graduate degree (95% CI, 1.31-13.6; p=0.02). This association persisted after controlling for the previously mentioned covariates (OR 3.04; 95% CI, 1.09-8.54; p=0.03 and OR 4.09; 95% CI, 1.23-13.5; p=0.02 respectively).

Table 3: Percentage of respondents agreeing with each suggested cause of myopia and myopia progression

Cause of myopia	# of respondents agreeing (%)
Electronic screen use	96/97 (99.0)
Eye fatigue	91/94 (96.8)
Heredity	80/95 (84.2)
Studying or reading	71/95 (74.7)
Eating sweets	57/91 (62.6)
Wearing glasses	26/85 (30.6)

B. Perspectives on methods to prevent myopia progression

Lifestyle modifications rather than medical treatments were thought to be most effective for preventing and slowing progression of myopia (Table 4). For example, restricting electronic screen use and outdoor activity were thought to be moderately or very effective for preventing myopia progression by 79.4% and 71.1% of respondents, respectively. Orthokeratology and ocular exercises were the treatments with the highest percentages of respondents choosing moderately or very effective (64.9% and 54.8% respectively). Acupuncture was thought to be the least effective, with only 27.3% of respondents choosing moderately or very effective.

Logistic regression demonstrated no statistically significant association between parental age/sex/education and views on methods to prevent myopia progression (Supplemental Material, Table 6).

Table 4: Perspectives on effectiveness of and willingness to use methods to treat myopia

	Method	# choosing moderately or very effective (%)	# willing to use method (%)	# already using method (%)
Treatments	Ocular exercises	51/93 (54.8)	83/93 (89.2)	4/93 (4.30)
	Periocular massage at acupoints	48/95 (50.5)	78/93 (83.9)	10/93 (7.63)
	OrthoK[A]	50/77 (64.9)	37/84 (44.0)	20/84 (23.8)
	Acupuncture	24/88 (27.3)	47/92 (51.1)	2/92 (2.17)
	Traditional Chinese Medicine (TCM)	---	33/90 (36.7)	0
Lifestyle modifications	Restrict electronic screen use	77/97 (79.4)	--	93/97 (95.9)
	Outdoor activity	69/97 (71.1)	--	--
	Restrict time spent studying or reading	49/97 (50.5)	--	60/97 (61.9)

[A]OrthoK = orthokeratology

C. Willingness to use treatment methods and currently used treatment methods

All respondents were willing to use at least one of the treatments listed on the survey to treat their child's myopia, but each treatment had 20 or fewer current users (Figure 1). Additionally, 70/97 (72.2%) were not using any treatment methods at all.

Parents were more likely to agree to a greater number of treatments if the child was a boy (OR 2.33; 95% CI, 1.15-4.79; $p<0.05$). This association persisted after controlling for covariates (OR 2.24; 95% CI, 1.09-4.68; $p<0.05$). Parental age/sex/education level and the child's degree of myopia were not associated with the number of methods chosen.

The most common currently used treatment method was orthokeratology, with a total of 20 current users. Analysis of willingness to use each specific method was performed. No logistic regression was performed on willingness to use periocular massage or ocular exercises since the percentage agreeing to use both these methods was close to 90%. A difference in willingness to use orthokeratology was noted based on education level and age of the respondent. Respondents with a graduate education were less likely to agree to using orthokeratology (OR 0.28; 95% CI, 0.10-0.79; $p=0.02$). Respondents ≥40 years of age were also less likely to agree to using orthokeratology (OR 0.36; 95% CI, 0.13-0.98; $p=0.05$). Both associations persisted after controlling for covariates (OR 0.22; 95% CI, 0.07-0.67; $p=0.008$ and OR 0.31; 95% CI, 0.05-0.83; $p=0.03$ respectively).

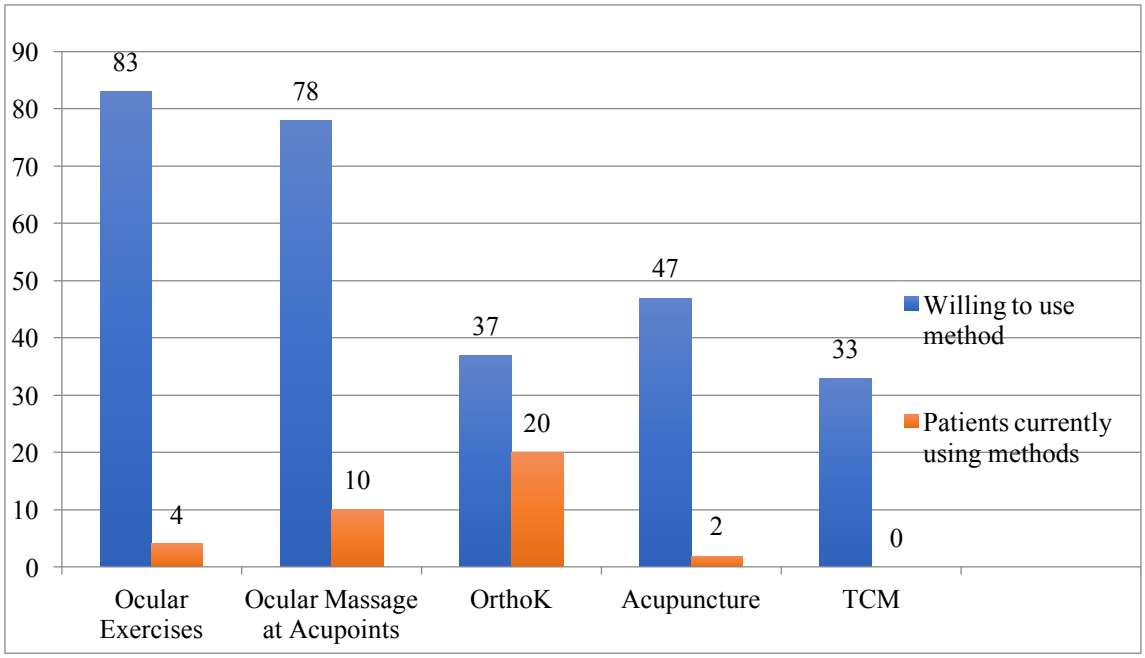

Figure 1: Number of parents willing to use and number currently using each treatment method

E. Currently used lifestyle modifications

93 (95.9%) parents reported restricting electronic screen use and 67 (69.1%) reported restricting studying/reading. Logistic regression demonstrated no statistically significant association between parental age/sex/education or child's sex/degree of myopia with amount of restriction (Supplemental Material, Table 6).

DISCUSSION

Myopia is a serious medical and public health problem, with studies indicating that almost 50% of the world's population will be myopic by 2050.[1] Additionally, almost 10% of the world's population will have high myopia by 2050, which significantly increases risk for visual impairment and blindness.[1] China has one of the highest burdens of myopia in children and young adults, with rates approaching 90% in urban populations. Studies also demonstrate that over half of rural teenagers in China have myopia.[4] Among those diagnosed with myopia in childhood, almost one-fourth become high myopes as adults, and myopic degeneration and myopic optic neuropathy are already leading causes of irreversible visual impairment and blindness in China.[9-11]

Eastern health professionals are very concerned about outcomes from myopia. The Chinese government has established a special branch within the Ministry of Education to handle refractive error.[40] Children in primary and junior schools across China are required to perform periocular massages during breaks between classes once or twice a day.[41] Prevention of myopia has also been defined as a key task for China's schools. However, parents, teachers, and educational administrators often oppose efforts that are meant to prevent myopia, such as limitation of homework loads. Though researchers argue that increasing time spent outdoors by school-age children in Asia is of immediate priority, only Taiwan has formally adopted this policy.[42]. Studies also indicate that significant strides can be made in screening children for ophthalmic problems and in educating parents on the importance of early screening.[43]

Most parents in our study believe myopia is dangerous to their child's vision (88.4%) and find myopia concerning (97.9%). Furthermore, despite the strong cultural emphasis on studying in China, 61.9% of parents in this study report restricting their child's studying and reading in attempts to slow myopia progression. Parents in our study were often eager to express their thoughts on reasons for the high prevalence of myopia in China, echoing sentiments commonly expressed by the Chinese public. These included concerns about increased use of electronic devices by China's youth, as well as concerns that the high pressure of preparing for the college entrance exam, or "gaokao", leads China's high school students to study too much and place strain on their eyes.[44]

Despite the great concerns about myopia in Eastern societies, most treatment methods included in our survey have not been studied in randomized clinical trials, which may explain why 72.2% of patients in this study are not currently using any methods to prevent myopia progression. For example, traditional Chinese methods such as ocular exercises and periocular massage at acupoints have been employed for many decades, but studies examining their effectiveness are inconclusive.[33,41,45,46] Orthokeratology and other corneal reshaping lenses have only been studied in small case-control studies, with most showing modest effect in preventing axial length elongation.[47-49] The significant concern demonstrated by parents in this study, in addition to a general willingness to make lifestyle modifications to prevent myopia progression, suggest that greater research into treatments to control myopia progression would be well-received.

Of note, parents in this study were more likely to be willing to use a greater number of treatment methods if their child has high myopia or the child is a boy. This finding may have important implications for future application of treatment methods. One study demonstrated that spending on health and education for girls is significantly less than for boys in a poor Chinese province; however, this association was not present in a wealthier Chinese province.[50] Additionally, lower parental education has been shown to increase son preference.[51] Our association persisted even after correcting for parental education, suggesting that other factors not measured such as family income may explain the difference in willingness to use treatment methods on boys vs. girls. Although there have been improvements to mitigate previously known son preference in China, the persistence of son preference even in the age of modernization and economic growth may be due to traditional Chinese values that emphasize a son's lifelong economic assets, particularly future support of elderly parents.[51]

Our study also found that parents with a graduate education were more likely to agree that studying/reading can cause myopia and less likely to agree to using orthokeratology, suggesting that education may impact parental views and treatment decisions. In speaking to parents who were unwilling to utilize orthokeratology, the main concerns cited were regarding adverse effects such as corneal ulcers or perforation. These concerns may account for the large difference in percentage of parents willing to use periocular massage versus orthokeratology, despite similar percentages of parents regarding these methods as moderately to very effective in controlling myopia.

Our study population was limited to children and parents visiting one ophthalmology/optometry clinic in Beijing and thus may not be generalizable to the Chinese population. The opinions of parents in this study may not reflect those of the Chinese population since parents and children seeking care may have greater concerns about vision than those who do not obtain ophthalmic care. The large majority of participants were urban residents. Additionally, although we attempted to approach all parents in the clinic waiting room, there may have been some parents who were missed given crowding in the clinic. Furthermore, we did not survey parents on other treatment methods that have previously been studied such as atropine, pirenzapine, multifocal lenses, and peripheral defocusing modifying contact lenses.[25] However, this study was conducted at a large tertiary hospital, had a large patient catchment area from near and far, and was conducted over several weeks, making the sample more representative. About 10% of participants were from cities outside of Beijing, but it is likely families with the means to travel far distances to Beijing to receive healthcare are significantly different from families who decide to receive care closer to home.

Almost all parents in this study find their children's myopia concerning and hope to prevent myopia progression. Despite a strong cultural emphasis on studying, parents in our study are concerned enough about myopia to limit studying. However, the majority of parents and children do not currently use methods beyond lifestyle modifications to slow progression. This may be due to difficulties with adherence, perceived low efficacy, or concerns about safety. Having a male child or a child with high myopia increased willingness to use

treatment methods among the parents surveyed. Parents with a graduate education were less like to agree to using orthokeratology and more likely to agree that studying/reading causes myopia.

In conclusion, myopia is a serious public health and medical issue that will continue to worsen in the coming decades. Although many Asian countries have begun to invest more to research causes of and treatments for myopia, most other countries have not reached the same level of dedication. Our study demonstrates how widespread concerns about myopia have become in urban Chinese populations. Greater research on practical and safe treatments for myopia would help provide effective treatment and guide future research and patient care.

REFERENCES

1. Holden BA, Fricke TR, Wilson DA, et al. Global Prevalence of Myopia and High Myopia and Temporal Trends from 2000 through 2050. *Ophthalmology.* 2016;123(5):1036-1042.
2. Chua J, Wong TY. Myopia-The Silent Epidemic That Should Not Be Ignored. *JAMA Ophthalmol.* 2016;134(12):1363-1364.
3. Tideman JW, Snabel MC, Tedja MS, et al. Association of Axial Length With Risk of Uncorrectable Visual Impairment for Europeans With Myopia. *JAMA Ophthalmol.* 2016;134(12):1355-1363.
4. Pan CW, Ramamurthy D, Saw SM. Worldwide prevalence and risk factors for myopia. *Ophthalmic Physiol Opt.* 2012;32(1):3-16.
5. Dolgin E. The myopia boom. 2015;519(7543):276-278. http://www.nature.com/news/the-myopia-boom-1.17120. Accessed 11/12/2016.
6. Wu LJ, You QS, Duan JL, et al. Prevalence and associated factors of myopia in high-school students in Beijing. *PLoS One.* 2015;10(3):e0120764.
7. Kleinstein RN, Jones LA, Hullett S, et al. Refractive error and ethnicity in children. *Archives of ophthalmology.* 2003;121(8):1141-1147.
8. Ip JM, Huynh SC, Robaei D, et al. Ethnic differences in refraction and ocular biometry in a population-based sample of 11-15-year-old Australian children. *Eye (Lond).* 2008;22(5):649-656.
9. Wu PC, Huang HM, Yu HJ, Fang PC, Chen CT. Epidemiology of Myopia. *Asia Pac J Ophthalmol (Phila).* 2016;5(6):386-393.
10. Hsu WM, Cheng CY, Liu JH, Tsai SY, Chou P. Prevalence and causes of visual impairment in an elderly Chinese population in Taiwan: the Shihpai Eye Study. *Ophthalmology.* 2004;111(1):62-69.
11. Xu L, Wang Y, Li Y, et al. Causes of blindness and visual impairment in urban and rural areas in Beijing: the Beijing Eye Study. *Ophthalmology.* 2006;113(7):1134 e1131-1111.
12. Rose KA, Morgan IG, Smith W, Burlutsky G, Mitchell P, Saw SM. Myopia, lifestyle, and schooling in students of Chinese ethnicity in Singapore and Sydney. *Archives of ophthalmology.* 2008;126(4):527-530.
13. Mutti DO, Mitchell GL, Moeschberger ML, Jones LA, Zadnik K. Parental myopia, near work, school achievement, and children's refractive error. *Investigative ophthalmology & visual science.* 2002;43(12):3633-3640.
14. Hsu CC, Huang N, Lin PY, et al. Prevalence and risk factors for myopia in second-grade primary school children in Taipei: A population-based study. *J Chin Med Assoc.* 2016;79(11):625-632.
15. Wu LJ, Wang YX, You QS, et al. Risk Factors of Myopic Shift among Primary School Children in Beijing, China: A Prospective Study. *Int J Med Sci.* 2015;12(8):633-638.
16. Lin Z, Vasudevan B, Mao GY, et al. The influence of near work on myopic refractive change in urban students in Beijing: a three-year follow-up report. *Graefes Arch Clin Exp Ophthalmol.* 2016;254(11):2247-2255.
17. Lu B, Congdon N, Liu X, et al. Associations between near work, outdoor activity, and myopia among adolescent students in rural China: the Xichang Pediatric Refractive Error Study report no. 2. *Archives of ophthalmology.* 2009;127(6):769-775.

18. Zhang M, Li L, Chen L, et al. Population density and refractive error among Chinese children. *Investigative ophthalmology & visual science.* 2010;51(10):4969-4976.
19. Guggenheim JA NK, McMahon G, Ness AR, Deere K, Mattocks C, St. Pourcain B, Williams C. Time Outdoors and Physical Activity as Predictors of Incident Myopia in Childhood: A Prospective Cohort Study. *Investigative ophthalmology & visual science.* 2012;53(6):10.
20. Rose KA, Morgan IG, Ip J, et al. Outdoor activity reduces the prevalence of myopia in children. *Ophthalmology.* 2008;115(8):1279-1285.
21. Dirani M, Tong L, Gazzard G, et al. Outdoor activity and myopia in Singapore teenage children. *Br J Ophthalmol.* 2009;93(8):997-1000.
22. Wu PC, Tsai CL, Wu HL, Yang YH, Kuo HK. Outdoor activity during class recess reduces myopia onset and progression in school children. *Ophthalmology.* 2013;120(5):1080-1085.
23. Zhou Z, Ma X, Yi H, et al. Factors Underlying Different Myopia Prevalence between Middle- and Low-income Provinces in China. *Ophthalmology.* 2015;122(5):1060-1062.
24. Chen HF, Huang SS, Zhang YZ, Zeng X, Huang ZH. [Control efficacy of Trichogramma japonicum against Chilo suppressalis and Chilaraea auricilia]. *Ying Yong Sheng Tai Xue Bao.* 2010;21(3):743-748.
25. Huang J, Wen D, Wang Q, et al. Efficacy Comparison of 16 Interventions for Myopia Control in Children: A Network Meta-analysis. *Ophthalmology.* 2016;123(4):697-708.
26. Smith MJ, Walline JJ. Controlling myopia progression in children and adolescents. *Adolesc Health Med Ther.* 2015;6:133-140.
27. Pineles SL, Kraker RT, VanderVeen DK, et al. Atropine for the Prevention of Myopia Progression in Children: A Report by the American Academy of Ophthalmology. *Ophthalmology.* 2017;124(12):1857-1866.
28. Chua WH, Balakrishnan V, Chan YH, et al. Atropine for the treatment of childhood myopia. *Ophthalmology.* 2006;113(12):2285-2291.
29. Chia A, Chua WH, Cheung YB, et al. Atropine for the treatment of childhood myopia: safety and efficacy of 0.5%, 0.1%, and 0.01% doses (Atropine for the Treatment of Myopia 2). *Ophthalmology.* 2012;119(2):347-354.
30. Zheng YF, Pan CW, Chay J, Wong TY, Finkelstein E, Saw SM. The economic cost of myopia in adults aged over 40 years in Singapore. *Investigative ophthalmology & visual science.* 2013;54(12):7532-7537.
31. Foster PJ, Jiang Y. Epidemiology of myopia. *Eye (Lond).* 2014;28(2):202-208.
32. Rose K, Harper R, Tromans C, et al. Quality of life in myopia. *Br J Ophthalmol.* 2000;84(9):1031-1034.
33. Seet B, Wong TY, Tan DT, et al. Myopia in Singapore: taking a public health approach. *Br J Ophthalmol.* 2001;85(5):521-526.
34. Lin LL, Shih YF, Hsiao CK, Chen CJ. Prevalence of myopia in Taiwanese schoolchildren: 1983 to 2000. *Ann Acad Med Singapore.* 2004;33(1):27-33.
35. Vitale S, Sperduto RD, Ferris FL, 3rd. Increased prevalence of myopia in the United States between 1971-1972 and 1999-2004. *Archives of ophthalmology.* 2009;127(12):1632-1639.
36. Saxena R, Vashist P, Tandon R, et al. Incidence and progression of myopia and associated factors in urban school children in Delhi: The North India Myopia Study (NIM Study). *PLoS One.* 2017;12(12):e0189774.

37. Parssinen O, Lyyra AL. Myopia and myopic progression among schoolchildren: a three-year follow-up study. *Investigative ophthalmology & visual science.* 1993;34(9):2794-2802.
38. Donovan L, Sankaridurg P, Ho A, Naduvilath T, Smith EL, 3rd, Holden BA. Myopia progression rates in urban children wearing single-vision spectacles. *Optom Vis Sci.* 2012;89(1):27-32.
39. Lee JW, Jones PS, Mineyama Y, Zhang XE. Cultural differences in responses to a Likert scale. *Res Nurs Health.* 2002;25(4):295-306.
40. World Health Organization. Blindness and Deafness Unit., WHO Programme for the Prevention of Blindness. *Elimination of avoidable visual disability due to refractive errors : report of an informal planning meeting, Geneva, 3-5 July 2000.* Geneva: World Health Organization; 2000.
41. Kang MT, Li SM, Peng X, et al. Chinese Eye Exercises and Myopia Development in School Age Children: A Nested Case-control Study. *Sci Rep.* 2016;6:28531.
42. Morgan IG, French AN, Ashby RS, et al. The epidemics of myopia: Aetiology and prevention. *Prog Retin Eye Res.* 2017.
43. Li L, Lam J, Lu Y, et al. Attitudes of students, parents, and teachers toward glasses use in rural China. *Archives of ophthalmology.* 2010;128(6):759-765.
44. Langfitt F. Why Is Nearsightedness Skyrocketing Among Chinese Youth? 2015; http://www.npr.org/sections/goatsandsoda/2015/02/05/383765377/why-is-nearsightedness-skyrocketing-among-chinese-youth. Accessed April 15, 2017.
45. Lin Z, Vasudevan B, Fang SJ, et al. Eye exercises of acupoints: their impact on myopia and visual symptoms in Chinese rural children. *BMC complementary and alternative medicine.* 2016;16:349.
46. You QS, Wu LJ, Duan JL, et al. Factors associated with myopia in school children in China: the Beijing childhood eye study. *PLoS One.* 2012;7(12):e52668.
47. Walline JJ, Jones LA, Sinnott LT. Corneal reshaping and myopia progression. *Br J Ophthalmol.* 2009;93(9):1181-1185.
48. Kakita T, Hiraoka T, Oshika T. Influence of Overnight Orthokeratology on Axial Elongation in Childhood Myopia. *Investigative ophthalmology & visual science.* 2011;52(5):2170-2174.
49. Cho P, Cheung SW, Edwards M. The longitudinal orthokeratology research in children (LORIC) in Hong Kong: a pilot study on refractive changes and myopic control. *Curr Eye Res.* 2005;30(1):71-80.
50. Burgess R, Zhuang J. Modernisation and son preference. 2000.
51. Wang W. Son preference and educational opportunities of children in China— “I wish you were a boy!”. *Gender Issues.* 2005;22(2):3-30.

Table 5: Counts of responses to questions from categories A, B, and D. Shading indicates how responses were collapsed into binary values.

Causes of myopia (category A)	**Strongly disagree**	**Disagree**	**Agree**	**Strongly Agree**
Screens cause myopia[A]	0	1	61	35
Wearing glasses worsens myopia	7	52	23	3
Studying/reading	1	23	61	10
Heredity[A]	1	8	73	15
Sweets	0	34	51	6
Eye fatigue[A]	2	1	75	16
Effectiveness of methods (category B)	**Not effective**	**Mildly effective**	**Moderately effective**	**Very effective**
Screen restriction	3	17	61	16
Acupuncture	17	47	23	1
Outdoor activity	1	25	51	18
Periocular massage	9	38	42	6

Restricting studying/reading	14	34	40	9
Ocular exercises	2	40	46	5
Orthokeratology	5	22	41	9
Amount of restriction (category D)	**No restriction**	**Mild restriction**	**Moderate restriction**	**Always restricted**
Screens	4	35	31	27
Studying/reading	37	43	12	5

[A]No logistic regression was performed due to small sample size even after collapse to binary value

Table 6: Results of logistic regression and ordinal logistic regression analysis for children under 18; each cell presented as p-value, odds ratio estimate (95% confidence interval).

		Independent variables (each independent variable fit one at a time)				
		Respondent Age (<40 vs. >=40)	**Respondent Sex**	**Respondent education (graduate education vs. no graduate education)**	**Child sex**	**Child degree of myopia (≤ -6.0 D vs. > -6.0 D)**
Views on causes of myopia	Studying or reading	**P=0.04, 2.67 (1.03-6.90)[B]**	P=0.18, 4.23 (0.52-34.5)	**P=0.02, 4.23 (1.31-13.6)[B]**		
	Wearing glasses	P=0.74, 0.85 (0.32-2.24)	P=0.32, 0.44 (0.09-2.20)	P=0.16, 0.50 (0.19-1.32)		
	Eating sweets	P=0.29, 0.60 (0.24-1.54)	P=0.65, 0.75 (0.21-2.64)	P=0.36, 1.52 (0.62-3.70)		

Views on effectiveness of lifestyle modifications and treatment methods	Acupuncture	P=0.91, 0.95 (0.42-2.16)	P-0.11, 2.61 (0.80-8.83)	P=0.26, 1.60 (0.70-3.69)		
	Screen restriction	P=0.92, 0.95 0.32, 2.76	P=0.28, 0.49 (0.13-1.80)	P=0.94, 1.04 (0.38-2.80)		
	Outdoor activity	P=0.28, 0.56 (0.20-1.59)	P=0.38, 2.03 (0.42-9.91)	P=0.28, 1.69 (0.65-4.40)		
	Periocular Massage	P=0.31, 1.57 (0.66-3.74)	P=0.45, 0.63 (0.18-2.11)	P=0.64, 1.22 (0.53-2.77)		
	Restricting studying/reading	P=0.98, 1.98 (0.89-4.49)	P=0.52, 1.46 (0.46-4.72)	P=0.05, 2.20 (1.02-4.83)		
	Ocular exercises	P=0.83, 1.10 (0.48-2.51)	P=0.25, 1.91 (0.63-5.90)	P=0.48, 1.33 (0.61-2.94)		
	OrthoK[A]	P=0.68, 1.17 (0.55-2.52)	P=0.93, 1.05 (0.36-3.04)	P=0.18, 0.60 (0.29-1.25)		

Lifestyle modifications	Amount of screen restriction	P=0.90, 0.95 (0.43-2.10)	P=0.53, 0.69 (0.21-2.17)	P=0.53, 1.27 (0.60-2.70)	P=0.70, 1.15 (0.56-2.37)	P=0.68, 0.27 (0.06-1.04)
	Amount of studying restriction	P=0.70, 1.17 (0.53-2.63)	P-0.86, 0.91 (0.29-2.79)	P=0.67, 0.85 (0.39-1.83)	P=0.21, 1.61 (0.77-3.60)	P=0.68, 0.76 (0.20-2.75)
Willingness to use treatment methods	Would use acupuncture	P=0.68, 0.84 (0.37-1.91)	P=0.18, 2.62 (0.64-10.8)	P=0.43, 1.41 (0.60-3.31)	P=0.55, 1.28 (0.57-2.86)	P=0.05, 8.26 (0.97-70.0)
	Would use OrthoK[A]	**P=0.05, 0.36 (0.13-0.98)[B]**	P=0.43, 2.00 (0.36-11.1)	**P=0.02, 0.28 (0.10-0.79)[B]**	P=0.13, 2.11 (0.80-5.56)	**[C]
	Would Use Chinese Meds	P=0.94, 1.03 (0.43-2.45)	P=0.79, 1.20 (0.32-4.60)	P=0.88, 0.94 (0.39-2.27)	**P=0.008, 3.22 (1.36-7.66)[B]**	P=0.23, 0.27 (0.03-2.35)

[A]OrthoK = orthokeratology
[B]Associations that remain significant after controlling for covariates (respondent sex, child's sex, and child's degree of myopia)
[C]All respondents with children with high myopia (n=7 for this question) were willing to use orthoK