The Impact of healthcare service program on the mental health of migrant children in eastern China:

Evidence from a cluster-randomized controlled trial

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Abstract: Physical health plays a crucial role in children's mental health but is often neglected by researchers and professionals. The vision-based healthcare program in China can be a good example of how physical health affects mental health. With a randomized control trial of a vision care intervention combining the distribution of free eyeglasses, incentives for teachers to improve compliance, and education of students and parents about vision care to analyze the causal relationship between vision-based healthcare service and mental health among migrant children. The research findings are as follows: (1) The prevalence of mental health problems among migrant children with visual impairment is high, particularly in relation to learning anxiety; (2) Vision-based healthcare service program has negative effects on migrant children's mental health and learning anxiety. (3) The heterogeneity analysis revealed that the negative effects are mainly concentrated in subgroups with specific characteristics regarding own health, peers, parents and teachers: (4) Mechanism analysis revealed that teachers who do not support students who wear glasses have a negative impact on students' perceptions of wearing glasses, knowledge about vision care and therefore mental health is negatively affected.

Keywords: Mental health; physical health; vision care; randomized controlled trial;

1. Introduction

Mental health problems such as anxiety and depression exert a substantial burden on affected children and adolescents, leading to consequences such as decreased academic achievement, shortened years of education, and enduring adverse effects on adult health (Eisenberg et al., 2009; Evans et al., 2007). Furthermore, adolescent mental health problems have been found to affect the long-term accumulation of human capital (Fletcher & Wolfe, 2008; Patel et al., 2007; Currie & Stabile, 2006). There is a substantial global prevalence of poor adolescent mental health, with reports suggesting that 10-20% of children are affected (Kieling et al., 2011). However, despite their prevalence and developmental consequences, children's mental health needs are often overlooked, particularly in low- and middle-income countries (LMICs).

Although various environmental and psychosocial factors have been linked to poor mental health in adolescence, researchers and policymakers have largely overlooked the substantial impact of physical health on children's mental well-being (Goodman et al., 2007; Wong et al., 2009; Wang et al., 2017; Ohrnberger et al., 2017). For example, health conditions such as diabetes, obesity, visual impairment, and chronic illness, which are prevalent among children and have only been rising in incidence, have all been associated with poorer mental health outcomes (Funuyet-Salas et al., 2022; Small, 2016; Yi et al., 2015; Hysing et al., 2007). Conversely, chronic and long-term mental health problems have been associated with the development of physical symptoms. The reciprocal relationship between physical and mental health problems creates a detrimental cycle that must be interrupted early to prevent escalation; however, there has been limited attention paid to understanding the impact and pathways through which physical health impacts mental health (Ohrnberger et al., 2017).

Research suggests that implementing early intervention and prevention strategies can be effective in preventing mental health problems from persisting into adulthood while improving well-being and productivity. However, it is concerning that only 10% of mental health trials are conducted in LMICs, where 90% of the world's children and adolescents reside (Kieling et al., 2011). There is moreover limited evidence on the impact of physical-based healthcare services on children's mental health, especially in LMICs. Among the studies conducted, interventions integrating family, individual, and school-based approaches, which include interventions providing health education on obesity, physical activity, and dietary control, were observed to enhance psychological well-being, pubertal development, and overall quality of life in children (Diao et al., 2020). However, the findings were insufficient to determine treatment effects of physical-based healthcare interventions on the sampled children's mental health.

Examining the intervention impacts of vision care services may offer a valuable illustration of how healthcare service programs have the potential to influence children's mental health. First, visual impairment is one of the most common physical impairments, affecting an estimated 19.2 million children under 14 years of age (Solebo and Rahi, 2014). Second, children with uncorrected visual impairment may run a higher risk of having poor mental health, as they tend to engage in fewer physical activities (Oh et al., 2004), achieve lower educational attainment (Ma et al., 2014), and face increased social isolation (Huure and Aro, 2000). Third, multiple school-based vision care service interventions have been implemented in LMICs such as China, where about 53.6 percent of children and adolescents had poor vision according to 2018 estimates (Ministry of Education of China, 2019); nearly half of the world's children with vision problems live in China (Resnikoff et al., 2008). However, findings from these vision care interventions are mixed. In some studies, distributing free eyeglasses to rural Chinese schoolchildren with visual impairments

significantly improved their visual function, which in turn reduced their willingness to drop out of school and improved their academic performance (Esteso, 2007; Nie et al., 2018; Ma et al., 2014; Glewwe et al., 2016; Sylvia et al., 2022). Yet another study found that vision correction through the distribution of free glasses had no significant effect on students' mental health and learning anxiety but had a heterogeneous effect on students with different learning intensities (Guan et al., 2018). Besides mixed findings, another limitation of current studies is the lack of clarity regarding the specific mechanisms through which these programs affect school-aged children's mental health.

In addition, China's rapid urbanization has produced a growing population of migrant children who are either "left behind" in rural villages with relatives when their parents move to urban areas for work or migrate with their parents to cities; in either situation, migrant children have been consistently found to be a vulnerable population both physically and mentally. Migrant children's mental health issues primarily revolve around factors such as low self-esteem, perceptions of discrimination, and a low sense of belonging, resulting in feelings of loneliness, diminished academic performance, and challenges in adapting to their environment (Lu & Zhou, 2013; Liu et al., 2014; Kuo et al., 2021). Migrant children are also more likely to be exposed to physical health risks due to their low utilization of health services (Sun et al., 2015). For these reasons, examining the impact of vision care interventions on the mental health of migrant children may provide valuable insights for establishing mental health service frameworks for vulnerable children in China and other developing contexts.

Finally, a prevalent issue in the provisioning of school-based healthcare services is low utilization, which diminishes the overall efficacy of the provided services. Concerning vision care services, several randomized intervention trials, which involved distributing free eyeglasses to visually impaired students, faced difficulties with low sample compliance. Rates of observed short-

term wear at unannounced visits ranged from 13% to 41% in interventions launched in China, Mexico, and Africa (Ma et al., 2014; Castanon et al., 2006; Wedner et al., 2008). A potential solution to low compliance rates is to offer incentives to teachers. Findings from one study suggest that providing not only free glasses but also education on their use, along with a teacher incentive in a vision care program, maintained wear in two-thirds to 90% of children throughout a school year (Yi et al., 2015).

Considering the literature gaps identified above, the primary goal of this study is to explore how a school-based vision care intervention, which supplied free eyeglasses to migrant elementary school students, affected students' generalized anxiety—a crucial component of their overall mental well-being. Moreover, as part of the intervention, the teachers of students in the treatment group were incentivized to promote positive attitudes toward eyeglasses and encourage their students to wear them. As a result, a secondary goal of this study was to examine the effectiveness of teacher involvement in a school-based healthcare program for improving program compliance.

2. Method

2.1. Study area

This study was conducted in Shanghai, the largest city in the world with a total population of 23.8 million in 2012, including 9.6 million migrants, and Suzhou/Wuxi, twin cities near Shanghai with a combined prefectural population of 17.0 million in 2014, of which an estimated half are migrants. These three cities were chosen because they harbor some of the largest migrant populations in China. In this study, the term "migrant" refers to families living in urban areas who do not have an urban household registration (hukou), resulting in limited access to local public healthcare and schools. Within the boundaries of these cities, there are substantial rural and

suburban areas, and the migrant population is primarily situated in these rural/suburban zones. In these communities, migrant children typically attend private and unregulated schools that receive minimal government support.

All elementary schools identified by the local bureaus of education in these cities as having a predominant migrant population were included in the count. A total of 94 schools were randomly selected, with 66 located in Shanghai and 28 in Suzhou/Wuxi. Within each school, a fifth-grade class consisting of children aged 10–12 was randomly chosen. Questionnaires were administered, and visual acuity tests and refractions were conducted.

2.2. Intervention

This was a cluster-randomized controlled trial with schools as the clusters (Figure 1). In October 2013, after the baseline survey and VA screening, but before refraction, eligible children were randomly assigned to a control or treatment group, the details are as follows:

Control: A prescription for glasses and a letter were sent to the parents to inform them of their child's refractive status. At the end of the study, the children were provided with free glasses, although this was not announced beforehand. No teacher incentive was provided.

Treatment: An optometrist distributed glasses at school based on measurement of the children’s refractive power as described above. A letter about the free glasses program was sent to the parents along with the child’s prescription and to promote glasses wear, a previously described educational intervention aimed at teachers and children. In addition, the research team informed the math, English and Chinese teachers of the selected classes about the safety and benefits of the glasses. If ≥80% of the children they taught who had received glasses wore them during two unannounced classroom visits, the teachers were given a tablet computer (approximate value: USD 350) (the teachers' approximate monthly income was USD 450). As per protocol, these teachers

then explained to their students that glasses do not harm vision and encouraged students to wear them in class. They also reminded students who did not wear glasses to put them on.

2.3 Data collection

2.3.1 Questionnaire

At baseline (September 2013, beginning of the school year), the enumerators administered questionnaires to children, parents, and teachers. Children characteristics concerning their age, gender, the wearing of glasses by themselves and peers, and a study-specific mathematics test was administered as an index of academic achievement. Family characteristics related to parents' education, wearing glasses, place of work (local or elsewhere) and family wealth. Teacher characteristics related to gender, education and age of the head teacher. As the teacher incentive was part of the intervention, teachers were asked about their attitudes towards children wearing glasses, whether they were supported or not.

In order to examine potential mechanisms, several of the questionnaire items aimed to measure knowledge about vision, perception of glasses, and interactions between teachers and parents about children's vision status.

2.3.2 Visual acuity assessment and refraction

Children underwent baseline visual acuity testing at school by a nurse and a trained assistant using the internationally recognized standard ETDRS (Early Treatment Diabetic Retinopathy Study) Visual Acuity Scale (Ferris et al., 1982; Precision Vision, La Salle, Illinois, USA) in a well-lighted, indoor room. According to the screening results, 1248 students had an uncorrected visual acuity (VA) of ≤6/12 in either eye (Yi et al., 2015). Moreover, the study formed a dummy variable based on VA to distinguish between mild and moderate/severe myopia (Yi et al., 2015). In the field of ophthalmology/optometry, LogMAR is one of the most commonly used

continuous scales, which offers a relatively intuitive interpretation of visual acuity measurement[1]. The higher the LogMAR value, the worse the person's vision.

Refractions: Children with uncorrected VA ≤6/12 in either eye received cycloplegia with up to 3 drops of cyclopentolate 1%. Automated refraction (Topcon KR 8900; Tokyo, Japan) with subjective refinement was performed by a refractionist previously trained by experienced pediatric optometrists from ZOC.

2.3.3 Mental Health Test (MHT) for general anxiety

The Mental Health Test (MHT), derived from the Children's Manifest Anxiety Scale (CMAS), has been proven to be a dependable assessment tool for measuring general anxiety. The CMAS has been widely used as tool for screening and clinical diagnosis in the United States and other developed countries (Reynolds & Paget, 1983). Professor Zhou Bucheng of East China Normal University developed the mental health test scale used in this study (Zhou, 1991). Researchers have used the MHT extensively throughout China to measure the mental health of elementary school students in urban contexts (Deng et al., 2002). The MHT has a reliability of 0.84–0.88 and a retest reliability of 0.78–0.86 (Wang, 2011). This high retest reliability indicates that the MHT measures an aspect of mental health that is stable over time.

The MHT contained 100 yes/no questions and was administered and proctored in the students' classrooms by our survey team. The test is scored in the following manner. Of the 100 test questions, 10 are used to determine if the student answers honestly (or intentionally answers the questions incorrectly). These questions are called reliability questions. If the student answered yes to more than 7 of these questions, the test is considered invalid. Invalid tests are not included

[1] This scale uses the logarithmic transformation: e.g. LogMAR = log10(MAR). In this definition, the variable MAR is short for Minimum Angle of Resolution, which is defined as the inverse of visual acuity, e.g. MAR = 1/VA. It has a constant increment of 0.1; each increment corresponds to approximately one line of visual acuity loss (in the ETDRS chart).

in the analysis. The remaining 90 points give the student's MHT score, with a higher score corresponding to a higher risk of mental health problems. A total score of 56 or more indicates that there is a risk of mental health problems and that professional help is required. The test results can be divided into eight subcategories. Each subsection represents a specific aspect of anxiety: learning anxiety, personal anxiety, loneliness, self-blaming tendency, sensitivity tendency, body anxiety, phobia anxiety and impulsiveness. A score of over 8 in a subsection is considered a high risk of having anxiety in that section.

2.4 Randomization and masking

Randomization was performed at Stanford University (Palo Alto, California, USA) using R software (R Foundation for Statistical Computing, Vienna, Austria) after the baseline survey but before refraction, eligible children were randomly assigned to the intervention or control group by school. The participating children, their parents, teachers, and enumerators were either masked (in the case of the study staff) or unaware of the overall design of the study and the explicit assignment to the treatment arm.

Table A1 presents the characteristics of children, families, and schools in both the treatment and control groups. Column (4) indicates that, at baseline, there were no significant differences between the two groups except for family wealth. The final section of Table A1 displays the overall MHT score and sub-dimensional scores. The average MHT score for the entire sample is approximately 37, with learning anxiety being the most prevalent and severe mental health issue among migrant children, with an average score of 8.37 out of 15 items, followed by self-blame tendencies and physical symptoms. Additionally, Table A2 demonstrates that attrition rates between baseline and endline surveys are similar for both treatment and control groups, suggesting no significant impact on the intervention's effectiveness.

2.5 Statistical analysis

Adjusted Ordinary Least Squares (OLS) regression models and a Logit regression model are used to assess the effect and mechanism of the vision care intervention on migrant children's mental health. The data was analyzed using Stata statistical software (StataCorp) and the analyses were adjusted for the clustered design using robust standard errors. The specific model setting are as follows:

$$MHT\_Score_{1ijk} = \beta_0 + \beta_1 Treatment_{ijk} + \beta_2 MHT\_Score_{0ijk} + \beta_3 X'_{ijk} + i.district + School_{jk} + \varepsilon_{ijk} \quad (1)$$

$$Y_{1ijk} = \beta_0 + \beta_1 Treatment_{ijk} + \beta_2 X'_{ijk} + i.district + School_{jk} + \varepsilon_{ijk} \quad (2)$$

Among them, 1 in the subscript represents the value of the variable at endline, and 0 represents the baseline value; MHT_Score_{1ijk} is the total standardized MHT test score of student i in school j in district k at endline survey and the mental health score of each dimension content scale; $Treatment_{ijk}$ indicates whether the student was assigned to the intervention group, 1 means yes, 0 means no. X'_{ijk} is the vector of children-level, parents-level and teacher-level characteristics, which included all variables listed in Table A1, and every baseline subsection MHT score for the given endline standard outcomes. $district$ is a dummy variable for the administrative district where the sample school is located to control the influence of geographical. $School_{jk}$ means clustering effect at the school level. Y_{1ijk} in equation (2) represent the intermediate variables including children's perception, knowledge and their teacher and parents' behavior regarding vision or glasses.

To reduce the inefficiency of the estimation due to missing values, we use multiple imputation in Stata to impute data for several variables at baseline, using the same approach as in literatures based on this randomized clustered controlled trail (Yi et al., 2015; Zhang et al., 2021).

2.6 Ethical considerations

The trial was approved by the Institutional Review Boards of Stanford University (Palo Alto, California, USA) and Zhongshan Ophthalmic Center, Sun Yat-sen University (ZOC, Guangzhou, China). Permission was obtained from the local education bureau in each area and from the principals of all participating schools, and at least one parent provided written informed consent for each child to participate. The principles of the Declaration of Helsinki were adhered to throughout. The original trial was registered at URL: http://isrctn.org under registration number ISRCTN16720066.

3. Results

3.1 Mental health risks for children with poor vision

Based on the MHT scale criteria, students with a total MHT score above 56 and a content scale score above 8 were classified as having mental health risks. Of the 4376 students surveyed, 145 failed the validity scale test and were excluded, leaving 1166 with poor vision and 3065 with normal vision. Table 1 shows a higher proportion of mental health cases among migrant children with poor vision (9.26%) compared to those with normal vision (6.82%). Learning anxiety is prevalent with rates of 51.2% for poor vision and 46.1% for normal vision. This is followed by self-blaming tendency and physical symptoms, which is consistent with existing research on Chinese students (Wang et al., 2015; Liu et al., 2018). Unpaired sample T-tests reveal significantly higher mental health issues in learning anxiety risk among migrant children with poor vision compared to those with normal vision ($P < 0.05$). This underlines the need for a targeted study on the mental health of migrant children with poor vision. Since the low incidence of other subsections of mental health, the study focused on general MHT, the most important three sections as the main outcomes in the following analysis.

3.2 Average treatment effects of the vision care intervention

Table 2 shows the average treatment effects of the vision healthcare services intervention on the mental health of migrant children. The results reveal that the vision care intervention significantly improved students' overall MHT score and enhanced learning anxiety. Specifically, after adjusting for other characteristics in model (1), there was a treatment effect of 21.4 percentage points ($P < 0.05$, column (1)) on the general MHT score and 25.7 percentage points ($P < 0.01$, column (2)). While the effect coefficients of the intervention on self-blame tendencies and physical symptoms also increased, the changes were not statistically significant. However, the rise in the coefficient implies that the treatment had an adverse impact on children's MHT score.

3.3 The mechanism of the vision care intervention on MHT

The most important thing we need to do is figure out why the vision healthcare service has a negative effect on migrant children's mental health. The study found the potential channel from four aspects: children's perception and knowledge of glasses, endline math scores, and teacher-parent behavior related to vision health. Table 3 shows the average treatment effect of vision healthcare services on these intermediate outcomes. Regarding perceptions of glasses, children were asked whether their classmates were teased for wearing glasses, whether they believed wearing glasses could help with learning, how easy it was to adapt to free glasses, and whether they were worried that their vision would worsen with eyeglasses. Columns (1)-(4) of the results show a positive overall change in the perception of glasses after the 6-month treatment compared to the control group. The treatment significantly increased the 21.4% probability of children believing that wearing glasses would help their learning ($P < 0.001$) and decreased the 11.1% probability of worrying about vision impairment with glasses.

Regarding the knowledge of glasses, we use 5 items about glasses use and vision care, in which Chinese people usually make mistakes (Li et al., 2010; Congdon et al., 2008). For the items, students are asked whether they agree or disagree with the following statements (1 = agree; 0 = disagree): "1. Eye exercises treat myopia; 2. Wearing glasses corrects myopia; 3. Wearing glasses helps to see clearly; 4. Wearing glasses lead to worsen vision; 5. No need to wear glasses for students." The correct answer lies on "1. Disagree; 2. Agree; 3. Agree; 4. Disagree; 5. Disagree." The result in columns (5)-(10) shows that the treatment had a positive effect on all knowledge questions and significant for the first 4 items ($P < 0.001$).

In column (11), we found no significant effect for math score, which is consistent with the result of the current study (Ma et al., 2021). For the parent and teacher aspects, the treatment resulted in a significant increase in parent support for wearing glasses ($P < 0.001$) and teacher-parent interaction about the children's vision problem. It is assumed that communication between teachers and parents about health conditions strengthens students' health awareness and improves their health status.

4. What is the issue underlying the negative impact of the treatment?

Given the significant negative effects of vision care service intervention on students' mental health, particularly on learning anxiety, and the fact that the mechanism analysis was unable to identify possible channels for the negative effects, it is worth considering whether there might be a heterogeneous treatment effect between different subgroups. It could be the case that there are heterogeneous treatment effects in subgroups. As different roles are involved in the causal chain of this randomized intervention experiment, including schools, families, and students, we tried to find explanations under four aspects: Teachers, parents, peers, and the students themselves.

4.1 Teacher support

From the school level, teacher incentive is one component of the intervention, and teachers' attitudes play a crucial role in shaping the mental health of children, especially in LMIC countries and for migrant children (Reinke et al., 2011; Loades & Mastroyannopoulou, 2010). Table 4 shows the conditional average treatment effect under teachers' attitudes toward healthcare service. The negative sign of the coefficient of the interaction variable of treatment and teacher support revealed the finding that the intervention has a greater impact on the mental health of migrant children who receive physical health care service with negative teacher attitudes. The interaction coefficient, −0.66, is statistically significant at the 1% level (Table 4, Column 2). Treatment children whose headteacher did not support them to wear eyeglasses experience a 0.804 SD rise in Learning Anxiety, significant at the 1% level. Conversely, treatment children whose headteacher supported them wearing eyeglasses experienced a 0.143 SD rise in Learning Anxiety, significant at the 10% level, much lower than the teacher didn't support group.

Subsequent examination of the mechanisms presented in Table 5 shows that children who receive support from their head teacher to wear glasses show positive results in terms of their perception of glasses, their knowledge about vision, and parental support. Conversely, treatment effects for children who do not receive support from their teachers are consistently found to be statistically insignificant on these dimensions.

4.2 Parental behavior

Table 6 displays the results of the heterogeneity analysis at the family level, which examines the impact of the treatment on children based on whether their parents wear eyeglasses or not. Although not statistically significant, the study found that parental wear behavior has a negative impact on treatment effectiveness. Specifically, the interaction between treatment and

parent wear had a negative adjustment effect on the treatment of children. Additionally, the study found that the treatment had a positive impact on children's learning anxiety among those whose parents did not wear glasses. Treatment increased their learning anxiety by 0.281 SD ($P < 0.05$), but there was no significant effect on children with at least one parent wearing glasses.

Further analysis (see Table A3) revealed that the treatment had a significant positive effect on children's perception and knowledge of glasses, parent support to wear, and teacher-parent interaction, regardless of whether their parents wore eyeglasses or not. Interestingly, the treatment coefficient of perception and knowledge outcomes in the parents-wearing group was higher than the group whose parents did not wear glasses. This result aligns with the understanding that children tend to perform better in areas where their families have a positive impact. Additionally, the study found that the treatment had a positive impact on the endline math scores of children whose parents did not wear eyeglasses, increasing their scores by 0.203 SD. This finding complements previous studies that found no significant effect of vision care programs on the academic performance of migrant children as a whole, but a positive impact on certain subgroups.

4.3 Peer effect

The survey aimed to investigate whether children's friends wore glasses before the project. Table 7 shows that the interaction term of treatment and peers who wear glasses had a negative adjustment on the treatment effect. The treatment significantly improved migrant children's MHT score by 0.266 SD ($P < 0.05$), learning anxiety by 0.326 SD ($P < 0.001$), self-blaming by 0.235 SD ($P < 0.1$), and physical symptoms by 0.207 SD ($P < 0.05$) in the group of peers who did not have glasses. However, there was no significant treatment effect on the group of peers who already had glasses. These results align with common sense. Further analysis revealed that the treatment

had a positive effect on children's perception, knowledge, and parental attitude toward wearing eyeglasses, regardless of whether their peers had glasses (Table A4).

4.4 Physical health degree

Based on the findings of previous studies that suggest a relationship between poor vision and mental health (Yi et al., 2015), we conducted an analysis to determine whether treatment has heterogeneous effects on the mental health of migrant children with different degrees of visual impairment. In Table 8, column (1), it can be observed that there is a non-significant treatment effect for children with mild degree vision impairment, whereas for children with moderate/severe vision impairment, the treatment has increased the general MHT score by 0.384 SD. In column (2), it can be inferred that the intervention effect was twice as high for children with moderate to severe visual impairment as compared to children with mild visual impairment in terms of learning anxiety ($P < 0.05$). The treatment effect on self-blaming tendency was also significantly increased by 0.351 SD in the moderate/severe group. However, the result of the mechanism analysis in Table A5 did not provide an explanation for the heterogeneous effect that the treatment had positive effects in both the mild and moderate/severe visual impairment groups. From the refraction, we can also conclude that children with moderate/severe visual impairment usually need glasses that are thicker and heavier, which might increase their resistance and fear of wearing glasses.

5. Discussions

Through a randomized intervention experimental study on 94 schools for migrant children in 3 cities and 9 administrative districts in eastern China, this study reaches the following research conclusions: (1) The prevalence of mental health problems among migrant children with visual impairment is high, particularly in relation to learning anxiety, which is significantly higher than

in children with normal vision; (2) eyeglass ownership and wearing rate among migrant children with poor vision are all low, free eyeglass intervention with teacher motivation and information education can significantly increase students' eyeglass wearing rate, treatment compliance increases significantly; (3) Vision-based healthcare service program has negative effects on migrant children's mental health and learning anxiety. But the heterogeneity analysis revealed that the negative effects are mainly concentrated in subgroups with specific characteristics regarding their own health, peers, parents, and teachers: Teachers do not support students who wear glasses, students with moderate and severe visual impairments, students whose parents do not wear glasses, students who do not have peers who have glasses. (4) Mechanism analysis revealed that teachers who do not support students who wear glasses have a negative impact on students' perceptions of wearing glasses, knowledge about vision care and therefore mental health is negatively affected.

Although vision-based healthcare intervention in this study has some negative effects on the mental health of migrant children with special characteristics, it is undeniable that wearing glasses is still a necessary tool to correct visual impairment. It is worth mentioning that one of the keys to the school health services project is the attitude of teachers towards health services. Teacher support plays an important role in children's utilization, perception of healthcare service and the formation of health knowledge, which further affects students' mental health. This reminds us that the effectiveness of healthcare services programs depends on all parties involved in the school. The students themselves, the parents and the teachers should reach a consensus on health issues to ensure that the health services in the school function efficiently. Moreover, the mental health problems of children require increased attention towards their physical health as well. Research in the specialized field of psychiatry suggests that psychiatrists can significantly contribute to enhancing patients' physical health by broadening their responsibilities beyond clinical psychiatric

care to include monitoring and treating essential physical indicators (De Hert et al., 2011). The whole society needs to take preventive measures and take care of children's mental health. This is especially true for vulnerable children in LMICs, who have fewer resources compared to other groups and whose mobility in family and school makes it difficult for them to recognize their health problems.

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Figure and Tables

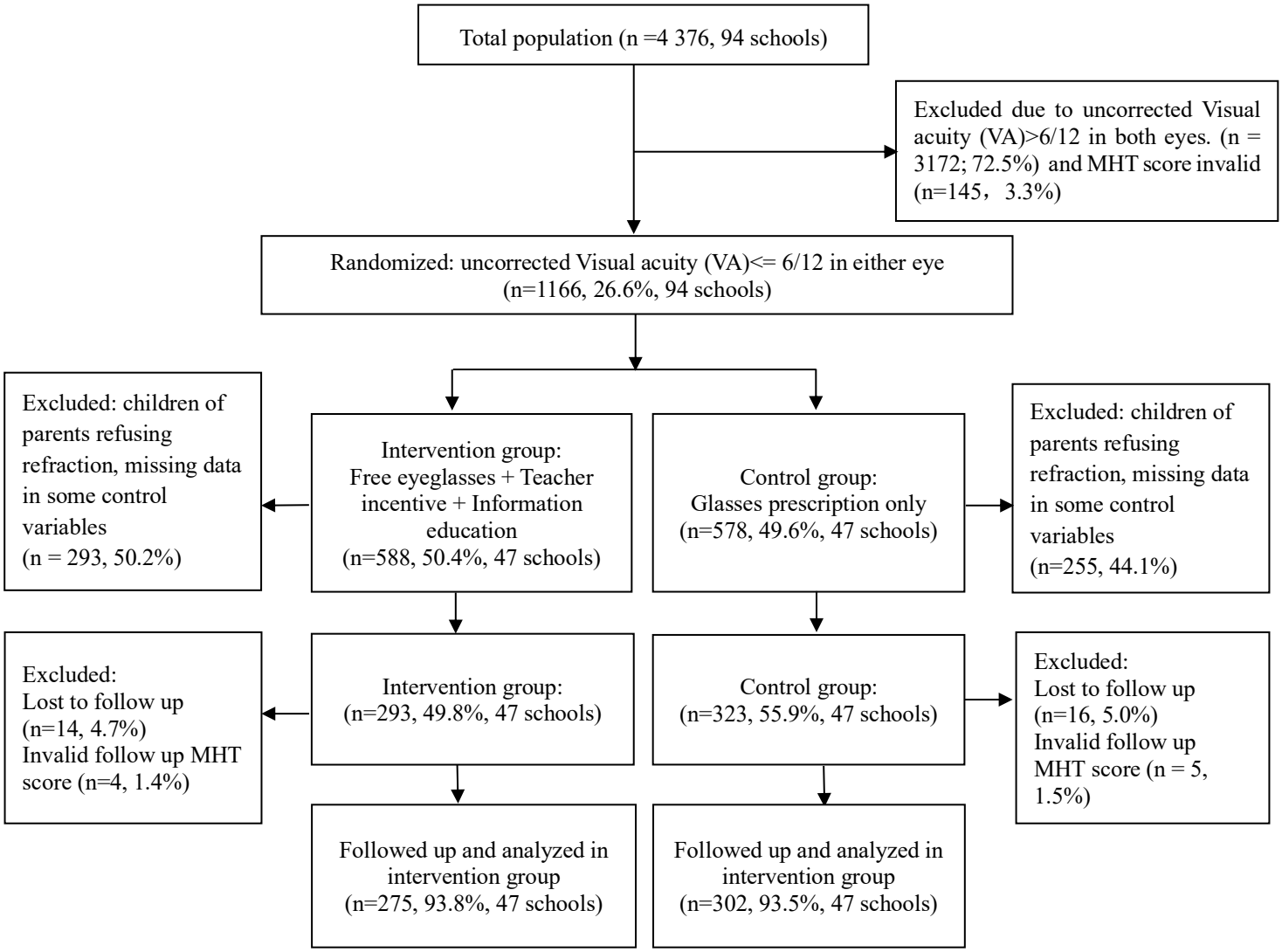

Figure 1. Flowchart of sampling and random allocation for Randomized Controlled Trials

Table 1. Difference of mental health risks between poor and normal vision

	Overall	Normal Vision	Poor Vision	Difference	P-Value
	(1)	(2)	(3)	(2)-(3)	
General MHT risk	0.075	0.068	0.093	-0.024**	0.006
	[0.263]	[0.252]	[0.290]	(0.009)	
Learning anxiety risk	0.475	0.461	0.512	-0.051***	0.002
	[0.499]	[0.499]	[0.500]	(0.017)	
Personal anxiety risk	0.022	0.020	0.025	-0.005	0.187
	[0.145]	[0.141]	[0.156]	(0.005)	
Loneliness tendency risk	0.007	0.007	0.007	0.000	0.453
	[0.081]	[0.081]	[0.083]	(0.003)	
Self-blaming tendency risk	0.100	0.100	0.099	0.002	0.572
	[0.300]	[0.301]	[0.298]	(0.010)	
Sensitivity tendency risk	0.045	0.047	0.039	0.007	0.853
	[0.207]	[0.211]	[0.195]	(0.007)	
Physical symptom risk	0.101	0.102	0.099	0.003	0.621
	[0.301]	[0.302]	[0.298]	(0.010)	
Phobic tendency risk	0.044	0.041	0.050	-0.008	0.128
	[0.205]	[0.199]	[0.218]	(0.007)	
Impulsion tendency risk	0.012	0.013	0.010	0.003	0.778
	[0.110]	[0.114]	[0.101]	(0.004)	
Observation	4231	3065	1166		

Notes: Standard errors are clustered at the school level and presented in parentheses. Standard deviations are presented in brackets.

Table 2. The effect of vision care intervention on the mental health of migrant children

	Post-treated standard score			
	General MHT score	Learning anxiety	Self-blaming tendency	Physical symptom
VARIABLES	(1)	(2)	(3)	(4)
Treatment	0.214*	0.257**	0.178	0.122
	(0.113)	(0.115)	(0.118)	(0.090)
Control variables	YES	YES	YES	YES
District FE	YES	YES	YES	YES
Observations	636	636	636	636
R-squared	0.389	0.268	0.189	0.334

Notes: Robust standard errors in parentheses; *** p<0.001 ** p<0.01, * p<0.05, † p<0.1

Table 3. The mechanism of the effect of vision care intervention on mental health of migrant children

	Post-treatment perception of glasses					Post-treatment knowledge of glasses				Post-treatment math score	Post-treatment parents and teacher behavior	
	Classmates be teased for wearing glasses	Wear eyeglasses helps studying	Easy to adapt eyeglasses	Worried about vision get worse with eyeglasses	Eye exercise treats myopia	Wear glasses corrects myopia	Wear eyeglasses helps seeing clear	Wear eyeglasses lead to worsen vision	No need to wear eyeglasses for pupils	Standard math score	Parents support to wear eyeglasses	Teacher and parents interact about vision problem
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Treatment	0.108	1.030***	0.365†	-0.997***	-1.453***	1.166***	1.635***	-1.306***	-0.289	0.167	0.720***	0.420*
	(0.295)	(0.207)	(0.211)	(0.302)	(0.240)	(0.198)	(0.344)	(0.269)	(0.191)	(0.110)	(0.197)	(0.213)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
District FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	625	625	410	409	624	625	624	623	623	625	625	625
Pseudo R-squared/R-squared	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.317	0.036	0.036

Table 4. Treatment effect of whether teacher supports wear eyeglasses

	Post-treated standard score			
	General MHT score	Learning anxiety	Self-blaming tendency	Physical symptom
VARIABLES	(1)	(2)	(3)	(4)
Treatment	0.378*	0.804***	-0.218	0.439†
	(0.185)	(0.224)	(0.506)	(0.237)
Teacher support	0.143†	0.074	0.085	0.129†
	(0.074)	(0.134)	(0.102)	(0.076)
Treatment × Teacher support	-0.300	-0.660**	0.276	-0.417†
	(0.191)	(0.231)	(0.514)	(0.238)
Control variables	YES	YES	YES	YES
District FE	YES	YES	YES	YES
Observations	616	616	616	616
R-squared	0.424	0.272	0.215	0.351
Treatment effect of teacher	0.079	0.143†	0.058	0.022
support wearing	(0.058)	(0.072)	(0.067)	(0.059)

Table 5. The heterogeneity effect of vision care service on intermediate outcome among whether teacher support wearing glasses or not

	Post-treatment perception of glasses					Post-treatment knowledge of glasses				Post-treatment math score	Post-treatment parents and teacher behavior	
	Classmates be teased for wearing glasses	Wear eyeglasses helps studying	Easy to adapt eyeglasses	Worried about vision get worse with eyeglasses	Eye exercise treats myopia	Wear glasses corrects myopia	Wear eyeglasses helps seeing clear	Wear eyeglasses lead to worsen vision	No need to wear eyeglasses for pupils	Standard math score	Parents support to wear eyeglasses	Teacher and parents interact about vision problem
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Treatment	0.325	0.114	0.506	-0.085	-1.104	1.203	-0.179	-0.296	-0.359	-0.361	0.620	0.154
	(1.543)	(0.946)	(0.650)	(1.037)	(1.144)	(1.144)	(1.210)	(0.741)	(0.953)	(0.508)	(0.704)	(0.777)
Teacher support (1 = yes)	-0.020	0.257	1.123*	0.123	0.181	0.472	-0.438	0.019	-0.145	0.171	0.332	-0.060
	(0.402)	(0.363)	(0.445)	(0.682)	(0.354)	(0.388)	(0.448)	(0.388)	(0.277)	(0.158)	(0.265)	(0.406)
Treatment × Teacher support	-0.212	0.887	-0.342	-0.926	-0.363	-0.146	2.053†	-0.988	0.127	0.481	0.018	0.243
	(1.531)	(0.962)	(0.676)	(1.158)	(1.129)	(1.141)	(1.245)	(0.786)	(0.995)	(0.516)	(0.705)	(0.780)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
District FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	616	616	401	400	615	616	615	614	614	616	616	616
Pseudo R-squared/R-squared	0.059	0.106	0.053	0.101	0.119	0.084	0.158	0.095	0.039	0.330	0.061	0.036
Treatment effect of teacher	0.018	0.230***	0.040	-0.120*	-0.317***	0.222***	0.122***	-0.163***	-0.044	0.120	0.156***	0.087†
Support student wear glasses	(0.050)	(0.050)	(0.055)	(0.051)	(0.050)	(0.043)	(0.029)	(0.032)	(0.039)	(0.118)	(0.050)	(0.048)

Table 6. Treatment effect of whether parents wear eyeglasses

	Post-treated standard score			
	General MHT score	Learning anxiety	Self-blaming tendency	Physical symptom
VARIABLES	(1)	(2)	(3)	(4)
Treatment	0.232†	0.281*	0.197	0.162†
	(0.121)	(0.122)	(0.128)	(0.095)
Parent wear (1 = yes)	0.230*	0.231†	0.171	0.422***
	(0.098)	(0.125)	(0.117)	(0.091)
Treatment × Parent wear	-0.099	-0.133	-0.104	-0.226
	(0.128)	(0.146)	(0.168)	(0.139)
Control variables	YES	YES	YES	YES
District FE	YES	YES	YES	YES
Observations	636	636	636	636
R-squared	0.389	0.269	0.190	0.336
Treatment effect of at least one	0.133	0.148	0.092	-0.063
parent wearing glasses	(0.133)	(0.148)	(0.160)	(0.136)

Table 7. Treatment effect of whether peer have eyeglasses

	Post-treated standard score			
	General MHT score	Learning anxiety	Self-blaming tendency	Physical symptom
VARIABLES	(1)	(2)	(3)	(4)
Treatment	0.266*	0.326**	0.235†	0.207*
	(0.122)	(0.122)	(0.137)	(0.099)
Peer had (1 = yes)	0.058	-0.035	-0.007	0.151
	(0.067)	(0.081)	(0.078)	(0.097)
Treatment × Peer had	-0.139	-0.162	-0.150	-0.220
	(0.111)	(0.119)	(0.127)	(0.134)
Control variables	YES	YES	YES	YES
District FE	YES	YES	YES	YES
Observations	633	633	633	633
R-squared	0.397	0.272	0.194	0.343
Treatment effect of peer	0.127	0.163	0.085	-0.012
having glasses	(0.131)	(0.137)	(0.129)	(0.128)

Table 8. Treatment effect of children's vision impairment degree

	Post-treated standard score			
	General MHT score	Learning anxiety	Self-blaming tendency	Physical symptom
VARIABLES	(1)	(2)	(3)	(4)
Treatment	0.147	0.200*	0.110	0.144†
	(0.093)	(0.098)	(0.108)	(0.083)
VA degree (1= moderate/severe)	-0.267*	-0.213	-0.290†	-0.066
	(0.125)	(0.132)	(0.147)	(0.131)
Treatment × VA degree	0.238†	0.201	0.241	-0.075
	(0.137)	(0.138)	(0.173)	(0.158)
Control variables	YES	YES	YES	YES
District FE	YES	YES	YES	YES
Observations	636	636	636	636
R-squared	0.396	0.273	0.197	0.336
Treatment effect of moderate/severe	0.384*	0.401*	0.351†	0.069
vision impairment	(0.185)	(0.184)	(0.197)	(0.170)

Appendix

Table A1. Baseline basic characteristics of intention-to-treat population

	Overall	Control	Treatment	Difference	P-Value
	(1)	(2)	(3)	(2)-(3)	
Children characteristics					
Age(years)	10.933	10.949	10.915	0.034	0.463
	[0.903]	[0.941]	[0.861]	(0.069)	
Gender (1=male)	0.510	0.526	0.494	0.032	0.362
	[0.500]	[0.500]	[0.501]	(0.038)	
LogMAR better	0.416	0.418	0.414	0.005	0.819
	[0.214]	[0.205]	[0.224]	(0.016)	
Baseline standard math score	0.116	0.108	0.124	-0.016	0.597
	[1.001]	[0.987]	[1.016]	(0.077)	
Family characteristics					
At least one parent has a high school education or above (1=yes)	0.305	0.305	0.305	0.001	0.709
	[0.461]	[0.461]	[0.461]	(0.036)	
At least one parent wears glasses (1=yes)	0.186	0.179	0.194	-0.014	0.500
	[0.390]	[0.384]	[0.396]	(0.030)	
Both parents live in the area (1=yes)	0.861	0.877	0.844	0.033	0.183
	[0.346]	[0.329]	[0.363]	(0.027)	
Family wealth (1=upper 50%)	0.550	0.536	0.577	-0.051†	0.053
	[0.498]	[0.500]	[0.495]	(0.040)	
Teacher characteristics					
Teacher's gender (1=male)	0.260	0.193	0.330	-0.137	0.195
	[0.439]	[0.395]	[0.471]	(0.033)	
Teacher has collage degree or above (1=yes)	0.306	0.241	0.376	-0.134	0.118
	[0.461]	[0.429]	[0.485]	(0.035)	
Teacher's age (years)	35.096	33.334	36.964	-3.629	0.183
	[11.160]	[10.843]	[11.204]	(0.846)	
Mental health test score					
General MHT score	37.101	37.489	36.688	0.801	0.494
	[13.200]	[13.258]	[13.145]	(1.012)	
Learning anxiety	8.377	8.281	8.479	-0.198	0.352
	[3.077]	[3.170]	[2.975]	(0.236)	
Personal anxiety	4.085	4.071	4.100	-0.029	0.903
	[2.235]	[2.221]	[2.253]	(0.171)	
Loneliness tendency	2.748	2.929	2.555	0.374*	0.024
	[1.952]	[2.050]	[1.825]	(0.149)	
Self-blaming tendency	5.499	5.523	5.473	0.050	0.874
	[2.351]	[2.368]	[2.335]	(0.180)	
Sensitivity tendency	5.078	5.116	5.036	0.080	0.776
	[2.097]	[2.095]	[2.102]	(0.161)	
Physical symptom	4.846	4.969	4.715	0.254	0.177
	[2.741]	[2.794]	[2.681]	(0.210)	
Phobic tendency	3.953	4.080	3.818	0.261	0.175
	[2.677]	[2.655]	[2.698]	(0.205)	
Impulsion tendency	2.516	2.520	2.512	0.008	0.864
	[2.166]	[2.216]	[2.116]	(0.166)	
Observation	682	352	330	682	

Table A2. Attrition test

	Attrition
VARIABLES	(1)
treatment	0.004
	(0.016)
Control variables	YES
District FE	YES
Observations	682
R-squared	0.031
Total attrition rate	4.84%

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A3. The heterogeneity effect of vision care service on intermediate outcome among whether teacher support wearing glasses or not

	Post-treatment perception of glasses					Post-treatment knowledge of glasses				Post-treatment math score	Post-treatment parents and teacher behavior	
	Classmates be teased for wearing glasses	Wear eyeglasses helps studying	Easy to adapt eyeglasses	Worried about vision get worse with eyeglasses	Eye exercise treats myopia	Wear glasses corrects myopia	Wear eyeglasses helps seeing clear	Wear eyeglasses lead to worsen vision	No need to wear eyeglasses for pupils	Standard math score	Parents support to wear eyeglasses	Teacher and parents interact about vision problem
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Treatment	0.152	1.096***	0.215	-0.834*	-1.375***	1.086***	1.564***	-1.206***	-0.209	0.203†	0.704**	0.409†
	(0.331)	(0.237)	(0.255)	(0.373)	(0.257)	(0.217)	(0.362)	(0.290)	(0.217)	(0.111)	(0.214)	(0.231)
Parent wear	-0.053	0.211	-0.263	0.484	0.401	-0.245	0.150	0.498	0.002	0.190	-0.064	0.306
	(0.418)	(0.280)	(0.594)	(0.536)	(0.288)	(0.383)	(0.388)	(0.349)	(0.369)	(0.145)	(0.291)	(0.343)
Treatment × Parent wear	-0.278	-0.370	0.694	-0.776	-0.417	0.469	0.589	-0.526	-0.462	-0.199	0.092	0.059
	(0.585)	(0.448)	(0.684)	(0.712)	(0.500)	(0.484)	(1.130)	(0.721)	(0.526)	(0.196)	(0.412)	(0.469)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
District FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	625	625	410	409	624	625	624	623	623	625	625	625
Pseudo R-squared/R-squared	0.062	0.103	0.047	0.103	0.121	0.087	0.150	0.096	0.043	0.319	0.064	0.036
Treatment effect of at least	-0.018	0.169*	0.214†	-0.204*	-0.395***	0.317***	0.109*	-0.250***	-0.114	0.004	0.192*	0.111
one parent wearing glasses	(0.074)	(0.086)	(0.127)	(0.088)	(0.089)	(0.084)	(0.043)	(0.079)	(0.077)	(0.206)	(0.089)	(0.103)

Robust standard errors in parentheses

*** p<0.001 ** p<0.01, * p<0.05, † p<0.1

Table A4. The heterogeneity effect of vision care service on intermediate outcome among whether peer having glasses or no

	Post-treatment perception of glasses					Post-treatment knowledge of glasses				Post-treatment math score	Post-treatment parents and teacher behavior	
VARIABLES	Classmates be teased for wearing glasses (1)	Wear eyeglasses helps studying (2)	Easy to adapt eyeglasses (3)	Worried about vision get worse with eyeglasses (4)	Eye exercise treats myopia (5)	Wear glasses corrects myopia (6)	Wear eyeglasses helps seeing clear (7)	Wear eyeglasses lead to worsen vision (8)	No need to wear eyeglasses for pupils (9)	Standard math score (10)	Parents support to wear eyeglasses (11)	Teacher and parents interact about vision problem (12)
Treatment	0.007	0.874**	0.666*	-1.027**	-1.518***	1.280***	1.632***	-1.008**	-0.423†	0.139	0.722**	0.326
	(0.330)	(0.271)	(0.268)	(0.397)	(0.285)	(0.240)	(0.430)	(0.327)	(0.255)	(0.124)	(0.247)	(0.272)
Peer have	-0.269	0.069	0.434	-0.063	0.102	0.426†	0.896*	0.502†	0.234	-0.058	0.377	0.490†
	(0.301)	(0.263)	(0.385)	(0.342)	(0.282)	(0.226)	(0.353)	(0.303)	(0.287)	(0.088)	(0.252)	(0.292)
Treatment × Peer have	0.295	0.392	-0.702	0.080	0.134	-0.232	-0.165	-0.763	0.302	0.067	-0.045	0.223
	(0.460)	(0.382)	(0.466)	(0.560)	(0.430)	(0.319)	(0.818)	(0.465)	(0.382)	(0.132)	(0.353)	(0.378)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
District FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	622	622	409	408	621	622	621	620	620	622	622	622
Pseudo R-squared/R-squared	0.062	0.106	0.048	0.100	0.122	0.093	0.165	0.101	0.048	0.317	0.067	0.050
Treatment effect of peer having glasses	0.046	0.280***	-0.008	-0.112*	-0.308***	0.231***	0.060*	-0.238***	-0.025	0.206	0.167*	0.132†
	(0.066)	(0.060)	(0.086)	(0.052)	(0.075)	(0.057)	(0.024)	(0.050)	(0.062)	(0.134)	(0.069)	(0.070)

Robust standard errors in parentheses

*** p<0.001 ** p<0.01, * p<0.05, † p<0.1

Table A5. The heterogeneity effect of vision care service on intermediate outcome among students' VA degree

	Post-treatment perception of glasses					Post-treatment knowledge of glasses				Post-treatment math score	Post-treatment parents and teacher behavior	
	Classmates be teased for wearing glasses	Wear eyeglasses helps studying	Easy to adapt eyeglasses	Worried about vision get worse with eyeglasses	Eye exercise treats myopia	Wear glasses corrects myopia	Wear eyeglasses helps seeing clear	Wear eyeglasses lead to worsen vision	No need to wear eyeglasses for pupils	Standard math score	Parents support to wear eyeglasses	Teacher and parents interact about vision problem
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Treatment	0.078	1.193***	0.716†	-0.964*	-1.546***	1.141***	1.618***	-1.382***	-0.517*	0.170	0.649**	0.395
	(0.335)	(0.241)	(0.366)	(0.393)	(0.252)	(0.208)	(0.407)	(0.318)	(0.248)	(0.116)	(0.235)	(0.247)
VA degree	-0.581*	0.283	0.538	-1.298*	0.116	0.170	0.054	-0.365	-0.117	0.161	0.498	0.567†
	(0.290)	(0.272)	(0.523)	(0.604)	(0.331)	(0.420)	(0.365)	(0.347)	(0.309)	(0.146)	(0.337)	(0.328)
Treatment × VA degree	0.149	-0.606	-0.839	-0.092	0.295	0.083	0.076	0.276	0.771†	-0.021	0.246	0.070
	(0.456)	(0.396)	(0.552)	(0.818)	(0.418)	(0.417)	(0.952)	(0.490)	(0.447)	(0.158)	(0.361)	(0.358)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
District FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	625	625	410	409	624	625	624	623	623	625	625	625
Pseudo R-squared/R-squared	0.066	0.105	0.049	0.125	0.122	0.087	0.149	0.096	0.048	0.320	0.072	0.044
Treatment effect of moderate/	0.028	0.138†	-0.029	-0.059	-0.285***	0.266***	0.106*	-0.124***	0.052	0.149	0.219***	0.114
severe vision impairment	(0.054)	(0.078)	(0.079)	(0.041)	(0.084)	(0.079)	(0.044)	(0.048)	(0.073)	(0.163)	(0.069)	(0.074)

Robust standard errors in parentheses

*** p<0.001 ** p<0.01, * p<0.05, † p<0.1