

AN INVESTIGATION OF VISION PROBLEMS AND THE VISION CARE SYSTEM IN RURAL CHINA

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Abstract. This paper examines the prevalence of vision problems and the accessibility to and quality of vision care in rural China. We obtained data from 4 sources: 1) the National Rural Vision Care Survey; 2) the Private Optometrists Survey; 3) the County Hospital Eye Care Survey; and 4) the Rural School Vision Care Survey. The data from each of the surveys were collected by the authors during 2012. Thirty-three percent of the rural population surveyed self-reported vision problems. Twenty-two percent of subjects surveyed had ever had a vision exam. Among those who self-reported having vision problems, 34% did not wear eyeglasses. Fifty-four percent of those with vision problems who had eyeglasses did not have a vision exam prior to receiving glasses. However, having a vision exam did not always guarantee access to quality vision care. Four channels of vision care service were assessed. The school vision examination program did not increase the usage rate of eyeglasses. Each county-hospital was staffed with three eye-doctors having one year of education beyond high school, serving more than 400,000 residents. Private optometrists often had low levels of education and professional certification. In conclusion, our findings shows that the vision care system in rural China is inadequate and ineffective in meeting the needs of the rural population sampled.

Keywords: vision problem, vision care, rural China

INTRODUCTION

Estimates of the prevalence of vision problems in rural China vary widely (He

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et al, 2004, 2007; Congdon *et al*, 2008a, b; Liang *et al*, 2009; Glewwe *et al*, 2011). Depending on the nature of the study and the cohort examined (children, adults, or the elderly), the estimates of vision problems (rates of myopia, etc) in China range from 15% to 82%. Nearly all the studies are small and few include data from rural China. No study to our knowledge pro-

vides an estimate of the total number of people in China with vision problems. It is possible, the prevalence of poor vision in China is among the highest in the world (Liang *et al*, 2009).

Proper eyeglasses are often all that is required to correct the majority of vision problems (Esteso *et al*, 2007). Despite the high potential prevalence of vision problems in rural China, few rural individuals appear to wear glasses (He *et al*, 2007; Glewwe *et al*, 2011).

Untreated vision problems that are easily corrected with eyeglasses can lead to a variety of broader problems. Studies indicate the absence of appropriate eyeglasses leads to decreased visual function (Esteso *et al*, 2007; Lu *et al*, 2009) and, for school-aged children, poorer educational performance (Ma *et al*, 2014). The World Health Organization estimates the potential global lost productivity from such cases to be as large as hundreds of billions of US dollars annually (Smith *et al*, 2009).

There are a number of possible reasons why many people with correctable vision problems do not seek treatment. In many circumstances even the least expensive eyeglasses may be beyond the budget of families in deep poverty. In China, however, except for the very poorest members of society, most families have enough disposable income to buy a pair of glasses (Li *et al*, 2008). Misinformation may be another demand-side factor behind the underutilization of eyeglasses; people may not be aware of their vision problems or mistakenly believe wearing eyeglasses will further deteriorate one's vision (Li *et al*, 2010; Yi *et al*, 2013). Little evidence-based, empirical research exists that explores how such demand side factors can impact eyeglasses uptake (Congdon *et al*, 2011).

Even less research has sought to explore supply side constraints of vision care in rural China. It is not known, for example, to what extent rural individuals seek vision care, and to the extent they do, where and when they seek it. The quality of available care in rural China is also not well understood. Research into these issues is necessary as health officials make fundamental decisions about the provision of health care services in poor areas (The Voice of Business, 2011).

The goal of this study was to assess the demand for and supply of vision care services in China's rural areas. To meet this goal, we have four objectives. First, we estimate the scope of the vision problem in rural China based on a nationally representative survey of rural households. Second, we documented the share of those individuals with vision problems that were able or willing to seek care. Third, we examine the extent to which care was provided on the basis of proper vision examinations. Finally, we explore the different venues—schools, private optical shops and the government public health system—from which rural individuals most often receive vision care. As part of this inquiry, we survey the types and quality of services provided by county hospitals, township health centers and village clinics. While the existing literature indicates certain demand side constraints to good vision care in rural China, we aim to document if there were supply side weaknesses that might be contributing to the low rate of eye glasses use.

MATERIALS AND METHODS

We use four data sets for this study: one main dataset and three supplementary datasets. The main dataset, the National Rural Vision Care Survey, was collected

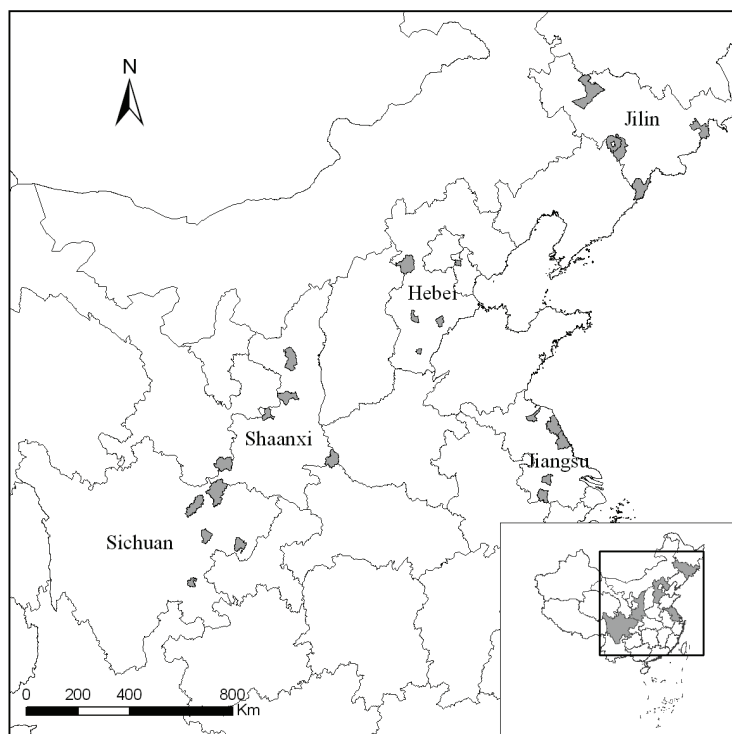


Fig 1—Location of study sites.

by the Chinese Academy of Sciences' Center for Chinese Agriculture Policy in collaboration with Stanford University. The survey was conducted in April 2012 in 100 villages, 50 towns, and 25 rural counties in Jiangsu, Sichuan, Shaanxi, Jilin, and Hebei provinces. The survey collected data on 145 village clinics and 50 township health centers. Data on the health and health care service use were also collected at the individual-level from a total of 8,107 individuals in 2,028 randomly sampled households. The sample households were in the 100 surveyed villages. The sample procedures followed that of Babiarz *et al* (2010) (Fig 1).

The Village Clinic Survey part of the survey was designed to obtain information about the qualifications of clinic staff, services offer and finances of each clinic. The head of each village clinic was asked

about the health services offered. The survey teams asked about the ability of the clinic to provide vision care services, including vision screening, vision exams and the edging and dispensing of glasses. They also asked village clinicians several questions about their knowledge of vision care.

To enable comparisons between the state of China's village clinics and larger, more centralized providers, survey teams also visited the township health centers serving each of the sample villages. The survey conducted at the township health centers mirrored the village clinic

survey. We collected information about the provision of vision services. Township health center doctors were also tested on their knowledge of vision care.

To determine the scope of vision problems among rural individuals and the extent to which they access vision care, we also administered a detailed survey of vision health and vision care utilization to randomly sampled households in each village. The household survey instrument had three major sets of questions. The first set of questions collected demographic data: gender, age and education of each household member. Consistent with prior research in rural China (Zhao *et al*, 2010), individuals aged 5-15 years were classified as children, individuals aged 16-49 were classified as adults, and individuals aged ≥ 50 years were classified as elderly. The second set of questions asked

respondents to self-report their vision status and their use of vision care services. This information was collected from each family member of a surveyed household. The third set of questions asked about the subject's knowledge of vision health and care.

Data from three other supplementary surveys were used in this study. The first supplementary survey was the Private Optometrists Survey. During the summer of 2012 we surveyed private optometrists in 18 counties of Gansu and Shaanxi provinces. The counties are located in two prefectures: Tianshui Prefecture in Gansu Province, and Yulin Prefecture in Shaanxi Province. In the survey we asked optometrists about their formal education and training, their experience and the scope of services provided. The selection of these counties was biased toward lower quality vision care, since these counties were in the poorest regions of northwestern China (even though the average per capita income in Yulin Prefecture is near the national average for rural China (CNBS, 2011a, b). However, the way we selected the respondents attempted to mitigate this bias. In each county we surveyed one optometrist. This optometrist was selected from all the optometrists in the county after making inquiries at the County Bureau of Health, the Center for Disease Control and the county hospital about which local optometrist was the best in the county. Our choice of poor counties could mean that the quality of the optometrist was below average, but the choice of the best optometrist would mean that our data came from optometrists in the upper level of quality in these poor counties.

The second supplementary survey was the County Hospital Eye Care Survey. The main purpose of this survey was to document the availability of eye doctors

(either ophthalmologists or optometrists) in each county. The survey included the same 18 counties in Gansu and Shaanxi provinces as those in the Private Optometrists Survey. Since the counties were the same, the same biases might have affected the results.

The third supplementary survey was of 252 schools in Shaanxi and Yulin prefectures: the Rural School Vision Care Survey. The schools in the survey were in the same 18 counties as the Private Optometrists Survey and County Hospital Eye Care Survey. The Rural School Vision Care Survey evaluated 253 school principals and 19,977 grade 4 and grade 5 students. In the survey the principals and students were asked if there had been vision exams at their schools. We also recorded the number of students wearing glasses at each school. We wanted to know if the vision care in schools resulted in children wearing glasses. Table 1 summarizes the four surveys used in this study.

In order to study whether the children at the studied schools who received the vision exams wore glasses at higher rates, we used the following equation:

$$\text{Percent of students wearing glasses} = a_0 + a_1 * p + a_2 * s + \mu + e$$

where the "Percent of students wearing glasses" is the number of students studied in grades 4 and 5 who reported wearing or having glasses divided by the total number of students in grades 4 and 5; p is an indicator variable (*ie*, a variable that takes the value of 0 or 1 to indicate the absence or presence of a given condition, respectively) if the principal reported the school had vision screening services during the previous two years; s is an indicator variable which equals 1 if >50% of students at the studied school stated the school had vision screening services; μ is the set of county level dummy

Table 1
Survey data used in the current study.

Survey	Survey year	Survey sites	Respondent	Sample size
National Rural Vision Care Survey (town section)	Apr 2012	Jiangsu, Sichuan, Shaanxi, Jilin, Hebei	Township Health Center	50
National Rural Vision Care Survey (village section)	Apr 2012	Jiangsu, Sichuan, Shaanxi, Jilin, Hebei	Village clinics	145
National Rural Vision Care Survey (household section)	Apr 2012	Jiangsu, Sichuan, Shaanxi, Jilin, Hebei	Households	2,028 households (8,107 individuals)
Private Optometrists Survey	Jul 2012	Gansu, Shaanxi	Optometrist	18
County Hospital Eye Care Survey	Oct 2012	Gansu, Shaanxi	Eye care professionals	18
Rural School Vision Care Survey	Oct 2012	Gansu, Shaanxi	Principals (Students)	253 schools (19,977 students)

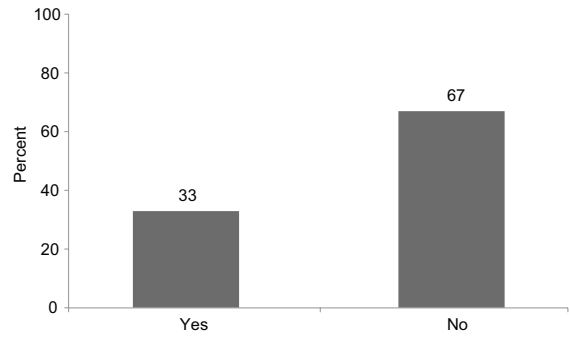


Fig 2A—Percent study subjects aged ≥ 5 years with vision problems.

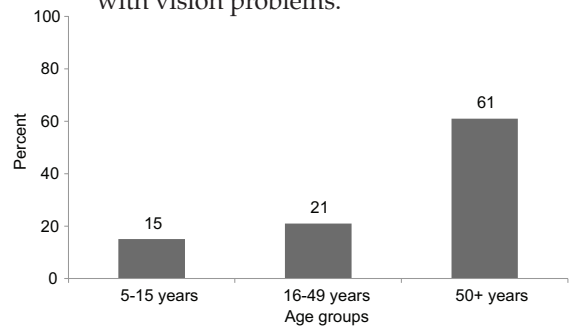


Fig 2B—Percent of study subjects by age group with vision problems.

variables (to account for all county-level fixed effects; *ie*, those variables that are not random) and *e* is the error term that adjusts for clustering at the class level. The coefficients on the *p/s* variable, *a1* and *a2*, measure the association between vision care activities at the school and percent of students at the school wearing glasses.

RESULTS

Vision problems were common among the subjects surveyed. Two thousand six hundred eighty-six of the 8,107 subjects sampled (33.13%) reported difficulty seeing (Fig 2A). This number varied by age cohort (Fig 2B).

Although many individuals in rural China report having vision problems, the data show many have not sought vision care. When asked if they had ever had a vision exam, 22% said yes (Fig 3A). The

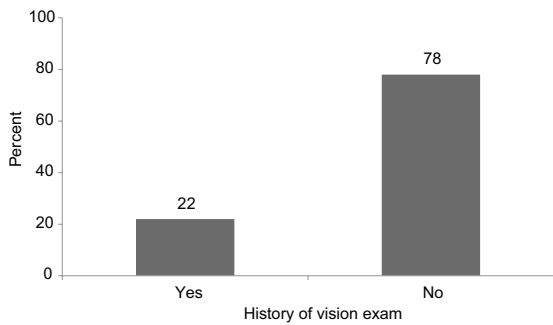


Fig 3A—Percent of study subjects aged ≥ 5 years who ever had a vision exam.

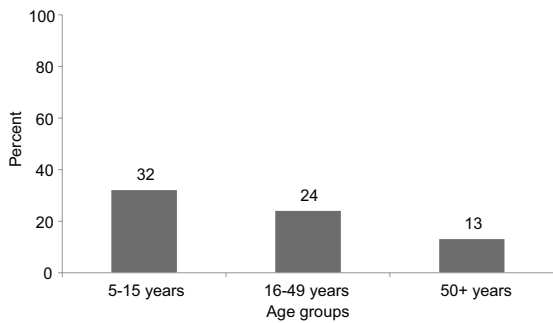


Fig 3B—Percent of study subjects by age group who ever had a vision exam.

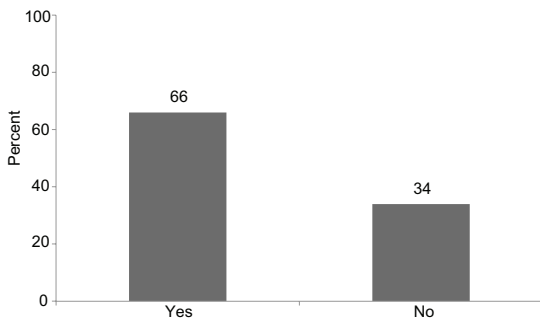


Fig 4A—Percent of subjects aged ≥ 5 years who report wearing glasses.

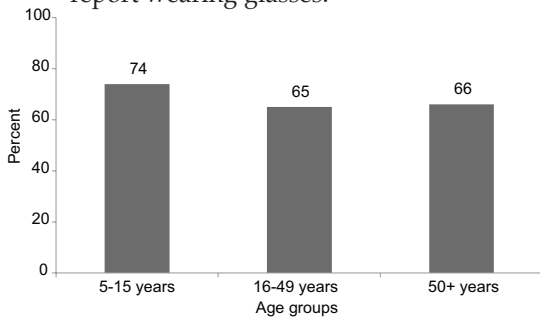


Fig 4B—Percent of subjects aged ≥ 5 years who report wearing glasses by age group.

data also varied by age (Fig 3B), with children being the most common group to have had a vision exam.

Considerably fewer people who reported vision problems also reported having glasses. Two-thirds of those who reported vision problems said they had ever worn glasses (Fig 4A). This was true for all age cohorts (Fig 4B).

A large proportion of the individuals who reported having vision problems or wearing glasses, did not receive quality vision care (Fig 5). There are two aspects to the quality issue. First, if a respondent told us he/she had a vision problem and wore glasses, we then asked them if they had purchased their glasses after receiving a vision exam; 54% responded no (Fig 5A). The rest of the respondents with poor vision who wore glasses and had a vision exam either had their glasses dispensed after being tested with an autorefractor only (31%) or with a full exam that included a vision screening chart, an autorefractor and subjective refinement (50%) (Fig 5B).

Twenty-nine percent of respondents in our Rural School Vision Care Survey self-reported receiving their vision examination at school. However, vision care was only provided at 34% of schools.

Thirty-five percent of respondents in the National Rural Vision Care Survey reported having their vision examination at a county hospital. Eighty-four percent of county hospitals in the sample had an ophthalmology department and 74% had more than one ophthalmologist. Thirty-eight percent of counties had only one ophthalmologist at the county hospital.

Thirty-six percent of those who had a vision exam had it at a private optical shop. The average optometrist in our survey only had a high school education

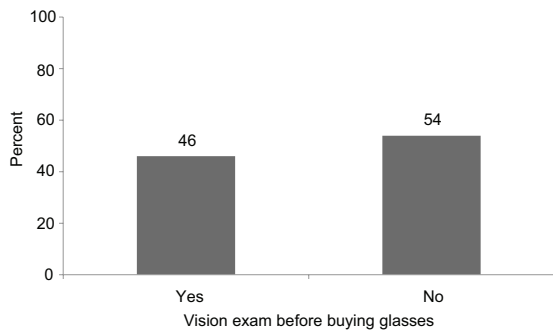


Fig 5A—Percent of subjects aged ≥ 5 years who had a vision exam before buying glasses.

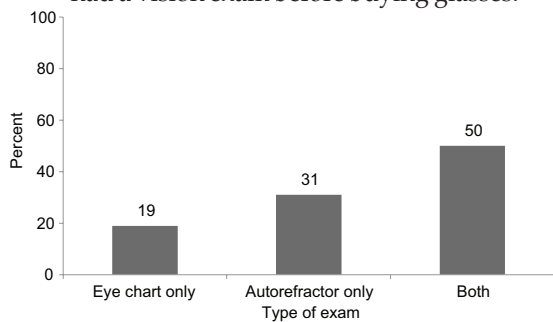


Fig 5B—Percent of subjects aged ≥ 5 years who had a vision exam before buying glasses by type of exam received.

(Table 2). Only 46% of optometrist shops had staff with an advanced optometrist certificate and less than a third of shops had staff with an optician certificate (Table 2).

Virtually no village clinics offered optometric services and only one in five township health centers did (Fig 6A). None of the village clinics and only 4% of township health centers were capable of edging lenses or producing spectacles (Fig 6B).

DISCUSSION

Our data show vision problems are common in China. Thirty-three percent of respondents reported having vision problems. Applying this percentage to China's total rural population, reported to be 650 million in 2010, (CNBS, 2011a)

gives an estimated 215 million people with vision problems.

There are limitations to self-reported data: it is possible more individuals have vision problems than the number reported. A previous study found children are particularly susceptible to underreporting, given the slow onset of many common vision problems and the fact that some problems may be relatively mild (Gwiazda *et al*, 2000). The underestimation among children may explain the disparity between the prevalence of vision problems among children found in our study (15%) and those from three other regions (He *et al*, 2004, 2007; Congdon *et al*, 2008a) (50%-60%). These latter findings are based on assessments by optometric professionals rather than self-reporting, which could have over-reporting bias. Our findings may represent the lower limit of an estimate for living children in rural China.

The high rate of eyeglass use among children with vision problems in our study (nearly three-quarters) is higher than many studies from China. Glewwe *et al* (2011) found 11% of elementary school children in Gansu Province who needed glasses actually were wearing them. Yi *et al* (2013) found that 16% of elementary school students in Shaanxi and Gansu provinces who needed glasses were wearing them.

This disparity may represent underreporting of vision problems among children in our study. It may be that the number of children wearing eyeglasses was probably correct, but the number of children with vision problems was probably underestimated in our study. This means the percent of children with vision problems who received vision care in our study represents the upper limit of the estimate.

Our data show having a vision exam did not guarantee access to quality vision

Table 2
Private vision care professionals.

	Unit	Weighted average
Level of education	Years	12
Optician certification (advanced or higher)	Percent	46
Optician certification	Percent	30

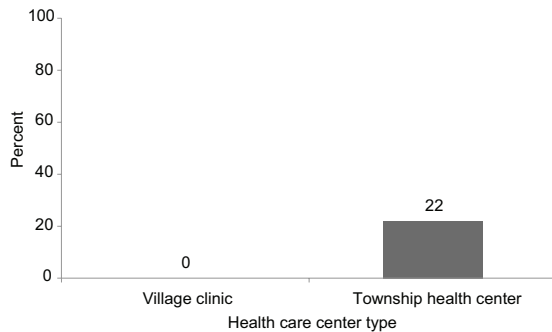


Fig 6A—Percent offering optometry services by health care center type

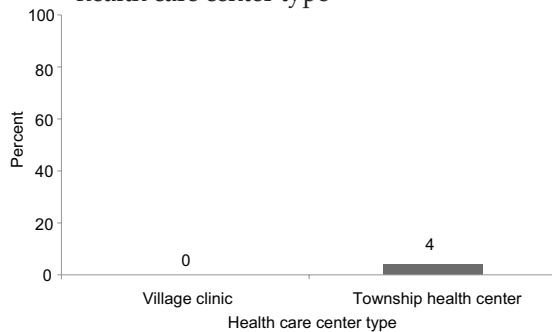


Fig 6B—Percent offering optician services by health care center type.

care (Fig 5B). Nineteen percent of those who had poor vision, wore glasses or had a vision exam were examined only with a vision chart (E-chart). Fitting eyeglasses based only on an autorefractor examination can be problematic (Zhao *et al*, 2004). Only about half of the eyeglasses prescribed were done so after having a complete eye exam. These findings are similar to another study (Congdon *et al*, 2008b).

There is little data regarding the quality of school based vision care in rural

China. This lack of data is because schools rarely record information about examinations undertaken on their premises. There is even less data from local county bureaus of education or health. Sharma *et al* (2008) found government-run vision screening programs in China's rural schools to be deficient, accurately identifying vision problems in less than 30% of children with vision problems.

Our results show the place where young people have vision exams, at school, does not influence the prevalence of wearing eyeglasses. Our interviews with school principals support this finding. They stated representatives from township health clinics with an unknown level of training arrive at the schools and conduct vision assessments on 200 to 300 students at a time. The assessments are done with a vision chart only. They last from one to three hours, despite the large number of students examined. Then, they frequently report only 1%-2% of students have vision problems, much lower than found in ours and other studies (20%) (Yi *et al*, 2013). Neither the school nor the health care providers communicate with parents.

Quality of care is a significant concern among rural private optical shops. Each optical shop is required to have two types of certification: optometry certification (to be allowed to provide eye exams) and optician certification (to be allowed to edge and dispense glasses). Both of these clas-

sifications have several tiers, the lowest of which can be secured by an employee by taking a short course. Advanced classifications require an employee to have had accumulated at least ten years of experience. In our study, fewer than half of private optical shops had advanced certification in optometry and fewer than a third had optician skills; the average employees had little more than a high school education. This shows that even top private optometrists in poor rural areas had low levels of formal schooling and professional certification.

No villages and only one in 20 townships provided public vision care services in our study. Four out of five rural residents have to travel to their county seat to obtain vision care service. The costs associated with making this trip, combined with the apparent misunderstanding of the benefits of eyeglasses reduce the frequency these services are sought. If the services are sought, the poor quality of service provided makes the effort of obtaining the service less.

Our data show school vision examination programs in China are ineffective. The ratio of eye doctors in the government health system to the population in poor counties is insufficient for adequate care.

Attention given to vision problems in rural China by national and provincial leaders is inadequate. The government has the responsibility to monitor and certify optometrists and ophthalmologists. It is unclear whether the public or private sector is better suited to meet the vision care needs of rural China. The lower population density and purchasing power of the rural communities are barriers to obtaining private sector care. However, public-private partnership could provide high quality screening at a central location, such as a school.

Subsidies to offset the cost of vision care in rural townships or counties may be needed to provide necessary vision care. Public health workers can play a role in communicating the importance of vision care to the rural population, who may be wary of similar overtures by the private sector. It is important to begin looking for solutions to this vision care problem.

In summary, our findings show that rural China has a vision care crisis. We estimate at least 215 million individuals in rural China aged 5 years and above have inadequate vision. A large fraction of those with inadequate vision are not being treated or are getting incomplete or poor quality treatment.

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