Elimination of blinding trachoma in China

Eradication du trachome cécitant en Chine

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Summary
Objective. — To present the change in the prevalence of blindness caused by trachoma between 1987 and 2006 by secondary data analysis based on two China National Sample Surveys on Disability (CNSSD).
Methods. — Secondary data analysis was performed on two China National Sample Surveys on Disability (CNSSD), which were national representative household surveys conducted in 1987 and 2006. The prevalence of blindness caused by trachoma was estimated by 10-year age group. In addition, the proportion of various causes of blindness was evaluated. The geographical distribution of blindness caused by trachoma both in 1987 and 2006 was analyzed in order to visualize the hot spots of blinding trachoma in China.
Results. — The prevalence of blindness caused by trachoma in China decreased from 51.5/100,000 in 1987 to 17.6/100,000 in 2006. In addition, the proportion of blindness attributed...
Introduction

Trachoma is an eye infection caused by Chlamydia trachomatis. The chronic inflammation of the eyelids induces scarring of the conjunctiva that can subsequently cause entropion and trichiasis with eyelashes scratching the cornea. Eyelashes as well as other alterations of the ocular surface can cause severe ocular pain, corneal opacity and consequently vision loss [1]. According to the estimation of the World Health Organization (WHO) in 2003, active trachoma affected nearly 84 million people worldwide with 7.6 million people having end-stage trachoma, of which about 1.3 million suffer from blindness [2].

Fortunately, previous studies showed that trachoma is a preventable cause of blindness, and the prevalence in the world has significantly decreased [3]. Poor personal and community hygiene are closely associated with the transmission of Chlamydia infection that leads to trachoma, especially in poor rural areas of many developing counties. The Alliance for the global elimination of blind trachoma by the year 2020 (GET 2020) established by WHO in 1997, recommended the SAFE strategy for trachoma control: surgery for trichiasis, antibiotics to treat Chlamydia trachomatis infection, facial cleanliness by personal hygiene and environmental improvement with education and improved local economy [4]. Over the past decades, lots of progresses have been made. According to the current WHO estimates, the prevalence of trachoma as well as blindness caused by trachoma has been decreased. However, there is little recent information available for India and China [5].

There are different epidemic research approaches recommended by WHO to investigate the prevalence of trachoma and leading blindness, including population-based prevalence surveys (PBPS) [6], trachoma rapid assessment (TRA) [7] and acceptance sampling trachoma rapid assessment (ASTRA) [8]. All these methods have their own advantages and disadvantages, but population survey is the gold standard method to provide the most relevant information for policy makers and health workers [1]. As estimated, half of the global burden of trichiasis is concentrated in three countries: China, Ethiopia and Sudan [4–8]. In fact, the SAFE strategy has been implemented in China since 1970s, especially during the past two decades. With the
rapid economic growth, the reform of Chinese healthcare policy and permanent urbanization, blinding trachoma was about to be eliminated from China. However, although there are numbers of prevalence surveys in different provinces and counties [9–12], national population-based prevalence survey on trachoma are lacking.

Therefore, we decided to evaluate the change in the prevalence of blindness caused by trachoma based on China National Sample Surveys on Disability (CNSSDs) performed in 1987 and 2006. CNSSD were nationwide sampling surveys performed to determine the prevalence of disability and needs for rehabilitation in China. Although CNSSD was not a specialized population-based survey on trachoma, it provided a national representative sampling survey on blindness and its causes. Secondary data analysis based on two CNSSDs would give accurate information on the prevalence of blindness caused by trachoma in China and its evolution in the past decades.

Methods

Ethical statement

The surveys were a routine public health practice to determine the prevalence of disability, including blindness and its causes. The Chinese Federal Ministry of Health approved the survey protocol and verbal consent procedures. Verbal informed consent to participate was given by the head of the household, each individual and parents of children in accordance with the declaration of Helsinki. Consent for household interviews and trachoma examination was documented by interviewers and examiners on the data collection forms.

Study site

China is the largest country in Asia covering an area of 9.6 million square kilometers. The 1987 survey was undertaken in 441 counties (districts), which together compose of 1.50% of the total Chinese population. In 2006 years, a total of 5964 communities from 2980 towns in 734 counties were sampled, with approximately 420 persons in each community.

Sampling

Secondary data analysis was performed based on two CNSSDs, which were national-representative household surveys conducted in 1987 and 2006. The 1987 survey sampled 1,579,314 subjects in 369,816 households from 441 counties, covering 1.50% of the total Chinese population [13,14]. The second stratified sample contained 2,526,145 subjects from 771,797 households (1.93% of the total Chinese people) in 2006 [15]. Four levels of sampling frame were used in both of the two surveys, including county or district of a city, town, village and community. Finally, a total of 5964 communities from 2980 towns in 734 counties were sampled, with approximately 420 persons in each community.

The results of post-survey quality checks showed that the sample was representative of the whole country and the data was reliable [16,17]. Considering the multi-stage of the stratified sampling, weight process was used to ensure that prevalence was correctly estimated. Details of both sampling and weighting processes have been described previously [13]. Data were extracted from two statistical reports based on two sampling surveys conducted in 1987 and 2006 respectively [13].

Trachoma screening

Trachoma screening was conducted by local general doctors and ophthalmic medical assistants trained with the WHO simplified grading system [7]. Potential examiners underwent training to apply the simplified grading scheme led by an ophthalmologist experienced in trachoma grading. A reliability test was evaluated using a set of standardized photographs and an additional reliability study of 50 patients was performed after training. Examiners had to achieve at least 80% inter-observer agreement in identifying trachoma signs compared to the ophthalmologist to participate in the survey. All eligible household residents present on the day of the survey were invited to undergo eye examination. In these two studies, the diagnosis of trachoma based on WHO recommendations [7]: trachomatous inflammation follicles (TF, five or more follicles of >0.5 mm on upper tarsal conjunctiva), trachomatous inflammation intensity (TI, inflammatory thickening obscuring more than half the normal deep tarsal vessels), trachomatous conjunctival scarring (TS, the presence of easily visible scars in the tarsal conjunctiva), trachomatous trichiasis (TT, at least one eyelash rubbing on the eyeball or evidence of recent removal of in-turned eyelashes) and Cornea opacity (CO, opacity of the cornea involving part of the pupil margin). The five major signs issued by WHO in 1987 were used as diagnostic and grading criteria for trachoma. Blindness was diagnosed based on the same definition and criteria. Two levels of blindness was defined as follows [18]:

- level 1: visual acuity of 0.02 or less, or limitation of the visual field to an angle no greater than 5 degrees in the better eye;
- level 2: visual acuity between 0.02 and 0.05, or limitation of the visual field to an angle between 5 and 10 degrees, in the better eye.

The prevalence of the blindness caused by trachoma was calculated with the number of the blindness related to trachoma divided by the number of people in the survey.

Statistical analysis

Statistical analysis was conducted using SPSS 13.0 (SPSS, Chicago, IL). Descriptive statistics were used to examine the sample characteristics and the prevalence of trachoma signs. To compare the prevalence of blinding trachoma across 20 years, the age-specified prevalence of blindness caused by trachoma was presented. In addition, proportion of different causes of blindness was compared. In order to show the hotspots of blinding trachoma, the geographical distributions of blindness caused by trachoma both in 1987 and 2006 were localized with ArcGIS 10.1 software (ESRI, Inc. Redlands, CA, USA). Deeper color represented higher prevalence, yellow areas suggested the absence of cases, and blank areas indicated that the region was not included.
into the survey. All other statistical analysis was conducted under software of Microsoft Office Excel 2007 (Excel version 14, Microsoft Corp).

**Results**

Based on the first survey (1,579,314 subjects, 1987), major causes of blindness were cataracts (46.07%) followed by corneal disease (11.44%), trachoma (10.12%) and refractive errors (9.73%). But the 2006 blindness cause survey revealed that cataracts (55.24%), retina, vitreous disease (10.28%), corneal disease (6.50%) and refractive errors (5.47%) were the main causes of blindness.

Between 1987 and 2006, the causes of blindness were quite different (Fig. 1). Especially trachoma, 10.1% of blindness was due to trachoma in 1987, with an important decrease to 0.9% in 2006. The overall prevalence of blindness caused by trachoma in China decreased from 51.5/100,000 in 1987 to 17.6/100,000 in 2006. Moreover, the blindness prevalence due to trachoma in each age group sharply decreased from 1987 to 2006. Table 1 shows the age-prevalence of blindness caused by trachoma. Few subjects were blind due to trachoma and the prevalence of blindness caused by trachoma among the population aged less than 40-year-old has decreased to less than 5/100,000. In addition, the prevalence of blindness caused by trachoma was still higher than 200/100,000 in 2006 only among population aged more than 80-year-old.

The prevalence of blinding trachoma according to the geographic localization is shown in Fig. 2. The data from two CNSSDs indicated that the blindness prevalence due to trachoma was higher than 200/100,000 in 38 sampled counties (8.6% of the 441 sampled counties) in 1987. In 2006, only 2.2% of sampled counties (16 of the 731 counties) have prevalence of blindness due to trachoma higher than 200/100,000.

Data of the 2006 CNSSD showed that the hotspots of blinding trachoma were limited to underdeveloped counties in Guizhou and Hubei provinces.

![Figure 1](image.png)

**Figure 1.** Relative causes of blindness in 1987 and 2006. Causes of blindness in 1987 (Fig. 1A), in which 10.1% of blindness attributing to trachoma; causes of blindness in 2006 (Fig. 1B), in which 0.9% of blindness attributing to trachoma.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Prevalence of blindness caused by trachoma in China.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>1987</td>
</tr>
<tr>
<td>Number of case</td>
<td>Number of sample</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>7</td>
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<tr>
<td>20</td>
<td>7</td>
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<td>8</td>
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<td>80</td>
<td>93</td>
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<td>Total</td>
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</tr>
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</table>
Discussion

Trachoma has long been known to be prevalent in parts of China. The severe cases can suffer from blindness. So, surveys are essential for quantifying disease prevalence and monitoring the blindness trachoma cases. Based on the 2011 provisional country reports from the 53 countries, the World Health Organization (WHO) estimated that 7.2 million have blindness trachomatis [19]. In China, secondary data analysis based on two CSSDs conclusively showed that the ratio of blindness caused by trachoma had significantly decreased from 10.1% in 1986 to 0.9% in 2006. Blinding trachoma is no longer one of the main causes of blindness at present, different from in 1987.

Last century, trachoma was widespread in China owing to economic issues and poor sanitation. In 1956, Prof. Feifan Tang and Xiaolou Zhang first discovered and isolated Chlamydia trachomatis, which clarified the cause of trachoma [20,21]. The discovery of Chlamydia laid a foundation for the prevention and treatment of trachoma, including the studies on microorganism typing, toxins, serological properties, pathogenic mechanism, local immunity and the development of vaccines and preventive measures from the perspective of clinical service and public health [22–25].

In China, the prevention and treatment of trachoma was tailored to its national conditions, as the Chinese government continuously increases investment in rural medical force development and rural medical insurance system. Chinese government implements the prevention of blindness and offers to more patients with trachoma to get surgery for trichiasis and antibiotics to treat Chlamydia trachomatis infection. Most of these works and efforts were financially and technically supported by the WHO with some projects, for example, “National Plan for the Prevention and Control of Trachoma”, “Eliminating blinding trachoma in China before 2016”, “Vision First, China Action”, etc. From September 1999, the Chinese government initiated with WHO health program to eliminate avoidable blindness by 2020, taking the elimination of blinding trachoma as one of its main goals. China put forward the strategy of combining prevention and treatment of trachoma with National Patriotic Health Campaign and advocated preventive measures, such as one towel for each person, face washing with running water, refraining eye rubbing with hands, use of clean water, concomitantly with the SAFE strategy of WHO. Meanwhile, the Chinese government set up a rural medical insurance system with an effective urban-rural medical network. Finally, training courses for health care professional on simplified WHO trachoma grading system and SAFE strategy were developed with documents, videos and courses. Similarly, moreover, population education programs aiming at improving the awareness of the general public in the prevention and treatment of trachoma was developed. So, with the development of Chinese economic and health, the
prevalence of blinding trachoma was remarkably declining. It was believed that the combined health and development approach would rapidly eliminate blinding (endemic or hyperendemic) trachoma. In a few regions of the world, like Mexico, Morocco, and Oman, trachoma had been successfully controlled with the same method [26]. Although achievements have been made in the prevention and control of blinding trachoma, there are still few prevalence hotspots of trachoma in China, limited in some underdeveloped mountainous areas [27,28]. For example, the blindness prevalence due to trachoma is more than 20 per 100,000 in some areas, including Zhongjiang County in Sichuan, Chaling County in Hunan and Zhuxi County in Shanxi. Therefore, the elimination of blinding trachoma among population aged 40 years and younger is still mandatory as active trachoma is still prevalent in some underdeveloped areas.

According to WHO, trachoma is no longer considered a public health problem when the follicular response (FR) prevalence in children aged 1–9 falls below 5% and the prevalence of trichiasis in children aged 15 or more is less than 0.1% [29,30]. However, China national data about the prevalence of FR and trichiasis have not been reported until now. Mariotti et al. estimated the prevalence of active trachoma based on population-based assessments conducted in 10 provinces in 2005 to be 2.34% in children aged 10-year-old or younger, and concluded that China is a country with a huge burden of trichiasis considering the number of children (0.22 billion) [4]. Although China has reached the goal of eliminating blinding trachoma, it does not mean that China no longer has trachoma cases. However, since 2006 and the last evaluation survey, with the continuous improvement of hygiene and environmental improvements, the elimination of trachoma becomes a possible reality in China. Further efforts need to be made to promote simplified WHO trachoma grading system, trachoma rapid assessment, and SAFE strategies at a broader scale to prevent the recurrence of trachoma [31,32].

Disclosure of interest

The authors declare that they have no competing interest.

References


