Prevalence of pulmonary tuberculosis in western China in 2010–11: a population-based, cross-sectional survey

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Summary

Background Progress in tuberculosis control in China has been the slowest in western areas, which have the highest prevalence. We assessed the prevalence of pulmonary tuberculosis in the Xinjiang province, China, 10 years after introduction of a control programme based on directly observed treatment, short course.

Methods In this population-based, cross-sectional survey, we used a multistage stratified random cluster sample design to estimate the prevalence of smear-positive and bacteriologically confirmed (either smear positive or culture positive, or both) pulmonary tuberculosis among adults (aged ≥15 years) in Xinjiang who had been resident in their household for the last 6 months. The screening strategy and diagnosis followed WHO guidelines. We estimated prevalence by combining inverse probability weighting and multiple imputation of missing data. We compared our prevalence survey estimates with the ones from the 2010 China national pulmonary tuberculosis survey and the ones from a provincial pulmonary survey done in Xinjiang in 2000. The new smear-positive pulmonary tuberculosis notification rate in 2011 in Xinjiang was obtained to allow the calculation of patient diagnosis rate (PDR).

Findings Between Sept 1, 2010, and July 31, 2011, 31 081 individuals were eligible, of whom 29 835 (96·0%) participated in the survey. We identified 50 (0·2%) smear-positive and 101 (0·3%) bacteriologically confirmed pulmonary tuberculosis cases. The weighted prevalence of smear-positive pulmonary tuberculosis was 170 (95% CI 103–233) per 100 000 people and of bacteriologically confirmed pulmonary tuberculosis was 430 (249–611) per 100 000 people. Compared with 2000 Xinjiang survey estimates, the prevalence of smear-positive pulmonary tuberculosis has decreased by 26·4% (from 231 [95% CI 148–314] per 100 000 people), whereas the prevalence of bacteriologically confirmed pulmonary tuberculosis has increased by 17·8% (from 365 [237–493] per 100 000 people). In each age group and sex, the pulmonary tuberculosis prevalence was higher in the 2010–11 Xinjiang survey than in the 2010 national survey. The PDR in 2011 was 0·34 (95% CI 0·25–0·44).

Interpretation Despite progress in other parts of China, the prevalence of pulmonary tuberculosis in Xinjiang remains high. The very low PDR suggests poor access to diagnosis and care. Further studies are needed to understand the barriers to diagnosis and care of this population, and efforts are urgently needed to enhance tuberculosis screening in this area.

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Introduction

Tuberculosis remains a major global health problem, responsible for ill health among millions of people each year, particularly in low-income and middle-income countries. Of the estimated 9·6 million people who developed tuberculosis globally in 2014, India accounted for 23% and China accounted for 10%.[1] During the past two decades, China has implemented a large-scale tuberculosis control programme to address its growing tuberculosis problem. This programme is based on directly observed treatment, short course (DOTS), and was implemented in 13 provinces of China in the 1990s and expanded nationwide after 2000.[2] Analysis of the 2010 national pulmonary tuberculosis prevalence survey in China indicated that scale-up of the DOTS strategy in China led to a decline in the prevalence of smear-positive pulmonary tuberculosis by 48% and bacteriologically confirmed pulmonary tuberculosis by 65% between 1990 and 2010.[3] However, the smallest declines occurred in western provinces (Chongqing, Gansu, Guangxi, Guizhou, Neimeng, Ningxia, Qinghai, Shanxi, Sichuan, Tibet, Xinjiang, and Yunnan), where the pulmonary tuberculosis prevalence was the greatest.[4]

The Xinjiang Uyghur Autonomous Region (Xinjiang) is located in northwestern China, with international borders with Russia, Mongolia, Kazakhstan, Kyrgyzstan, Tajikistan, Afghanistan, Pakistan, and India, with a population of 20 million people and 13 ethnic minorities. It is one of the provinces known to have a high burden of tuberculosis. A pulmonary tuberculosis survey done in Xinjiang in 2000 showed that the prevalence of smear-positive pulmonary tuberculosis among adults (aged ≥15 years) was 231 per 100 000 people and of bacteriologically confirmed tuberculosis was 365 per 100 000 people.[5,6] The DOTS strategy was introduced in some counties in Xinjiang in the 1990s and expanded to the whole region after 2000.

The effect that DOTS has had on the burden of pulmonary tuberculosis in Xinjiang was not clear from

Research in context

Evidence before this study

We searched MEDLINE, Embase, Google Scholar, and some key Chinese databases WanFang and ZhiWang for studies published from Jan 1, 1945, to Oct 20, 2015, with the search terms "tuberculosis", "pulmonary tuberculosis", "infectious disease", "survey", "provincial survey", "prevalence", "China", and "Asia". We searched for studies published in Chinese in the Chinese databases and those published in English in the other databases. To maintain relevance to current efforts in tuberculosis care and control and given that 1990 is the baseline year for 2015 global tuberculosis targets, we focused on national surveys done between 1990 and 2012 in Asia and provincial surveys done in China. Globally, 21 surveys were done in 12 countries, and published results were available for 18. Four countries (China, Cambodia, South Korea, and the Philippines) have repeated national surveys since 1990 and have shown declines in the prevalence of smear-positive and bacteriologically confirmed pulmonary tuberculosis by 50% over 10 years. In China, the Ningxia, Gansu, Guangdong, Henan, Jiangsu, and Shandong provinces did separate provincial surveys after the fifth China national pulmonary tuberculosis survey in 2010. The prevalence of bacteriologically confirmed pulmonary tuberculosis among adults aged 15 years or older was similar in Ningxia, Gansu, Guangdong, Henan, and Jiangsu (range 63 per 100 000 people to 79 per 100 000 people) and lowest in Shandong (30 per 100 000 people). These provinces have also done repeated provincial surveys since the 1990s, and all reported that the prevalence of both smear-positive and bacteriologically confirmed pulmonary tuberculosis has declined by more than 50% since the 1990s.

Added value of this study

This study provides new data on the burden of pulmonary tuberculosis in the Xinjiang province of western China. The results show that the prevalence of pulmonary tuberculosis is quite high in Xinjiang compared with other parts of China. Ethnic minorities, men, and those living in rural southern Xinjiang are at an increased risk. A small decline in smear-positive prevalence and a small increase in bacteriologically confirmed prevalence after implementation of DOTS-based tuberculosis control programmes for 10 years indicates that progress in tuberculosis control in western China has been small.

Implications of all the available evidence

Although China has achieved a 50% reduction in pulmonary tuberculosis prevalence nationally since the 1990s, regional disparities are large, and the burden of tuberculosis in western China remains high. Low case detection rates with DOTS indicate that a substantial number of tuberculosis cases in western China are still undetected, meaning that DOTS might not be effectively implemented in western China where people, health infrastructure, and human resources in tuberculosis care are poor.

the 2010 national survey as only three of the survey clusters (roughly 1500 participants per cluster) were from Xinjiang, a sample size too small to produce precise estimates. Therefore, a population-based pulmonary tuberculosis prevalence survey with more extensive sampling was done by the Xinjiang Uyghur Autonomous Region Health Bureau (or Health and Family Planning Commission of Xinjiang Uyghur Autonomous Region after 2015) and Xinjiang Center for Disease Control and Prevention (CDC) to measure more precisely the burden of pulmonary tuberculosis in Xinjiang than the 2010 survey. Preliminary findings were reported by Yang and colleagues.[6] In this report, we present a more detailed analysis than that of Yang and colleagues of the prevalence of smear-positive and bacteriologically confirmed pulmonary tuberculosis and the demographic determinants of bacteriologically confirmed pulmonary tuberculosis. We also report the patient diagnosis rate (PDR), an indicator of case detection performance of tuberculosis control programmes.[7,8]

Methods

Study design

In this population-based, cross-sectional survey, we estimated the prevalence of smear-positive and bacteriologically confirmed pulmonary tuberculosis in adults (aged ≥15 years) in Xinjiang using a multistage stratified random cluster sample design. To confirm local residency and to exclude the mobile population, we considered all adults who had been resident in their household for at least the last 6 months eligible for survey participation. We stratified the province into urban (cities), semi-urban (towns), and rural areas (townships). We allocated six clusters to urban areas, seven to semi-urban areas, and nine to rural areas, which was proportional to the population of each stratum.[9] We defined a cluster as a community (defined by postal code) in a city, town, or village in a township. Within each stratum, we first selected cities, towns, or townships with probability proportional to size. Within the selected cities or towns, we first selected streets with probability proportional to size and then communities within streets with simple random sampling done with Stata 13.0, assuming that communities within the same street have similar population sizes. Within the selected townships, we selected villages with simple random sampling with Stata 13.0 on the basis of the same assumption above. This method gave an approximately self-weighting design. In each community or village, we visited all households. If the population of eligible individuals in a cluster was fewer than 1500 people, then we added part of the next adjoining village or community to reach the