Knowing the true burden of disease is essential in the fight against tuberculosis: This is the story of the second largest disease prevalence survey ever conducted which took place in Pakistan.
Pakistan ranks 5th among the 22 highest tuberculosis (TB) burden countries in the world. In 2012, the World Health Organization (WHO) estimated the number of patients developing TB disease each year (incidence) as 231 per 100,000 per year, with a lower and upper margin of 190 and 276 (using a 95% confidence interval [CI]). The number of TB patients at a certain point in time (prevalence) was estimated at 350 per 100,000 people, with a lower and upper margin of 158 and 618 (using a 95% confidence interval). More than two decades have passed since the last TB prevalence survey was conducted in Pakistan and in order to get a more precise estimate of the TB prevalence and its trend over time there was a need to conduct another survey.

The primary objective of the survey was to estimate the prevalence of bacteriologically confirmed pulmonary TB amongst the adult population (15 years and older) in a nationwide representative survey conducted from 2010-2011. Preparations for the survey started in 2008, through TB CARE I, and KNCV Tuberculosis Foundation (KNCV) was contracted as the main technical partner. KNCV provided support for all aspects of the survey, from developing the technical approach and methodology of the study (the protocol), to data collection, data cleaning, data analysis and report writing.

Protocol development started in February 2009. In order to get a reliable and nationally representative prevalence estimate, 95 sub-districts (tehsils) were selected in such a way that the most populated sub-districts had a higher chance of being selected than less populated sub-districts (random weighted selection). In each sub-district, a cluster of 1,400 individuals of 15 years and older was randomly selected, resulting in a sample size of 133,000 persons, which made this the second largest prevalence survey ever conducted, after China.

Given that not all districts of Pakistan were considered safe enough to be included in the survey, adjustments were made to accommodate this. The Federally Administered Tribal Areas, Dera Bugti district in Balochistan, and 17 subdistricts in Khyber Pakhtoon Khwa, inhabited by 6.5% of Pakistan’s population, were excluded because of security concerns. Five additional clusters were randomly selected as replacement clusters, in the event that districts became inaccessible for security reasons during the field work. In the end, three clusters (all located in Balochistan) needed to be replaced. A private company was contracted to carry out a security assessment of the highest-risk areas and based on their assessment, security guidelines for data collection staff were published.

Seven mobile digital X-rays were procured through an international bidding process, supported by KNCV and a professional procurement agent. The first tender had to be annulled because it was found that the winner had provided incorrect information, causing a delay of six months. In the summer of 2010, when the preparations for
field work were in full swing, the worst floods in 80 years struck the country, covering about one-fifth of Pakistan’s total land, affecting 20 million people and causing 2,000 deaths. The prevalence survey team then assessed how severely the selected clusters had been affected by the flood. As most of the 95 selected clusters were not affected by the flooding, it was decided to proceed with the survey preparations and visit the 12 worst affected clusters in Sindh at the end of the survey.

The first pilot was conducted in August 2010 in one cluster. A second pilot was conducted in November 2010 because the first pilot had an unexpectedly low participation rate of 54%, whereas 80% is considered the minimum requirement. Several actions were taken to increase the participation rate, such as expanding the opening hours of the survey booth into the evenings, retraining of census teams to improve their communication about the survey, giving benefits to participants (e.g., the provision of free medicines to symptomatic participants), engaging local leaders in motivating the local community to participate, provision of free transportation to persons living relatively far away from the screening site, and giving children a small present at the screening site, which encouraged their parents to visit. All of these actions contributed to achieving a participation rate of 81% in the second pilot. In January 2011, the TB prevalence survey field work finally started and continued without any delays until December 2011.

Experts from KNCV conducted more than 20 technical missions to help develop the protocol and standardize all the survey procedures, monitor the data collection and data entry, check the collected data for completeness and consistency, and assist in data analysis and reporting. The work was being supported in Pakistan by a team of KNCV country nationals that assisted the National TB Program (NTP) with supervision and monitoring of data collection, and by providing input to expert review committee missions.

All 95 selected clusters were visited between August 2010 and December 2011 as planned. There were six field teams that simultaneously conducted field work, doing one cluster at a time. The fieldwork lasted 14 days per cluster and started with a household inventory and head count (census) followed by screening for signs and symptoms, digital chest X-ray and a questionnaire. Those eligible for sputum examination were on TB treatment at the time of the survey, had a cough for more than two weeks and/or had abnormal X-ray shadows. Those with a cough of any duration who, for any reason, did not have a chest X-ray or whose chest X-ray image was not interpretable were also requested to submit a sputum sample. Two sputum-smear specimens were requested (one immediately and another one the following morning) for sputum smear microscopy and culture examinations. Bacteriologically confirmed patients were those who had the TB bacillus (*Mycobacterium tuberculosis*) in their sputum, TB bacilli grown in culture or acid-fast bacilli found by microscopy. Data were entered in a computer program (EpiData Association, Odense, Denmark) and data analysis was done with another software program (Stata version SE 11.2, Stata Corporation, College Station, TX, USA).
Data collection teams and their equipment had to travel long distances between clusters, often on poorly maintained roads, challenging the sturdiness of the X-ray equipment. One machine developed a mechanical problem, which was repaired by the service provider, but as the survey had one spare machine, survey operations were not affected. The teams also faced extreme weather conditions in the summer and winter in the Northern mountainous areas. The most remote clusters in Sindh were reached in July 2011, when temperatures were sometimes over 45°C. Together with the relatively long transportation distances, maintaining a cold chain before and during specimen transportation—which is needed to keep *Mycobacterium tuberculosis* alive and grow it on culture—was a real challenge.

Furthermore, many participants weren’t able to speak Urdu (the lingua franca of Pakistan), and local health workers, who spoke the local language, turned out to have little understanding of the survey, and sometimes translated the screening questions incorrectly.

While the national KNCV team could visit all clusters, the international consultants were only able to visit the pilot sites and the first two cluster sites for security reasons. After December 2010, security reasons also prevented field visits by external consultants for general quality assurance and on adherence to the SOPs for data recording and reporting.

Key data were collected on up to eight different paper forms which needed to be merged using a unique participant identification number (PIN), consisting of cluster number, household number and participant number. The data on the forms could only be merged after completion of a cluster, with errors in the PINs only being identified after attempts to merge the data for data analysis. Major problems were discovered with PIN allocation, as many participants were not listed in the census data lists from which they should have been recruited. Other errors eventually made it necessary to recheck all PINs on all forms and registers against names, father names and recorded age. After the field work was completed in December 2011, this work took the data management unit several months to resolve and resulted in a decrease of 2,063 persons, taking the sample population to 131,377 persons, but also led to a slight increase in the participation rate from 79.6% to 80.7%.

Out of 131,377 persons, 131,329 were eligible to participate in the survey, as they were 15 years or older and mentally able to fully participate. Of these 105,913 (81%) participated in the survey. Eligible females were more likely to participate (88%) than eligible males (72%); this is a statistically significant difference; *p*<0.001. The participation rate was fairly similar in the different age categories. In total, 10,471 (10%) participants were eligible for sputum examination, from whom 8,521 (81%) submitted at least one sputum specimen. Of these, 341 had a positive bacteriological result: 207 were sputum-smear positive and culture positive for TB; 26 had probable TB (two positive smears or one positive smear plus an abnormal X-ray image); and 108 had smear-negative culture positive TB.

Based on these data, the prevalence of bacteriologically (sputum-smear and culture) confirmed pulmonary TB was estimated at 361 per 100,000 persons (with a 95% CI of 308-414/100,000), while the prevalence of smear-positive TB was estimated at 252 per 100,000 (95% CI, 205-298). These figures are in range with the rate previously estimated by WHO in 2011 (350/100,000, 95% CI 158-618), but with a much narrower CI. Of the 315 TB culture-positive persons, 7.6% were on treatment for TB at the time of enrolment in the survey. Based on the number of notifications reported by NTP, the estimated case detection rate was 45.1%. This means that only 45% of the patients with pulmonary TB were notified to NTP within a period of one year.
This TB prevalence survey in Pakistan was the second largest TB survey ever conducted. It was conducted despite political insecurity and serious floods. Nonetheless, because of the good collaboration between KNCV and the NTP, the survey was successfully conducted with an acceptable participation rate and data quality, as well as high quality laboratory data. The data cleaning and validation steps were cross-checked by representatives from WHO headquarters and considered to meet international standards.

The survey findings reaffirm, but now with more precision than before, that case-detection in Pakistan is well below the target of at least 70%. This is largely due to either under-diagnosis or under-notification of patients diagnosed and treated in the flourishing private health care sector. The finding of a higher prevalence of TB patients among males compared to females (365 versus 246 per 100,000 population) points to a need to expand access to services for TB diagnosis. For example, the public sector health care facilities currently only offer services in the morning hours, which is a barrier for the mainly male working population. This can be overcome by expanding diagnostic and treatment services in time and place, through better cooperation between the Ministry of Health and the private health care sector.

The relatively high TB prevalence in older age groups and in rural areas demonstrates the need for improved case-finding by actively engaging trained community health workers in suspect identification and referral. Sixty-eight percent of all TB patients diagnosed in the survey had sputum-smear positive TB (which is generally regarded as more advanced disease than sputum-smear negative TB), and most of them were not on TB treatment. This suggests that there is insufficient understanding by the population of the symptoms and signs of TB disease, or financial barriers, that result in delayed health care seeking or even no care seeking. In addition health care providers may fail to recognize the signs and symptoms of TB early enough to initiate diagnostic examination, or referral of the patient. These findings call for improving awareness about disease symptoms, making TB care free and easily accessible, and contact tracing in the community, in combination with training of health workers. Further analysis of the determinants of health seeking behavior and alertness among the health care providers, will help the program to design interventions to improve case detection.

You can download and read the full survey report here:

Download Full Survey Report

Contact Details

E-mail pmu@tbcare1.org
Phone +31-70-7508447
Website www.tbcare1.org
Twitter @tbcare1

TB CARE will contribute to three USAID target areas:

- Sustain or exceed 84% case detection rate and 87% treatment success rate
- Treat successfully 2.55 million new sputum-positive TB cases
- Diagnose and treat 57,200 new cases of multi-drug resistant TB (MDR-TB)

By focusing on eight priority technical areas:

- Universal and Early Access
- Laboratories
- Infection Control (IC)
- Programmatic Management of Drug Resistant TB (PMDT)
- TB/HIV
- Health Systems Strengthening
- Monitoring & Evaluation (M&E), Operations Research (OR) and Surveillance
- Drug Supply and Management

And four over-arching elements:

- Collaboration and Coordination
- Access to TB services for all people
- Responsible and Responsive Management Practices
- Evidence based M&E