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# Preoperative work up: are the requirements different in a developing country?

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# Prevalence of pulmonary tuberculosis on the roof of the world

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## SUMMARY

**SETTING:** The Shimshal Valley, a remote village in Northern Pakistan, is one of the seven Pamirs of Central Asia, widely known as the roof of the world.

**OBJECTIVE:** To investigate the prevalence of pulmonary tuberculosis (TB) in the Shimshal Valley.

**DESIGN:** The Rapid Village Survey Method (RVS) was used to investigate the prevalence of pulmonary tuberculosis. The selection criteria were chronic cough, hemoptysis, past history of TB and close contact with a tuberculous patient. After clinical examination, a chest radiograph was done and a single spot sputum sample was obtained for smear examination.

**RESULTS:** The total population of the village was 1077, of whom 231 cases were studied. Overcrowding affected

75% of the study population. The prevalence of smear positive pulmonary TB in the village studied was 554 per 100 000 population, and the prevalence of active smear-negative TB was estimated at 1949/100 000. The prevalence of active pulmonary TB increased with age and the only risk factor for active TB was age over 45 years. Of the 21 cases with a past history of pulmonary TB, only 38% had completed a full course of chemotherapy.

**CONCLUSION:** Pulmonary TB is a very serious health issue in the rural community (Shimshal Valley) of Pakistan. This study highlights the lack of efficacy of national tuberculosis control programs in the country.

**KEY WORDS:** tuberculosis; prevalence; rapid village survey

THERE HAS BEEN a global resurgence of tuberculosis (TB) in the last decade and the vast majority of these TB cases occur in the impoverished countries of Asia, Africa and South America.<sup>1</sup>

Pakistan is a developing country with a population of 130 million people. In this country 1.5 million people suffer from TB, and more than 210 000 new cases occur each year.<sup>2</sup> At present, only 1 per cent of central government expenditure is spent on health care, and over half the country has little or no access to health care. Until recently there were no official guidelines for tuberculosis control in Pakistan, and there is serious concern that drug resistance is likely to increase at an alarming rate.

Shimshal Valley is a remote village in the Northern Areas of Pakistan, situated in the neighborhood of the Peoples' Republic of China, the former USSR, India and Afghanistan. The eight great mountain ranges including Karakoram, Hindukush, Himalaya and Pamir converge on this land of rocks and glaciers. Shimshal Pamir is one of the seven Pamirs of Central Asia, well known as the roof of the world. It is at an elevation of 7800 feet above sea level and at a distance of 45 kilometers from Karakoram highway, which links Pakistan to the other Central Asian States. The hardship endured by the people of the

region can be illustrated by the fact that there is not a single road to Shimshal Valley that is traversible on horseback. One therefore has to walk for 36 hours through the rocky mountains to reach the valley. According to a survey in 1996, pulmonary TB was the leading cause of death among adults in this region, whereas pneumonia was the leading cause of infant mortality (School research group. Mortality, morbidity and birth rate in Shimshal Valley. Unpublished data).

The objective of our study was to investigate the prevalence of pulmonary TB in Shimshal Valley using the Rapid Village Survey method.

## MATERIAL AND METHODS

### *Planning and organization*

Before starting field activities, a series of meetings was held with members of the Aga Khan Health Services, Pakistan (AKHSP) and the Government Health Department, Northern Areas of Pakistan (GHDNAP), to assess feasibility of the survey and funding. The funding for X-ray films and laboratory supplies was provided by AKHSP, a portable X-ray machine by GHDNAP, and the Aga Khan Foundation provided

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transportation by helicopter between the nearest town (Gilgit) and Shimshal Valley. The fuel for the electric generator, food and accommodation was arranged by the village volunteer service.

The final study design was approved after discussion with an epidemiologist and a pulmonologist. The work was carried out by a team consisting of a general surgeon, a resident family physician, three laboratory technicians, two lady health visitors, two health workers and a group of dedicated volunteers.

#### *Rapid Village Survey method (RVS)*

The study design was based on the experience of RVS for case finding in the control of pulmonary tuberculosis and leprosy by Elink Schuurman<sup>3</sup> and Tumbelaka.<sup>4</sup> This method is cost-effective and the overall accuracy is similar to the total village survey (TVS) method. The RVS team reached the village on 26 June 1996, and a meeting was held with the village president, health workers and volunteer services. The survey was planned over a five-day period. The health workers performed a door-to-door visit in the village, identified the villagers who fulfilled the selection criteria (as defined below) and invited the villagers, via a standard message, to report to the RVS center. Information about the schedule of the study was also conveyed by the radio broadcasting services. There was no registered medical practitioner in the village, and thus the survey provided the villagers with a unique opportunity to see a qualified physician.

The basic demographic data were provided by the village school research group. Data about symptomatic and high risk populations were gathered from the records of health workers. The demographic data were recorded by the medical health workers and the history and physical examination were done by a general surgeon and a family medicine resident. A portable chest radiograph was performed and a single spot sputum sample was obtained in the clinic. Free medicines were distributed for common illnesses, and difficult cases were referred to tertiary care centers in other parts of the country. The RVS team departed on the sixth day of the visit.

#### *Selection criteria*

The selection criteria used in the survey included: history of chronic cough (more than three weeks' duration), history of hemoptysis, past history of pulmonary TB, and close contact with a TB patient.

All subjects who had one or more of the above selection criteria were identified during door-to-door visits by the health workers and invited to attend the RVS center. At the end of day four, the lists of suspected cases were checked and the volunteers visited the houses of those who had not yet presented voluntarily to the RVS center. In this remote village we were able to screen all the suspected cases identified by the health workers.

#### *Definitions*

**Smear positive pulmonary TB:** A person with a smear positive for acid-fast bacilli (AFB), on a single spot sputum examination.

**Smear negative pulmonary TB:** A person with upper lobe infiltrates and/or cavitation on chest radiograph, in the absence of a positive sputum smear.

**Healed pulmonary TB:** A person with evidence of fibrosis and/or calcification on chest radiograph in the absence of the above criteria for active TB.

**Adult:** A person aged 15 or over.

#### *Statistical analysis*

The database was completed after the sputum AFB smears had been read by a consultant pathologist and the chest radiographs by a consultant pulmonologist. The data were coded and entered into a commercially available program, Excel 7.0. Statistical analysis was done with the help of an epidemiologist using a statistical software package (SPSS 4.0). The data were analyzed for evaluation of active and healed tuberculosis. Univariate analysis was done to assess the significance of risk factors for active pulmonary TB such as age, sex and overcrowding. The level of statistical significance was set at  $P < 0.05$ .

## **RESULTS**

The total population of the village was 1077, of whom 49.7% were male and 54.5% were adults. The overall literacy rate was 18.4%, 25.9% in males and 10.9% in females. The source of income was agricultural produce and livestock in 94%, and 6% were in service or business. The crude birth rate was 4.93% and crude mortality rate was 1.02% per annum.

The characteristics of the study population are summarized in Table 1. The majority of the population (75%) lived in overcrowded conditions (more than three persons per room). Chronic cough was present in 82% of the study population, of whom two-thirds had productive cough. A history of hemoptysis was obtained in 35% of cases. Physical examination revealed crepitations in 38 (17%), bronchial breath sound in 26 (11%), rhonchi in 17 (7%) and cervical lymphadenopathy in three (1%) cases. Of the 231 study subjects, a satisfactory chest radiograph was obtained in 212 (92%) and a single spot sputum sample in 109 (47%) cases.

Six sputum samples were smear positive and the prevalence of smear positive pulmonary TB in the village studied was 557/100 000. A further 21 cases had features of active TB based on radiological appearance, and the prevalence of smear negative active pulmonary TB was estimated at 1949/100 000 (Table 2). Based on radiological findings of pulmonary fibrosis and/ or calcification compatible with TB, the preva-

**Table 1** Characteristics of the study population in Shimshal Valley, 1996. (Total population = 1077)

Characteristic	n (%)
Population studied	231
Sex: Male	98 (42)
Female	133 (58)
Age: <15 years	18 (8)
15–45 years	134 (58)
>45 years	79 (34)
Past history of TB	21 (9)
Close contact with TB patient	159 (69)
Chest radiograph	
Normal	40 (17)
Active infiltrates/cavitation	23 (10)
Fibrosis/calcification	149 (65)
Poor quality/not obtained	19 (8)
Single sputum smear examination	
Smear positive	6 (2.5)
Smear negative	103 (44.5)
Sputum not obtained	122 (53)

lence of healed TB was estimated at 13 835/100 000 population. The prevalence of active pulmonary TB increased with age: the only significant risk factor for active pulmonary TB was age >45 years. Only 8% of the study population were in the pediatric age group, and no case of active pulmonary TB was found among them. In this village, 82% of children had received BCG vaccination.

Of the 21 subjects with a previous history of pulmonary TB, three (14%) were still sputum AFB positive on a single smear and 28% were symptomatic with active infiltrates and/or cavitation on chest radiograph. Only eight (38%) cases had completed a full course of anti-TB treatment.

## DISCUSSION

The results of our survey confirm that in this remote village, where 75% of the population lives in overcrowded conditions, pulmonary TB is a major health problem. The prevalence of smear positive pulmo-

nary TB (557/100 000) and smear negative TB (1949/100 000) is considerably higher than in other developing countries.<sup>5–7</sup> These smear positive patients continue to be a source of infection in the village, and when no treatment is provided each patient is expected to survive for about 2 years and to infect 10 to 15 further individuals each year.<sup>8</sup> During the period 1994 to 1996, 70% of the 24 adult deaths in the village were related to diagnosed or suspected cases of pulmonary TB. There was increased prevalence of pulmonary TB with increasing age, consistent with other studies from Asia.<sup>9</sup>

Our study also highlights the problem of poor compliance with treatment among patients known to have pulmonary TB. Only 38% completed a full course of anti-TB treatment. The reasons for poor compliance were unavailability of anti-TB medications, lack of a surveillance program for tuberculosis control, poor socio-economic conditions and low literacy rate. These partially treated patients remain a continuous source of TB infection, and could potentially promote the emergence of multidrug-resistant strains. In addition, as suggested by the Bangalore study, each year 10% to 15% of smear negative patients would be expected to progress to become smear positive.<sup>10</sup> The overcrowding observed in the study population would also be a strong risk factor for the spread of TB bacilli in the community.

Our study design using the RVS method has been validated for case finding in the control of pulmonary TB.<sup>3</sup> Shimshal Valley was considered a suitable site for RVS, and the local factors that contributed to the validity and success of the survey were: 1) a village isolated from the rest of the country where all the people lived closely together; 2) a preliminary survey was available about the suspected and high risk population; 3) a strong village organization, dedicated health workers and volunteer service ensured a successful survey, and health workers were able to visit each house in the village to invite people to participate in the survey; 4) in the absence of a qualified medical practitioner in the village, the RVS was a rare opportunity for people to be examined by a qualified doctor and obtain free medicine for common medical ailments.

Our study differed from that of Elink Schuurman et al.<sup>3</sup> in some aspects. We did not have the facilities to perform cultures on the sputum samples obtained. Instead we depended on radiographic findings to detect smear-negative active cases. The sensitivity of chest radiograph in detecting active and healed cases of TB has been described to be low in mass radiography.<sup>11</sup> Of interest is a follow-up study of nearly 300 Chinese subjects who were considered to have active TB on clinical and radiological features but were sputum AFB negative on five smear examinations. Over the next 30 months, 71% had active disease confirmed and another 15% had evidence of changing

**Table 2** Characteristics of patients with active TB

	Smear positive	Smear negative
Total number	6	21
Sex: Male	1	9
Female	5	12
Age: <15 years	0	0
15–45 years	3	5
>45 years	3	16
Close contact with a TB patient	5	12
Past history of TB	3	3
Chest radiograph		
Active infiltrates/cavitation	3	21
Fibrosis/calcification	3	0

lesions on serial chest radiographs, indicative of active disease.<sup>12</sup>

Secondly, compared to only 5% in their study, we screened nearly 20% of the entire village population, and believe that the chance of missing further symptomatic patients was small. Our study was, however, not followed by a total village survey. The prevalence of smear-positive cases among suspected individuals was similar in both studies, but the overall prevalence of smear-positive TB in the village was much higher in our study.

Our study has certain limitations. A single spot sputum sample was used for smear examination, potentially leading to an underestimation of disease prevalence. Ideally, three early morning sputum samples should have been collected, and this might have resulted in an even higher prevalence rate. However, in a study of smear-positive patients, 90% were found to be positive on their initial smear.<sup>13</sup>

Secondly, TB culture was not performed on the sputum samples obtained. Had resources been available, this would have helped us to define more accurately the prevalence of smear-negative, culture-positive cases, and to identify drug resistance patterns.

Thirdly, radiological features were used to define active and healed TB. We accept that a number of infectious, inflammatory, neoplastic and occupational diseases can mimic TB. Furthermore, patients with TB may have atypical presentations, and differentiation between active and healed TB may be difficult on radiological features alone. However, in a high prevalence region such as the Shimshal Valley, the commonest feature of reactivation TB is upper lobe infiltrates/cavitation,<sup>14</sup> and pleural/pulmonary fibrosis and calcification in the upper zones is usually secondary to remote TB infection.

Fourth, very few children were included in the study and this, coupled with difficulties in the interpretation of radiograph and smear examinations in children, may have resulted in a failure to identify any cases with active TB. The prevalence of active TB in children in the village remains unknown. Similarly, the prevalence of extra-pulmonary TB was not studied.

Finally, our study may have underestimated the prevalence of active TB due to sample selection (exclusion of asymptomatic cases, failure of some symptomatic cases to report to the RVS center).

In order to prevent the spread of disease and to decrease TB related mortality, we made the following recommendations to the AKHSP. 1) Urgent treatment of smear positive and treatment failure cases. The success of treatment should be monitored carefully according to WHO recommendations,<sup>15</sup> and the target of successful treatment should be 80–90% compliance. 2) Treatment should be fully supervised by the health care workers. 3) Health care workers from the same village should be trained to monitor short course chemotherapy, to record patient data and to

perform sputum AFB smears. 4) Treatment failure and relapses should be screened for multidrug-resistant bacilli. 5) Smear-negative cases with radiological features of active TB should also be treated. 6) New cases of pulmonary TB should be detected by a regular screening program, and all persons with productive cough should have three sputum smears for AFB examination. 7) BCG vaccination should be continued and its efficacy evaluated. 8) Chemoprophylaxis should be given to high risk cases who do not have active TB.

The successful implementation of a pulmonary tuberculosis control program in Shimshal Valley is possible through close collaboration between AKHSP and GHDNAP, but community participation will be the key to success. Implementation of our recommendations for control of pulmonary tuberculosis in Shimshal Valley was started in May 1997, and the program will strictly follow the WHO guidelines with emphasis on directly observed treatment and short course chemotherapy.

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## R É S U M É

**CADRE :** La vallée de Shimshal, un village éloigné du Nord Pakistan, est un des sept Pamirs de l'Asie Centrale, bien connu comme le toit du monde.

**OBJECTIF :** Investiguer la prévalence de la tuberculose pulmonaire (TB) dans la vallée de Shimshal.

**SCHEMA :** La Méthode d'Enquête Rapide pour les Villages (RVS) a été utilisée pour investiguer la prévalence de la tuberculose pulmonaire. Les critères de sélection furent la toux chronique, l'hémoptysie, les antécédents de tuberculose, ainsi que des contacts étroits avec un patient tuberculeux. Après examen clinique, un cliché thoracique a été pratiqué, et un échantillon unique de crachat a été obtenu sur place pour examen direct.

**RÉSULTATS :** La population totale du village comportait 1077 habitants, parmi lesquels 231 cas ont été étudiés. On a constaté une surcharge d'habitants chez 75% de la

population étudiée. La prévalence de la tuberculose pulmonaire à bacilloscopie positive fut de 554/100 000 habitants dans le village étudié, et la prévalence des tuberculoses pulmonaires actives à bacilloscopie négative a été estimée à 1949/100 000. La prévalence de la tuberculose pulmonaire active augmente avec l'âge, et le seul facteur de risque décelé pour une tuberculose active fut un âge au-delà de 45 ans. Des 41 cas avec des antécédents de tuberculose pulmonaire, 38% seulement avaient eu une chimiothérapie complète.

**CONCLUSION :** La tuberculose pulmonaire est un problème de santé très sérieux dans la communauté rurale de la vallée Shimshal au Pakistan. Cette étude éclaire le manque d'efficacité des programmes nationaux de lutte contre la tuberculose dans le pays.

## R E S U M E N

**MARCO DE REFERENCIA :** El Valle Shimshal, un pueblo remoto en el Norte de Pakistán. Es uno de los siete Pamirs de Asia Central, conocidos como el techo del mundo.

**OBJETIVO :** Investigar la prevalencia de la tuberculosis pulmonar en el Valle Shimshal.

**MÉTODO :** Se utilizó el Método Rápido de Encuesta para los villorrios (RVS) para investigar la prevalencia de tuberculosis pulmonar. Los criterios de selección fueron la tos crónica, hemoptisis, historia previa de TB y contacto íntimo con enfermos tuberculosos. Después del examen clínico se efectuó una radiografía de tórax y en el mismo lugar un examen único directo de esputos para buscar bacilos.

**RESULTADOS :** La población total del pueblo era de 1077 personas, y de ellas se estudiaron 231. Vivían haci-

nados el 75% de los estudiados. La prevalencia de TB pulmonar con esputo positivo en el pueblo fue de 554/100 000 habitantes, y la de TB activa con esputo negativo fue estimada en 1949/100 000. La prevalencia de TB pulmonar activa aumentó con la edad y el único factor de riesgo para la TB activa fue la edad por encima de los 45 años. Sobre los 41 casos con historia previa de TB pulmonar, sólo el 38% había hecho un tratamiento completo.

**CONCLUSIÓN :** La tuberculosis pulmonar es un grave problema de salud en la comunidad rural (Valle Shimshal) de Pakistán. Este estudio demuestra la falta de eficacia de los programas de control de la tuberculosis en el país.