People and Culture in Oceania, 34: 101-111, 2018

Communication

High Prevalence of Undetected Tuberculosis and Its Link to Low Utilization of Health Services and Poor Health Seeking Behavior of Prolonged Cough Patients in Rural Coastal Papua New Guinea: Prior to the Global Fund Program

Suparat Phuanukoonnon*

The objective of the study was to determine the burden of pulmonary tuberculosis (PTB) in a rural Papua New Guinea (PNG) setting using an active case detection approach and to describe the health seeking behavior of prolonged cough patients. A cross-sectional, house-to-house survey was carried out in November 2005 to March 2006 in rural communities in Sum Kar district, Madang Province to identify the prolonged cough patients. Sputum from prolonged cough patients was collected to confirm the presence of PTB with acid fast bacilli (AFB) microscopy. Questionnaire survey and semi-structured interviews were carried out to explore factors related to health-seeking behavior. A total of 184 of 7,311 (2.5%) people (aged≥15 years) reported prolonged cough, and 15 new PTB cases (205/100,000) were diagnosed and detected from the survey. Passive case finding detected only 32% of all PTB cases, whereas approximately 40% of PTB cases had never sought care at any forms of health facilities. Those seeking health care did so within 16 days after onset of cough. The health system's delay, however, was pronounced, with an overall median delay of 12 months. Closer distance to the health center and the severity of clinical conditions were significant factors for promptly seeking health care. The PNG TB control program would need to improve PTB diagnosis capacity at rural health facilities as well as integrate an active case finding approach into the program.

Keywords: undetected tuberculosis, health seeking behavior, Papua New Guinea

1. Background

In Papua New Guinea (PNG), tuberculosis (TB) was a major health problem and ranks as the first leading cause of hospital death in 2008 (National Department of Health of Papua New

* Papua New Guinea Institute of Medical Research, Papua New Guinea.
Department of Social and Environmental Medicine, Faculty of Tropical Medicine, Mahidol University, Thailand.
[e-mail: suparatp@hotmail.com; suparat.phu@mahidol.ac.th]

Guinea, 2009). The TB notification rate from AFB smear positive in PNG was 111 per 100,000, and PNG was thus categorized as a high-burden country by WHO (van Maaren et al., 2007). Direct Observation Treatment Short-course, or DOTS TB control strategy, was piloted in 1997 in a few provinces, but the process toward its implementation has been slow and inconsistent due to insufficient funding and manpower. In addition, the rural health facilities had been deteriorated over decades, adding a challenge to the DOTS delivery. The DOTS TB control program sets a goal at 70% case detection and 85% cure rate, with the aim of decreasing the incidence of TB among non HIV-infected people by 5–10% per year (Dye et al., 1998; Borgdorff et al., 2002).

As the majority of the PNG population (>80%) lives in rural areas with often-difficult access to major health facilities, the DOTS program has not yet reached the majority of the rural population in PNG. Consequently, at 21%, the case detection rate in PNG was the lowest in the Western Pacific Region (van Maaren et al., 2007). In PNG, only passive case finding of TB patients (i.e., only those who present at health facilities are screened and diagnosed) has been adopted. Consequently, the current estimates of TB prevalence in PNG are based exclusively on notification records of TB patients who visited health facilities and received treatments. Given the limited access to health centers in many areas due to geographical difficulties as well as the lack of laboratory diagnosis and poor overall reporting, the current figures of TB cases most likely represent only a fraction of the true burden of TB in PNG. Pulmonary tuberculosis (PTB) is one of the forms of TB, and is the only form that can be transmitted. PTB was accounted for more than 80% of all TB cases recorded and registered at the Modilon Hospital in 2005.

Prior to this study, no active case finding (i.e., actively screen and diagnose targeted populations or high-risk groups) studies had been carried out to determine the actual burden of PTB illness in PNG. This study aimed to determine the true burden of PTB in a rural PNG setting using active case detection approach and to describe the health seeking behavior of prolonged cough patients.

2. Methods

2.1 Study Settings

This study was conducted in the catchment of the Mugil Health Center, one of the 2 main health facilities of the Sumgilbar local level government (LLG) area of Sum Kar district, situated along north coast of Madang Province (Figure 1). The total population of this district was 84,944 (per the 2011 census).

Figure 1. A Map of the Sumkar District of Madang

2.2 Sampling

A cross-sectional survey was carried out in the Sumgilbar area from November 2005 to March 2006. The survey covered 21 villages located in 7 council wards within an area of approximately 550 km.^{2} Two-stage sampling was performed. Seven wards were purposively selected (out of 29), and 21 villages were randomly selected from the village lists of each ward from 7 wards in order to represent the catchment areas of the Mugil Health Center. A survey for prolonged cough detection covered the total population of all ages from all households in selected villages. A questionnaire survey and semi-structured interviews were carried out with all prolonged cough individuals (a cough persisting for more than 3 weeks) whose ages were15 years or older.

2.3 Materials

The questionnaire contained questions on TB symptoms, causes of TB illness, transmission mode, how to cure TB illness, how to prevent TB illness, and sources of TB health education.

Semi-structured interviews were conducted to explore factors associated with delayed seeking of health care. Trained nursing officers conducted the interviews. The health-seeking action timeline was constructed from the time of onset of cough to the time of the first health-seeking action (e.g. visited health centers or bought medicine or herbal medicine), elapsed time from the onset of cough to the first health seeking action, and then the elapsed time to the second health seeking action, and so on until the patients were diagnosed with PTB. The questionnaire and semi-structured interviews were conducted by the principle investigator and trained nursing officers.

Reviews of the TB register records at Mugil Health Center were conducted to validate and

confirm the already-diagnosed PTB cases having been diagnosed 2 years prior to the survey, from April 2004 to April 2006.

3. PTB Diagnosis

The house-to house survey identified 2 groups: (1) already-diagnosed PTB patients; and (2) prolonged-cough individuals. Three sputum samples were collected from these 2 groups on 2 consecutive days, for spot, morning, and another spot collection. The specimens were smeared on slides at the Mugil Health Center, batched and delivered to the laboratory at Modilon Hospital (approximately 60 km from the Mugil Health Center) for Acid Fast Bacilli (AFB) staining and microscopy reading. All slides were doubly read, and the slides in which both results were not agreed were sent to the Papua New Guinea Institute of Medical Research Bacteriology lab in Goroka for the third read and the results confirmed. The results were recorded in the TB registration book (TB05 form), a reporting system of the National TB control program. The definition of "new TB case" in this study was new patients who have never been treated for TB or have taken anti-TB drugs for less than 1 month (WHO, 2006).

4. Data Management and Analysis

The principal investigator checked all forms for completeness. All data were doubly entered into the designated database. Data analysis was conducted using STATA 8 (Stata Corp. College Station, TX). Chi-square tests were used to determine the relationship between seeking health care and demographic variables such as sex, and logistic regression models from multivariate analyses were used to determine any association with poor health-seeking behaviors as an outcome variable and explanatory variables, which consisted of age groups, having more than 2 TB clinical conditions (prolonged cough, fever, night sweat, weight loss, poor appetite, fatigue, and blood-tinged sputum), and distance to the health center (categorized as time of travel, e.g. <30 minutes, 30–59 minutes, >59 minutes). For the data from semi-structured interviews, the timeline was calculated for the median elapsed time of delay. Patient delay was classified from the time elapsed that patients presenting at the health center more than 30 days after the onset of symptoms, and the health system's delay was classified as TB diagnosis made later than 30 days after the first visit to the health center. Newly diagnosed TB cases from the active case finding survey were not included in the analysis of the health system's delay.

Table 1. Summary Number of PTB Status in Sumgilbar Area

15 Prolonged Cough	Positive AFB	15 New PTB Cases
7 Already Diagnosed PTB	Positive AFB	7 PTB Cases
5 Already Diagnosed PTB	Negative AFB	No Confirmed as True PTB

4.1 Study Approval

This study obtained ethical approval from the Medical Research Advisory Committees (MRAC No. 04/15) as well as permission from the Provincial Health advisor, the Chief of Officers (CEO) at the Modilon Hospital. Signed informed consent was obtained prior to conducting the study. Results of AFB tests were made available to all participants who submitted specimens. Participants with positive TB results and identified as new TB cases were referred to the Mugil Health Center for commencing TB treatment.

5. Results

5.1 Prevalence of Pulmonary TB Illness

All households in the catchment of the Mugil Health Center were surveyed (N=1,142), covering the population of 7,311; 184 (2.5%) people reported coughing for 3 weeks or longer (Table 1). Three sets of sputum specimens were collected from 144 participants, while 25 participants could not produce sputum, and 15 submitted saliva samples. This study found a total of 22 PTB cases; 15 were diagnosed from this survey and 7 cases were already-diagnosed PTB. None of the 21 prolonged cough children (<15 years of age) were found to be AFB positive. Reviews of health records of participants confirmed 15 of 22 cases as new PTB cases.

Of 7 already-diagnosed PTB patients with AFB positive, 4 cases were on anti-TB treatment in an intensive phase (in the first 2 months: daily treatment of Isoniazid, Rifampicin, Pyrazinamide, and Ethambutol), and 3 were on a continuous phase (from 2 to 6 months: intermittent treatment of Isoniazid and Rifampicin).

In addition, the survey found 5 already-diagnosed PTB participants on TB treatment, which were AFB-negative. The AFB-negative patients would not be included in analysis as the TB registration records showed that initial PTB diagnosis was based only on chest X-ray—without AFB results it was thus not possible to determine whether they were true PTB cases.

Based on these results, the actual prevalence rate for new PTB in the study areas was calculated. Total PTB prevalence rate was 301/100,000 of the population (22 of 7,311), and the prevalence of new PTB cases was 205/100,000 of the population (15 of 7,311). If all 5 cases with negative AFB currently under continuous phase treatment had been true PTB cases, the rate would increase further to 369/100,000 (22+5 of 7,311). Assuming a comparable rate of AFB positivity

Table 2. Numbers of Sputum Confirmed TB Cases from the Active Case Detection Survey Compared with the Passive Case Detection in Sum Kar District in November 2006

	Male	Female	Children	Total
Total Survey	2,703	2,596	2,012	7,311
Cough for More than 3 Weeks	77	73	34	184
Sputum Submitted	63	60	21	144
New AFB+ Cases from this Survey (Active Case Finding)	9	6	0	15(68%)
1. Prior Visit Health Center (Not Tested for PTB)	1	5	N/A	6
2. Sought Other Forms of Treatment (e.g. Traditional Medicine, Bought Antibiotics)	2	0	N/A	2
3. Not Seeking Any Forms of Health Care	6	1	N/A	7
Total New TB Cases from Active Case Finding	9	6	0	15 (100%) $205/10^5$ pop
Total TB Cases from Passive Case Finding	4	3	0	7 (32%) $96/10^5$ pop
Total TB Cases	13	9	0	22 or $301/10^5$ pop

among participants that did not return a valid sputum sample in this survey, the new PTB rate raises to 262/100,000 (i.e., (15)+[(15/144)*40]/7311), and the overall TB rate would be 385/100,000 of the population ((22)+[22/144)*40] / 7311).

The prevalence of TB cases from "passive case finding" was 55/100,000 of the population (4 of 7,311), i.e., it detected 32% all TB cases (7 of 22). Table 2 shows that of 15 newly diagnosed TB cases detected through this survey, 6 cases previously visited the Mugil Health Center but did not get tested for PTB. If PTB diagnosis were to be improved and able to detect PTB from these 6 cases, passive case finding could have detected 46.4%, or (7+6) of (22+6) of PTB cases. We found 7 new PTB cases did not seek any forms of healthcare and were diagnosed only through this active case finding survey (7 of 22, or 32%) (Table 2).

5.2 Pattern of Health-seeking Behavior of Prolonged Cough Patients

A total of 150 adult participants with prolonged cough were interviewed (male=77, female=73). After the onset of cough, 90 of 150 participants reported seeking some form of healthcare, with 50 seeking healthcare at least once at the health center, and there was no significant difference between male and female participants (Chi-square test: $p>0.5$). However, only 7 (14%) that visited the health center had their sputum tested.

For the first choice of treatment, 32 participants (35%) visited health centers, 50 (56%) used traditional herbal medicine, and 8 (9%) used modern medicine, mainly antibiotics obtained from other sources, typically from family members or friends, and 2 bought medicine (other antibiotics,

Table 3. The Elapsed Time of Seeking Health Care among Study Population with Cough for More than 3 Weeks and PTB Patients

Elapsed Time of Seeking Health Care				
Prolonged Cough			Median (Days)	Range (Days)
Overall (N=50)			5	1 to 16
Adult	Male	(N=24)	4	1 to 16
	Female	(N=26)	7	2 to 16
PTB Cases				
Overall (N=12)			7	2 to 14
	Male	(N=6)	4	1 to 10
	Female	(N=6)	7	5 to 14

as TB medicine had been only available at health facilities). Sixty-one (68%) sought care within 7 days after the onset of cough.

5.3 Elapsed Time to Health-seeking at the Health Center

The elapsed time ranged from 1 to 16 days with a median time of 4 and 7 days for male and female participants, respectively (Table 3).

The health system delay was estimated from the 7 cases which had been previously diagnosed with PTB at the health center. Four male and 3 female TB patients received their PTB diagnosis with a median delay of 12 months (male=10 months, female=12 months, with a range 9–60 months). Notably, 40% (60/150) of participants did not seek any form of healthcare after onset of cough. Of these, 11.6% (or 7 of 60) were found to be AFB positive.

Having more than 2 of these clinical conditions (prolonged cough, fever, night sweat, weight loss, poor appetite, fatigue, and blood-tinged sputum) (odd-ratio (OR)=8.55 CI95 [3.74, 19.53], $p<0.001$) and older age (40–59 years: OR=1.71, CI95 [0.70, 4.16], 60+years: OR=3.82, CI95 [1.74, 9.91], $p=0.017$) were independently associated with increased general health-seeking. More than 2 clinical conditions (OR=40.16, CI95 [11.93, 135.19], $p<0.001$), and age 60 or older (OR=4.22, CI95 [1.23, 14.47], $p=0.022$) were also associated with increased health-seeking at the health center. Distance from the health center, however, greatly reduced the likelihood of seeking care (30–59 minutes: OR=0.32, CI95 [0.10, 1.00], 60+ minutes: OR=0.01, CI95 [0.00, 0.05], $p<0.001$).

5.4 Reasons for Delay of Seeking Health Care or Not Seeking Health Care

Initially, participants used local herbal medicine to cure the cough. Only if the cough persisted until they could no longer perform daily activities would they seek healthcare. Participants not seeking any forms of healthcare often reported that they did not think “cough” was a serious problem. They saw many people coughing in their coastal villages, where cigarette smoking and

inhalation of smoke from fire or dust from roads were common. Sixty participants (40%) identified long distance from home to the health centers and the high cost of public transportation as a major impediment to seeking healthcare. Twenty-two participants (15%) were too sick to travel and needed relatives to accompany them to the health center, and this increased their financial burden through the additional cost of transport and loss of time at work for the relatives. Ninety participants (60%) revealed their fear of stigmatization due to having TB illness. Over 80% of participants perceived that TB illness made people become "sick, weak, and dependent," which was considered non-productive to household income generation.

6. Discussion

We conducted the first active case detection survey to investigate the prevalence of TB illness in rural communities in PNG, which showed a great need to improve the detection rate through a combination of active case detection and strengthening of AFB diagnosis at rural health facilities to reach a 70% TB case detection rate as outlined in the PNG National TB control plan. The current passive case finding system detects only 32% of PTB cases (Table 2).

With a prevalence rate of TB cases of 301/100,000 pop., the active case detection surveys detected a substantially higher rate than the reported TB notification rate from AFB smear positive results of 111/100,000 pop. (van Maaren et al., 2007). The TB rate in this study could be higher, though some samples yielded low sensitivity under AFB microscopy. The new diagnosis tools, such as fluorescence microscopy and GeneXpert assays utilizing the Xpert MTB/RIF kit (Cepheid, Sunnyvale, California, USA), which were not available during the time of the study, would have increased the PTB detection.

One of the reasons for low detection was that over 30% of new TB cases did not seek any forms of healthcare, and 6 patients were not tested for TB although they had visited the health center. This low utilization of public health centers implied the significant number of TB cases remained undetected in rural communities. Similarly, a low rate of health services utilization was seen in rural India, where only 23% of prolonged cough patients visited public facilities (Fochsen et al., 2006). In addition, only 14% of prolonged cough cases who visited the health center in this study had a sputum smear examination, even lower than the 27% that received a sputum examination in rural India. There is thus an acute need to improve the diagnosis capacity in the rural health center and to integrate an active case finding approach to the existing TB control program in PNG.

In our setting, if patients with prolonged cough participants did seek treatment, they sought treatment as early as 4 days after the onset of cough. This is significantly faster than in Bangladesh,

Vietnam, or Nigeria, where average patient delays ranged from 8 to 9 weeks (Ahsan et al., 2004; Odusanya and Babafemi, 2004; Long et al., 1999). The 12-month health system delay observed in this study was much longer than other developing countries, where delays ranged from 1 month in the Philippines, 5.4 weeks for women and 3.8 weeks for men in Vietnam, to 12 weeks in Botswana (Long et al., 1999; Steen and Mazonde, 1999; Auer et al., 2000). This long health system delay results in prolonged TB transmission in the affected communities.

Even if passive case finding were able to detect all PTB cases in patients visiting the health center, a 46.4% case detection rate would still fall short of the PNG national TB control target of 70% case detection. While an active case finding with its required high workloads may not be cost-effective in low TB prevalence areas (Murray and Salomon, 1998), active case detection would be required to improve case detection in PNG, where the current health system could detect only one third of TB cases (32%).

The Department of Health of PNG has received major funding from the Global Fund to implement DOTS since 2007. Training in AFB microscopy in peripheral health level was planned and implemented, including the introduction of GeneXpert assays in major provincial hospitals. The TB case detection rate in PNG has increased over time under Global Fund support from 44% in 2000 to 79% in 2016 (World Bank, 2018). The TB notification rate of all forms of TB increased from 94 per 100,000 population in 2008 to 333 per 100,000 population in 2016. However, the proportion of pulmonary TB cases with sputum test results in 2016 remained low (26.6%) (Aia et al., 2018). The goal of the End TB strategy (2015–2030) is that by 2025 case detection and treatment coverage reaches 90%. This study served as a baseline and guidance for improving the TB control program in rural areas by integrating the active case finding in the TB national control program as well as improving TB diagnosis capacity in rural health settings.

Acknowledgements

This study was funded by AusAID core funding for respiratory diseases research to PNGIMR. I thank Prof. John Reeder for his scientific support during his directorship at PNGIMR and Prof. Ivo Mueller for data analysis support. I thank Mr. Moses Baisal, Mrs. Mary Salib, and Mrs. Jenifer Igu from PNGIMR Madang for data collection and Mr. Elija Dabod for providing the data at the Mugil Health Center. I thank Mr. Hendrick, the late Mrs. Audrey Michael, and Mrs. Mition Johanes for AFB microscope. I appreciate the support from Dr. Jetro Usurup and the Modilon Hospital, community leaders, and thank the villagers in Sum Kar for participating in and providing valuable information for this study.

References

Ahsan, G., J. Ahmed, P. Singhasivanon, J. Kaewkungwal, K. Okanurak, N. Suwannapong, P. Akarasewi, M.A. Majid, V. Begum, and K. Belayetali (2004) Gender difference in treatment seeking behaviors of tuberculosis cases in rural communities of Bangladesh. *The Southeast Asian Journal of Tropical Medicine and Public Health* 35(1): 126–135.

Aia, P., L. Wangchuk, F. Morishita, J. Kisomb, R. Yasi, M. Kal, and T. Islam (2018) Epidemiology of tuberculosis in Papua New Guinea: Analysis of case notification and treatment-outcome data, 2008–2016. *Western Pacific Surveillance and Response Journal* 9(2): 9-19.

Auer, C., J. Sarol, Jr., M. Tanner, and M. Weiss (2000) Health seeking and perceived causes of tuberculosis among patients in Manila, Philippines. *Tropical Medicine and International Health* 5(9): 648–656.

Borgdorff, M.W., K. Floyd, and J.F. Broekmans (2002) Interventions to reduce tuberculosis mortality and transmission in low- and middle-income countries. *Bulletin of the World Health Organization* 80(3): 217–227.

Dye, C., G.P. Garnett, K. Sleeman, and B.G. Williams (1998) Prospects for worldwide tuberculosis control under the WHO DOTS strategy. *Lancet* 352(9144): 1886–1891.

Fochsen, G., K. Deshpande, V. Diwan, A. Mishra, V.K. Diwan, and A. Thorson (2006) Health care seeking among individuals with cough and tuberculosis: A population-based study from rural India. *The International Journal of Tuberculosis and Lung Disease* 10(9): 995–1000.

Long, N.H., E. Johansson, K. Lönnroth, B. Eriksson, A. Winkvist, and V.K. Diwan (1999) Longer delays in tuberculosis diagnosis among women in Vietnam. *The International Journal of Tuberculosis and Lung Disease* 3(5): 388–393.

Murray, C.J., and J.A. Salomon (1998) Expanding the WHO tuberculosis control strategy: Rethinking the role of active case-finding. *The International Journal of Tuberculosis and Lung Disease* 2(9 Suppl 1): S9–15.

National Department of Health of Papua New Guinea (2009) *Health Sector Review 2001–2009*. Goroka: National Department of Health.

Odusanya, O.O., and J.O. Babafemi (2004) Patterns of delays amongst pulmonary tuberculosis patients in Lagos, Nigeria. *BMC Public Health* 4(18).

Steen, T.W., and G.N. Mazonde (1999) Ngaka ya Setswana, ngaka ya sekgoa or both? Health seeking behavior in Botswana with pulmonary tuberculosis. *Social Science and Medicine* 48(2): 163–172.

World Bank (2018) Tuberculosis case detection rate. Available from: https://data.worldbank.org/indicator/SH.TBS.DTEC.ZS

The World Health Organization (2006) *Guidelines for the Programmatic Management of Drug-resistant Tuberculosis*. Geneva: World Health Organization (Official document number: WHO/HTM/TB/2006. 361).

van Maaren, P., B. Tomas, P. Glaziou, T. Kasai, and D. Ahn (2007) Reaching the global tuberculosis control targets in the Western Pacific Region. *Bulletin of the World Health Organization* 85(5): 360–363.