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ORIGINAL RESEARCH

Active Case Finding of Tuberculosis: Randomized Evaluation of Simple and Infotainment Chest Camps

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Abstract

BACKGROUND In Pakistan, many tuberculosis (TB) cases are not reported to the national surveillance system. An active case finding strategy in the form of conventional (simple) or innovative (infotainment) chest camps can contribute to diagnosing these missed cases.

OBJECTIVE To compare the yield in terms of TB patients detected at a simple chest camp (SCC) versus an infotainment chest camp (ICC) in rural areas.

METHODS A cluster randomized controlled trial with 2 parallel arms was conducted in 4 districts of Pakistan from June 2012 to May 2013. Rural neighborhoods (n = 318) were randomly allocated in a ratio of 1:3 to receive either SCC or ICC. Incidence of TB (all forms and sputum smear positive [SS+]) and number needed to screen (NNS) to diagnose 1 TB case were calculated. Cluster analysis was done according to intention to treat and risk ratio (RR), and 95% confidence intervals (CIs) were calculated.

FINDINGS A total of 3086 participants were tested at the SCC and 9029 at the ICC, of whom 38.5% were female. Mean age was 37.4 ± 15.9 years. Incidences of previously undiagnosed TB (all forms) for SCC and ICC were 23.6 (95% CI 20.04-27.4) and 22.1 (95% CI 20.3-24.1) per 100,000 population ($P = .42$), SS+ TB 22.5 (95% CI 19.3-26.1) and 21.6 (95% CI 19.8-23.6) ($P = .67$), respectively. NNS to diagnose 1 TB case were 260 (95% CI 234.3-289.6) and 258 (95% CI 233.3-287.9) for SCC and ICC, respectively ($P = .9$). RRs for all forms of TB and SS+ TB in SCC compared to ICC were 0.94 (95% CI 0.73-1.19) and 0.95 (95% CI 0.74-1.22) and P values were .58 and .71, respectively.

CONCLUSIONS Both types of chest camps are equally effective in active case finding of previously undiagnosed TB cases in rural areas in 2 provinces in Pakistan.

KEY WORDS active case finding, tuberculosis, chest camp, number needed to screen

INTRODUCTION

Pakistan is recognized as one of the 22 countries with the highest burden for tuberculosis (TB) worldwide, with estimated incident cases reaching to 0.37-0.65 million in 2014.[1] One of the major limitations in Pakistan is the inability to reach the "missed cases" of TB.[1] These are the patients in

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the community who are either not diagnosed or, if diagnosed, may not be reported to the National Tuberculosis Control Program (NTP) and the national surveillance system and may not receive treatment.[1] According to NTP, only 32% of all TB patients are reported to the national surveillance system at present.[2] Missed patients can potentially continue to infect others in the community if not treated correctly. The World Health Organization (WHO) recommends innovative strategies to reach out to these missed patients, thus preventing the spread of the disease.[1]

Two strategies can be used to find the missed TB cases: passive case finding (PCF) and active case finding (ACF).[3] PCF consists of self-referral of the patient with symptoms of TB to the health facility.[4] ACF comprises of set of activities to bring the diagnostic facilities to those in the community, even before the stage of self-referrals.[4] Focus has now shifted from PCF to ACF to diagnose and thus to treat TB early for its effective control and prevention. Studies in other settings demonstrated good yield of ACF.[4-6] According to a systematic review, ACF detects undiagnosed TB cases that are less severe, though its impact on treatment outcome remains uncertain.[7]

Various types of ACF approaches have been implemented in developing countries.[3] These mainly consist of house-to-house or door-to-door surveys and mobile vans with diagnostic facilities for TB case detection.[8] The concept of 'chest camps' dates back to 1970s, when they were first conducted in South Asian countries.[3] The basic idea of a camp is community involvement and social mobilization by mass awareness campaigns in places where TB is highly prevalent.[3] These campaigns consists of conventional activities like announcements in the neighborhoods, distributing pamphlets, posting posters, and raising awareness in schools for the prevention and control of TB.[3] Innovative activities like street theater performances by cured TB patients and community volunteers can be embedded in the social mobilization campaign to motivate people to come to the chest camp and spread awareness about TB. These different strategies, conventional or innovative, for social mobilization activities may affect the effectiveness of the ACF by the chest camps. The limitation or extent of these activities that will be feasible and effective in resource-limited settings remains unknown.

This study aimed to compare yield in terms of detection of TB patients (incidence rate and proportion of TB cases among participants) and number needed to screen to diagnose 1 TB case, by simple social mobilization activities comprised of conventional activities, as explained earlier, followed by a chest camp, referred to as simple chest camp (SCC), versus a set of innovative activities consisting of an infotainment package for the community involvement followed by the chest camp, referred to as the infotainment chest camp (ICC).

METHODS

Study Design. This is a cluster randomized controlled trial with 2 parallel arms (Fig. 1):

- *Simple chest camp (SCC)*: This consisted of simple advocacy campaign in the community before the camp. The campaign included announcements at public places like mosques, markets, and schools with invitations to the chest camp and hanging posters with the invitation for the community. This was followed by standard TB messages delivered at the chest camp.
- *Infotainment chest camp (ICC)*: This consisted of a package of community awareness and advocacy about symptoms, diagnosis, and treatment of TB in the form of an infotainment event (entertaining program giving information about TB) for all the members of the community (ie, for all ages and both genders) 1 day before the camp. The infotainment script (composed of short drama performances, songs, games, and quizzes) was delivered by previous TB patients cured of the disease and volunteers from the local community. TB messages were reiterated at fixed intervals of half an hour at the chest camps.

A mobile laboratory was set up at all the chest camps with all the equipment and reagents available. Social mobilizers (staff of the TB diagnosis team) identified people with symptoms of TB. Those found to have TB were asked to give their sputum sample, which was tested for acid-fast bacilli (AFB) at the mobile laboratory according to the guidelines of NTP Pakistan.

Study Setting and Duration. This study was conducted in rural areas of 4 districts in Pakistan—3 (Bahawalpur, Gujranwala, and Vehari) in the province of Punjab and 1 (Abbottabad) in Khyber Pakhtunkhwa province. It was conducted for 1 year (June 2012 to May 2013), after approval from the NTP and the provincial tuberculosis control programs (PTPs) and with consent from the local health authorities.

Study Population. The rural areas of the districts are geographically divided into Union Councils (UCs),

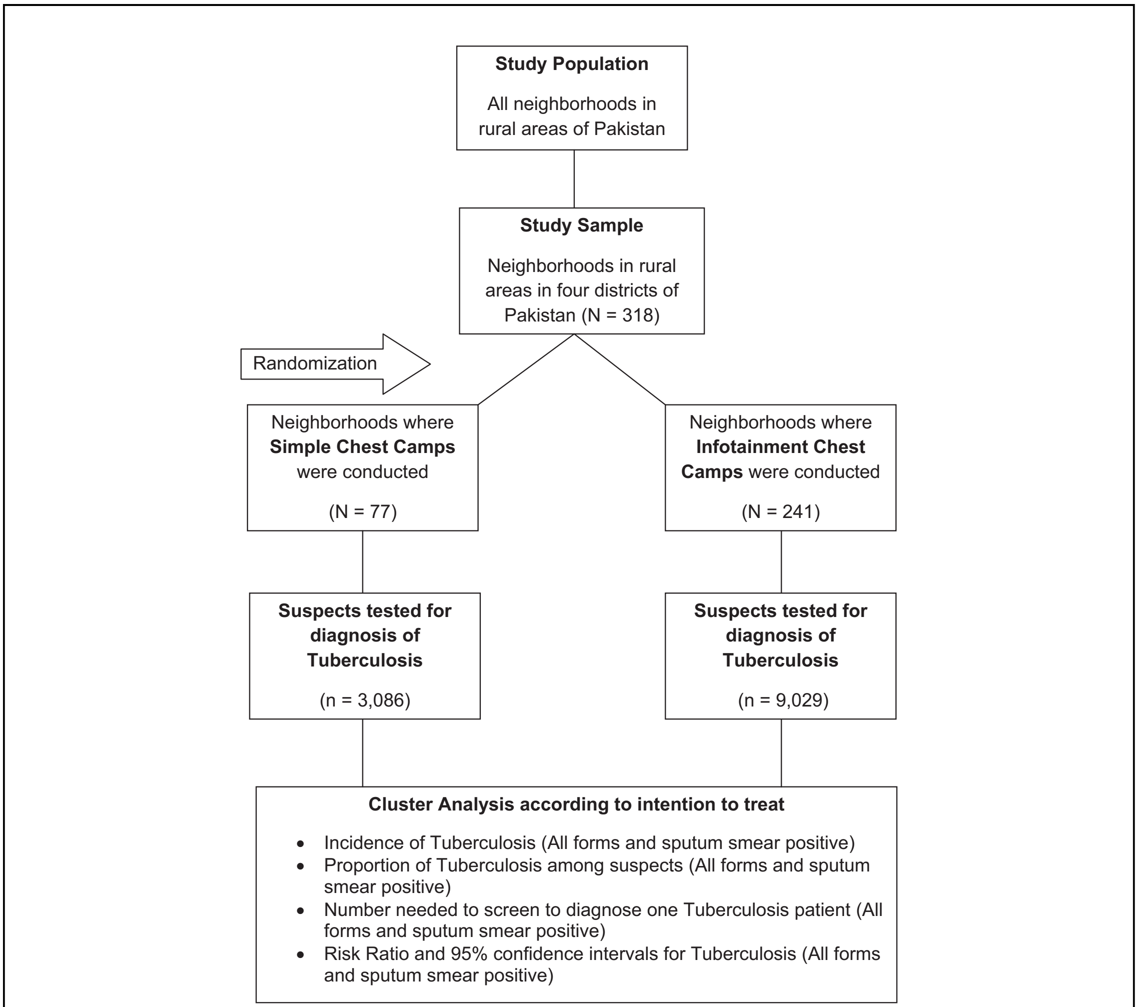

Figure 1. Study design.

which have neighborhoods (NBH). Each NBH comprises a population of 10,000 people. There were a total of 318 NBHs in the 4 districts; all were included in the study. The ACF through chest camps targeted a rural population of 3.19 million of all ages and both genders. Patients already diagnosed with TB and receiving treatment were excluded.

Randomization. The process consisted of line listing of the UCs and NBHs in each UC, followed by assigning numerical codes to NBHs. Thereafter the 318 NBHs were randomly allocated to either SCC or ICC in a ratio of 1:3 by random number generator via simple randomization using the function of “Unique Values.”[9]

Blinding. The implementers as well as the study population could not be blinded because of the health education nature of the interventions. Nevertheless, those collecting data on the outcome variables, as well the data analyst, were blinded to the allocation of the NBH.

Sample Size Considerations. Estimating a 15% increase in detection of all-forms TB cases from the present rate of 376 per 100,000 in Pakistan,[10] at least 71 NBH were required in each intervention arm at 80% power and 5% level of significance. To avoid the spillover effect and addressing the ethical concern of not negating intervention to any of the community in the 4 districts, all the 318 NBH were included in the study. Taking a ratio of 1:3, SCC was implemented in 77 randomly selected NBH, and 241 randomly selected NBH received ICC.

Data Management and Statistical Analysis. Data regarding age, gender, diagnosis of TB, and sputum smear result were collected through standard data entry TB registers of NTP. Data were collected by the data collectors trained uniformly for data

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collection procedures maintaining confidentiality of the study participants. Data were entered into MS Excel and analyzed in SPSS Version 19 (IBM Corp., Armonk, NY) and R-package Version 3.1.1 (R Foundation for Statistical Computing, Vienna, Austria). Mean and standard deviation were computed for the continuous variables and frequency and percentage for the categorical variables. Incidence rate per 100,000 population, proportion of TB cases among participants, number needed to screen to detect 1 TB case, and risk ratios from regression analysis (adjusting for clusters) were calculated with 95% confidence intervals (CIs). $P < .05$ was considered significant.

Ethical Considerations. The study was conducted in accordance with the ethical principles laid down in the Declaration of Helsinki. Ethical approval was given by the National Bioethics Committee of Pakistan (Reference No. 4-87/15/NBC-167/RDC/4574). The TB patients identified in all the camps were referred to the health facilities according to the standard protocol of the NTP.

RESULTS

A total of 12,115 participants underwent sputum smear microscopy for AFB having a mean age of 37.4 ± 15.9 years and 38.5% (n = 4659) were females. Age and gender distribution and percentage tested out of the population at risk are between SCC and ICC are shown in Table 1. Total number of participants diagnosed with TB (all forms) was 5.9% (n = 718), of whom 97.3% (n = 699) had sputum smear–positive (SS+) TB. The numbers of TB cases detected in both SCC and ICC are listed in Table 1.

Incidence of previously undiagnosed TB (all forms) was found to be 22.4 per 100,000 and SS+ TB was 21.8 per 100,000 population at risk. The incidence rate and its 95% CIs for all forms of TB, SS+ TB, SS− TB, and extrapulmonary TB were statistically similar between SCC and ICC (Table 2). Proportion of TB cases (all forms, SS+, SS−, and extrapulmonary) among participants was statistically similar between the 2 types of chest camps at both individual and cluster level analyses (Table 3).

Number needed to screen to diagnose 1 TB case was 260 (95% CI 234.3-289.6) for SCC and 258 (95% CI 233.3-287.9) for ICC ($P = .9$). Regression analysis adjusting for cluster found that the risk of having TB (all forms) was 0.94 (95% CI 0.73-1.19) and for SS+ TB it was 0.95 (95% CI 0.74-1.22) ($P = .58$ and .71) among those tested for sputum smear at SCC versus ICC (Table 4).

DISCUSSION

Simple chest camp (SCC) and infotainment chest camp (ICC) were found to be equally effective with respect to detecting undiagnosed TB (all forms, SS+, SS−, and extrapulmonary TB). At a glance, ICC would require fewer people to be screened to detect 1 TB case (all forms) compared

Table 1. Baseline Characteristics and Number of TB Cases in Simple Chest Camp (SCC) and Infotainment Chest Camp (ICC)

Variables	Total (N = 318)	SCC (N = 77)	ICC (N = 241)
Target population (population at risk)	3,192,628	773,170	2,419,458
Number of participants tested (n [% age])	12,115 (0.38)	3086 (0.39)	9029 (0.37)
Average participants per cluster	38	40	37
Age (mean ± SD)	37.4 ± 15.9	36.9 ± 15.9	37.5 ± 15.9
Age groups (n [% age])			
<25 y	3093	848 (27.2)	2245 (24.9)
26-40 y	4703	1163 (37.3)	3540 (39.3)
41-60 y	3231	849 (27.3)	2382 (26.5)
>60 y	1088	254 (8.2)	834 (9.3)
Female gender (n [% age])	4659 (38.5)	1161 (37.6)	3498 (38.7)
No. of TB cases (all forms) (n [% age])	718 (5.9)	183 (5.9)	535 (5.9)
No. of SS+ cases (n [% age])	699 (5.7)	174 (5.6)	525 (5.8)
No. of SS− cases (n [% age])	13 (0.11)	6 (0.19)	7 (0.07)
No. of extrapulmonary TB cases (n [% age])	8 (0.07)	3 (0.09)	5 (0.05)

N is the number of clusters in the first row of the table.
SS, sputum smear; TB, tuberculosis.

Table 2. Incidence Rate of Tuberculosis in Simple Chest Camp (SCC) and Infotainment Chest Camp (ICC)

Incidence Rate per 100,000	SCC	ICC	*P*
TB all forms	23.6 (20.03-27.36)	22.1 (20.28-24.07)	.42
SS positive TB	22.5 (19.29-26.11)	21.6 (19.88-23.64)	.67
SS negative TB	0.77 (0.28-1.68)	0.28 (0.11-0.59)	.06
Extrapulmonary TB	0.38 (0.07-1.13)	0.20 (0.06-0.48)	.60

SS, sputum smear; TB, tuberculosis.

with SCC, but this difference was not statistically significant.

Secondary prevention in the form of early diagnosis is the single most effective strategy for the control of tuberculosis. The earlier the case is detected, the earlier the chemotherapy for tuberculosis will be started to render the TB patient noninfectious and stop the spread of this infectious disease.[11,12] Low access (physical and social) and lack of awareness or health education about tuberculosis diagnosis and treatment have been identified as 2 important factors causing delay in the detection of this preventable and treatable condition.[13-15] Both types of chest camps brought the diagnostic facility for TB to the people in the community, addressing the low access issue. Simple chest camp, in which the targeted population was invited to attend the chest camp in the form of announcements at public places and displays of posters, worked as efficiently as the infotainment package in the infotainment chest camp. This indicates that people with previously undiagnosed TB can be reached even with limited resources in rural communities in developing countries.

Old age is one of the factors causing delay in diagnosis of TB.[16] Although age distribution in terms of mean age was same for both the chest camps, analysis by age categorization revealed that participants aged 26-40 years and those older than 60 years attended ICC more compared with SCC. Those younger than 25 years and between 41-59 years attended SCC more compared with ICC. The difference in age groups between SCC and ICC was statistically significant ($P = .016$). Hence the infotainment package in ICC in the form of events before the chest camp with dramas, songs, and quizzes giving information about TB and its treatment by the cured TB patients in the community and volunteers might be a motivational factor for young and old age groups in contrast to youth and middle-aged populations. Many studies have found that women experience more diagnostic delay than men.[16-19] More women attended the ICC compared with SCC, though this difference was not statistically significant.

House-to-house or door-to-door survey as well as mobile vans or units have proved to be effective active case finding strategies in many low-resource settings.[5,16,17] Proportion of TB cases among those screened by this strategy vary from 2%-7.6%.[5,16-18] The proportion of TB cases (all forms) diagnosed at the 2 chest camps was 5.9%. This reflects that chest camps can be as effective as door-to-door survey and mobile vans for detection of undiagnosed TB.

One strength of this study is its cluster randomized design, which not only takes care of the spillover effect but also renders equal distribution of characteristics in the intervention arms as also seen in Table 1. Confidence intervals of incidence rates as well as risk ratios (for all forms of TB and SS+ TB) are narrow, making the findings internally valid. The study was conducted in a rural setting in Pakistan; hence results can be generalized to rural

Table 3. Proportion of TB Cases Among Participants in Simple Chest Camp (SCC) and Infotainment Chest Camp (ICC)

Form of TB	Individual Level Analysis			Cluster Level Analysis		
	ICC (per 1,000,000)	SCC (per 1,000,000)	*P*	ICC (per 1,000,000)	SCC (per 1,000,000)	*P*
All forms of TB	59,327	59,088	.96	52,014	48,829	.58
Sputum smear positive	58,216	56,198	.67	49,364	47,198	.71
Sputum smear negative	778	1927	.09	12	7	.68
Extrapulmonary TB	555	963	.43	3	2	.87

TB, tuberculosis.

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Table 4. **Logistic Regression Analysis Adjusting for Clusters**

Type of TB	Risk Ratio (RR) & 95% CI RR	P
All forms	0.94 (0.73-1.19)	.58
Sputum smear positive	0.95 (0.74-1.22)	.71
Sputum smear negative	0.56 (0.03-9.51)	.69
Extrapulmonary TB	0.07 (0.01-52.67)	.87

CI, confidence interval; TB, tuberculosis.

communities of developing countries, where undiagnosed TB is a public health challenge for the control and prevention of this infectious disease.

This study did not inquire into the cost-effectiveness of the interventions, which is one of the limitations. Future studies would need to take into account costs for running the 2 types of camps to assess cost effectiveness. This may help decision makers to decide on which type of camp to use.

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