

Burden of Pulmonary Tuberculosis and Its Radiological Pattern, in Asymptomatic Young Males in Karachi, Pakistan

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ABSTRACT

Objective: To estimate the burden of pulmonary tuberculosis among asymptomatic young male applicants in a government organization in Pakistan and to find out the pattern of disease on chest x-ray and high-resolution CT chest.

Study Design: Prospective longitudinal study.

Place and Duration of Study: Pakistan Air Force (PAF) Faisal Base Hospital Karachi, Pakistan, from Dec 2017 to Feb 2019.

Methodology: An active search for detecting pulmonary tuberculosis was conducted in 1819 asymptomatic young male adults between 18 and 30 years who had applied for employment in a government organization with a pay scale ranging from 2 to 14 grade. Screening chest x-ray (CXR) was done as a part of their medical examination. High-resolution CT chest, sputum smear bacilloscopic and GeneXpert mycobacterium tuberculosis/resistance to Rifampicin assay tests were done in cases in which chest x-ray was suggestive of pulmonary tuberculosis.

Results: Chest x-Ray and high-resolution CT of five out of 1819 male applicants were suggestive of pulmonary tuberculosis. Three cases (0.16%) were confirmed as positive on lab tests. Radiographic and High-resolution CT patterns showed upper lobe lesions, consistent with the radiological appearance of the immuno-competent host disease.

Conclusion: The considerable presence of pulmonary tuberculosis was detected among asymptomatic young adults of this region; therefore, formulating a strategy to actively detect and treat analogous populations with high susceptibility to Pulmonary tuberculosis could help reduce this endemic disease.

Keywords: Asymptomatic, burden, Karachi, males, Mycobacterium, Pattern, Pulmonary, Radiological, Tuberculosis.

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INTRODUCTION

According to WHO 2018 global tuberculosis (TB) report, TB is still one of the top ten causes of human mortality and morbidity. It is estimated that approximately 10.0 million people (range 9.0-11.1 million) developed TB disease globally in 2017. There were cases in all countries and age groups, but 90% were adults (aged ≥ 15 years).¹ Two thirds of this global disease load is carried by eight countries; Pakistan is 5th among them.¹ In Pakistan, this grim situation exists despite the availability of free of charge screening and treatment through the national TB control program.² Tuberculosis (TB) in children and the elderly has received increasing attention in recent years, while adolescents and young people are often considered low risk of TB.³ However, in 2012, it was estimated that out of all the new tuberculosis cases worldwide, 17% of young people developed tuberculosis, the majority of whom live in African and South-East Asian regions.⁴ These facts call for improved TB prevention and management in this age group as well as the reflection

of their role in unfolding TB epidemics around the world.

In 2017, out of an estimated 10 million cases, 6.4 million cases were reported internationally, representing 64% of the new cases.¹ In Pakistan, an increase in the case detection rate was seen from 63% in 2015 to 69% in 2016; however, uncovering missing TB cases is still the key challenge in TB control.⁵ The reasons for missing cases are inadequate case detection and under-reporting of detected cases.¹

Tuberculosis is still endemic in most Asian and African countries.⁶ WHO reports of 2016 signifies that out of 10.4 million incident cases of tuberculosis in 2015, approximately 4 million went unidentified and were referred to as missing cases.⁷ The United nation has set the goal of ending the tuberculosis epidemic by the end of 2030.⁸ In order to meet the challenge of ending TB, it is vital to find these 4 million missing patients and ensure that they get quality care.

Most of the surveys conducted in TB endemic countries of Asia from 1990 to 2012 used TB symptoms as screening criteria to survey participants to determine the burden of the disease. However, it is evident

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from the data of these surveys that 40-79% of cases did not report TB symptoms and were only detected on CXR screening.⁹

In Pakistan, the survey conducted in 2010-2011 to estimate the prevalence of TB amongst adults also illustrated that only 61% of the diagnosed TB cases had symptoms (cough >2wks, fever, night sweats etc.). In contrast, detection of other TB cases was based on X-Ray abnormalities.¹⁰

Above mentioned information highlighted the fact that TB is also prevalent in asymptomatic individuals, and it is important to detect the disease, recognize its pattern and cure these missing patients to reduce the mounting tuberculosis burden. As a step toward this goal, the objectives of this study were to determine the burden of pulmonary tuberculosis (PTB) among asymptomatic young adults and to find out the pattern of disease on chest x-ray (CXR), and high resolution Computed Tomography (HRCT) chest.

METHODOLOGY

This prospective longitudinal study was carried out at the Department of Radiology in Pakistan Air Force Faisal Base Hospital Karachi from December 2017 to February 2019. 1819 was deduced as the sample size utilizing the Epi-Info software, taking the frequency of tuberculosis in asymptomatic young males as 24.1 per 100,000 populations 15 and the margin of error as 5%.¹¹ Non-probability, consecutive sampling was performed.

Informed written consent was granted from the participants, and permission was taken from the Hospital Ethical Committee (IRB approval certificate number FH/6240/1/P-1).

Inclusion Criteria: All the physically fit, asymptomatic young male adults between the ages of 18 to 30 years, who had applied for employment in a government organization with a pay scale ranging from Grade 2 to Grade 14, were included.

Exclusion Criteria: Applicants with a history of treated tuberculosis were excluded from the study.

1819 applicants reporting to PAF Faisal Base Hospital for their medical examination were sampled via the non-probability consecutive sampling technique. A screening Chest X-ray was done as a part of their medical examination. Age, educational level achieved and residing city or village of all the participants were noted. HRCT chest, sputum smear bacillo-

scopy and GeneXpert MTB/RIF tests were done in cases where CXR was suggestive of pulmonary tuberculosis. These individuals were also given a structured questionnaire in Urdu to fill. The questionnaire included having cough of any duration, fever, night sweats, weight loss, close contact with any person with tuberculosis, number of family members sharing a single living space and approximate monthly income. Detailed X-Ray and HRCT patterns of the disease were also recorded.

Statistical Package for Social Sciences (SPSS) version 23.0 was used for the data analysis. Quantitative variables were summarized as mean \pm SD and qualitative variables were summarized as frequency and percentages.

RESULTS

One thousand eight hundred nineteen male candidates were screened, ranging between 18 to 30 years; the mean age was 22.9 ± 3.6 years. Education level was categorized into four groups; the percentage of candidates in each group was as follows: 275 with no education (15.1%), 116 (6.4%) with first to fifth-grade education, 424 (23.3%) with sixth to eighth-grade education and 1004 (55.2%) with tenth-grade level education. All the applicants were from Sindh province; 1626 (89.4%) were residents of Karachi, while 193 (10.6%) were non-Karachi residents.

Out of 1819 candidates, CXR of five cases were suspected of pulmonary tuberculosis. They ranged in age between 18 to 29 years and were all residents of Karachi, belonging to lower socioeconomic status. X-ray showed reticular and nodular opacities (Figure) affecting the upper lobe unilaterally (20%) or bilaterally (80%).

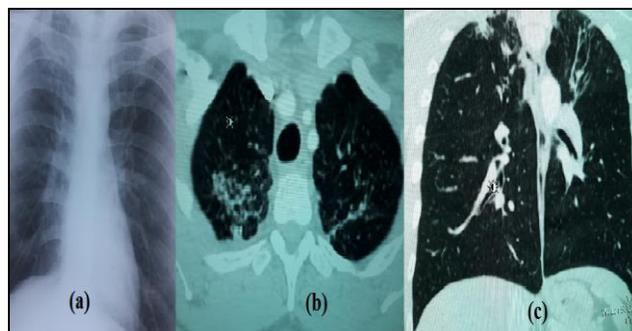


Figure: Radiological pattern of disease (a) showing upper zone reticulonodular shadowing (b) Axial and (c) coronal reformatted HRCT chest images showing reticulonodular shadowing involving the apical segments of bilateral upper lobes.

Burden of Pulmonary Tuberculosis

They were further investigated by HRCT, Sputum smear bacilloscopy and Gene expert test (Table-I and Table-II).

and GeneXpert MTB/RIF assay. CXR has high sensitivity but low specificity for diagnosing pulmonary tuberculosis.¹¹ In contrast, smear microscopy for AFB

Table-I: Summary of results.

Cases	1	2	3	4	5
CXR Suggestive of PTB	Yes	Yes	Yes	Yes	Yes
Sputum Smear Positive	Yes	No	No	No	No
GeneXpert	Yes	Yes	Yes	No	No
Rifampicin Sensitive	Yes	Yes	Yes	-	-
Age in Years	27	18	24	18	29
Education	Primary	nil	10 th Grade	10 th Grade	10 th Grade
Residence	Karachi	Karachi	Karachi	Karachi	Karachi
Socioeconomic Status	Lower Class	Lower Class	Lower Class	Lower Class	Lower Class
Number of Family Members Sharing Living Space	9	10	11	7	11
History of Close Contact with TB Patient	No	No	No	No	No
Cough	Occasional	No	No	No	No
Other Symptoms related to Tuberculosis	No	No	No	No	No

Table-II: Radiological patterns on CXR and High-Resolution CT Chest of cases presumptive of Pulmonary Tuberculosis.

Cases	1	2	3	4	5
Location of lesions	Apical Segment of Right Upper Lobe and Posterior Basal Segment of Left Lower Lobe	Apical Segments of both Upper Lobes	Apical Segment of both Upper Lobes	Apical Segment of Right Upper Lobe	Apical Segment of Left Lower Lobe
Unilateral /Bilateral	Bilateral	Bilateral	Bilateral	Unilateral	Unilateral
Reticular and Nodular Lesions	Yes	Yes	Yes	Yes	Yes
Miliary Pattern	No	No	No	No	No
Patchy Areas of Consolidation	No	Yes	No	No	No
Cavitations	No	No	No	No	No
Bronchiectasis	Yes	Yes	Yes on Right	No	No
Lymph Nodes (LNs) Enlargement /Location	Multiple Mediastinal LNs	Few Mildly Enlarged Mediastinal LNs	Right Paratracheal LN	Few mildly Enlarged Mediastinal LNs	No
Size/Location of Largest Lymph node	16 x 8 mm in right paratracheal	11 x 9 mm pretracheal	9 x 6 mm right paratracheal	10 x 8 mm pre tracheal	Calcified left hilar node, 6 X 6 mm
Pleural Effusion	No	No	No	No	No

Out of 1819 asymptomatic adult males (18-30 yrs), three individuals (0.164%) were found bacteriologically positive for pulmonary tuberculosis. This was 0.164% of the total screened population, the adjusted frequency estimates were 164/100000 (95% CI 142-186).

DISCUSSION

The objectives of this study were to detect and determine the burden of pulmonary tuberculosis among asymptomatic young male adults, apply for jobs in an organization where the medical examination is a prerequisite for induction, and find out the disease pattern on CXR HRCT chest. The detection was based on finding disease patterns by screening CXR. The bacteriological confirmation of the presumptive diagnosis of PTB was done by sputum smear bacilloscopy

and GeneXpert MTB/RIF is an accurate and quick test for detecting tuberculosis with high specificity.^{12,13}

These young adults whose educational qualifications ranged from; no formal education to grade ten education had applied for jobs with a pay scale ranging from Grade 2 to Grade 14, which are low paying jobs. The sample population typically belonged to low socioeconomic status, living in overcrowded spaces with poor sanitation, hygiene, and living standards. The majority of the screened population were residents of Karachi, and all the three diagnosed cases of pulmonary tuberculosis were also residents of Karachi.

This study high-lighted a substantial burden of pulmonary tuberculosis carried by asymptomatic young male adults between 18 to 30 years of age who

consider themselves fit entirely in this part of the world. They were not prolonged coughers, nor was there any prolonged contact with patients of tuberculosis, which are the most common criteria used to screen and detect the prevalence of tuberculosis in most of the surveys conducted in endemic countries.^{6,12} The burden of bacteriologically confirmed TB among symptomatic young people aged 10–24 years ranged from 45 to 799 per 100 000 in the Asia-Pacific region and from 160 to 462 per 100 000 in the African region.⁶ In Pakistan, a nation-wide cross-sectional survey among adults (≥ 15 years) conducted in 2010–2011 estimated that 241 per 100000 coughers had Pulmonary Tuberculosis.¹⁰ A retrospective study was conducted to determine the incidence rate of pulmonary TB in the Dir valley among the suspected patients.¹³ This study revealed that smear-positive pulmonary tuberculosis was higher in females than males, with the largest of positive cases having ages between 21–40 years. However, local, regional and international studies regarding the burden of tuberculosis in asymptomatic patients are scarce. Our research implied that these asymptomatic, apparently healthy individuals carrying the disease could be one of the imperative fraction of the unidentified “missing cases”, an important missing link hindering the control of this endemic disease.

This research showed that all the positive cases belonged to low socioeconomic status, having an average of ten family members sharing a single living space, however, none of the positive cases confers close contact with TB patients. Young adults spend most of their time outside their household and are at the risk of exposure to disease by same-age peers rather than their family members. Overcrowded classrooms and poor ventilation augment the risk.^{14,15}

In the absence of positive sputum smears, most cases of pulmonary tuberculosis are diagnosed based on clinical and radiological indicators.¹⁶ WHO recommends using Gene-Xpert MTB/RIF as the initial diagnostic test to detect pulmonary TB and rifampicin resistance instead of conventional microscopy, culture and drug-susceptibility testing (DST) for all patients with signs and symptoms of TB.¹⁷ Our research showed that in asymptomatic cases, out of five people radiologically presumptive of PTB, only one case was positive for AFB sputum smear. At the same time, GeneXpert/RIF was positive in three cases.

CXR is the main modality employed for diagnosis and follow-up of PTB and may be the only imaging

required in sputum-positive cases. HRCT chest is an important tool for detecting radiographically occult disease, detailed evaluation of parenchymal lesions and mediastinal lymph nodes, and assessing disease activity and complications.¹⁸ As per classical teachings, upper lobe reticulonodular lesions, consolidations and cavitations are the hallmark of post-primary infection, while lower lung disease, lymphadenopathy and effusions represent primary infection.¹⁹ Convincing evidence confirms that upper lobe disease is typical of an immuno-competent host, whereas lower zone disease, adenopathy and effusions are hallmarks of tuberculosis in an immunocompromised host.²⁰ In this study, all the positive cases demonstrated bilateral upper lobe lesions, and the lower lobe was also involved in one case. Reticulonodular lesions and bronchiectasis were the dominant patterns, patchy confluent opacities were also seen. No cavitations or effusion were detected in any of the cases, a disease pattern consistent with tuberculosis in immuno-competent hosts. All cases showed mild lymphadenopathy in pre and paratracheal locations, with no significant hilar node enlargement.

Asymptomatic patients are likely to be in the initial stages of the disease; for such paucibacillary disease, the higher sensitivity test like GeneXpert MTB/RIF assay should be more readily and freely available. Even though the mass radiography as a case detection strategy could not be possible in Pakistan due to its prohibitive cost and our less developed public health care system, wherever feasible, some strategies like radio-graphic screening in schools and colleges situated in slums can be planned to meet patients in this vulnerable group.

LIMITATIONS OF STUDY

Although we screened 1819 individuals over 15 months, this was still a small sample of the whole population to generalize the results. Further more, female applicants were not included in this study as the number of female candidates were very low. Still, considerable numbers of healthy individuals were diagnosed with pulmonary tuberculosis. Screening with CXR is mandatory in all preliminary medical examinations conducted for induction of candidates, not only in military services but also in other Government and private organizations in Pakistan. An effort should be made to collect and analyze the data from all such sources, so that prevalence of disease in a larger sample of the population can be determined.

CONCLUSIONS

The considerable presence of pulmonary tuberculosis was detected in asymptomatic young male adults of this

region; therefore, formulating a strategy to actively detect and treat analogous populations with high susceptibility to PTB could help reduce this endemic disease.

Conflict of Interest: None.

Authors' Contribution

HZ: Proposed topic, basic study design, HHS: Data collection, FN: Quality insurer, HRI: Methodology and manuscript writing, MUK: Statistical analysis & interpretation of results.

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