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Incidence of Pulmonary Tuberculosis among health care workers of Mayo Hospital, Lahore

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Abstract
The present study was designed to determine the incidence of tuberculosis (TB) in tertiary care hospital (Mayo hospital, Lahore) from January 2014 to June 2014. Several demographic factors analyzed were found to be significant in transmission of pulmonary tuberculosis ($p < 0.05$) except marital status ($p=0.09$) and age ($p=0.212$). Out of 50 suspected patients, 26 (52%) cases were recorded as a positive for pulmonary tuberculosis: out of which, six healthcare (HCWs) were found. Mean incidence of TB was 23% (6 out of 26) for all HCWs, 4 were nurses and 2 for other professionals, while for general population 79% (20 out of 26) cases were positive. The observed ratio among HCWs and general population was 60% and 50% respectively. It is concluded that incidence of TB among HCWs was more than general population. The reason is deprived medical conditions and facilities in Pakistan. Control programs to stop nosocomial transmission of TB should be adopted in hospitals to reduce risk for HCWs. Finding the risk of TB among HCWs is crucial to enable authorities to take preventive measures in health care facilities and shield HCWs.
Keywords: Healthcare workers, pulmonary tuberculosis, latent TB infection, Mycobacterium tuberculosis.

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INTRODUCTION

Tuberculosis is the most widespread infectious disease in the world. *Mycobacterium tuberculosis* (an obligate pathogenic bacterium) is the causative agent of this disease. It is highly contagious, chronic granulomatous disease; (McAdam *et al.,* 2007). The determined vision endorsed by the World Health Organization (WHO) and Stop TB partnership is to eradicate TB as a public health problem by 2050 attaining an incidence rate of less than 1 case per million of the world population (WHO, 2006: WHO, 2013).

TB affects either lung as a respiratory disease named as pulmonary tuberculosis, or other parts of human body as extra pulmonary tuberculosis (Solovic *et al.,* 2011). Fever, chills, loss of appetite, weight loss, night sweats, and fatigue are the prevailing symptoms of TB (Dolin *et al.,* 2010). Certain diseases also increase the risk of development of TB, like diabetes mellitus, malnutrition, chronic lung disease (particularly silicosis), chronic renal failure, alcoholism, cancer and immunosuppression (Lim *et al.,* 2013). The risk factors linked with hepatocellular carcinoma cancer include age, sex, diet, alcohol, and infection with hepatitis B virus (HBV) and/or hepatitis C virus (HCV) (Ali *et al.,* 2015). Muhammad et al. (2013) found co-infection of diabetes mellitus with HCV and HBV. HCWs are at danger of getting many infections at their work place through airborne, blood borne, faecal oral transmission and direct contact.

The use of modern techniques like interferon gamma release assay and polymerase chain reaction (PCR) have made the diagnosis of TB quite easy which was a difficult task previously. The diagnosis of pulmonary as well as extra-pulmonary TB is convenient by these assays. However, the conventional methods Ziel Nielsen staining (ZN), Lowenstein Jensen (LJ) media and chest X-rays) are also very useful feasible methods to diagnosis the pulmonary tuberculosis. ZN staining is a good technique to identify AFB (acid fast bacilli) and LJ (Lowenstein Jensen) media is a gold method of culturing the *M. tuberculosis* and chest X-ray technique is also gold method to diagnose the growth of *M. tuberculosis* in lungs. Modern methods are no

doubt best methods but the conventional methods are feasible and somewhat good for identification (Dolin *et al*., 2010).

Pulmonary TB is a curable disease but it is increasing in Pakistan because of lack of awareness and low literacy rate. Many patients have accepted it as a part of their lives and no steps are being taken to prevent it from spreading.

There are no safety measures adopted in hospitals to save HCWs from this occupational disease. Moreover, there are no isolated wards for the TB patients. Therefore, the present study is designed to find out the frequency of pulmonary TB patients among general population and health care workers. Besides, it will make the patients and HCWs are of the possible risk factors and co-morbid conditions associated with pulmonary TB.

The aims of the present study are to identify the risk factors and assess the population-attributable fraction (PAF) (percentage) of pulmonary TB in the general population associated with exposure to HCWs in their working settings.

MATERIALS AND METHODS

Sample collection

The current study was performed at the outpatient department of Model Chest Clinic, Sir Ganga Ram Hospital, Lahore. Health records of HCWs from 2010 to 2013, obtained from Mayo Hospital, Lahore. Pulmonary Tuberculosis was diagnosed by microbiological (Gram Staining, ZN staining, LJ Method) tests in active TB (fever, sputum, fatigue, loss of appetite, weight loss and night sweats). Demographic data and incidence of pulmonary tuberculosis in HCWs were provided by the Administration Department of Mayo Hospital, Lahore. Whole experimental work was carried out at Model Chest Clinic, Ganga Ram Hospital, Lahore and Pathology Lab, Fatima Jinnah Medical College, Lahore.

Collection of sputum samples

Almost 50 persons fulfilling the inclusion criteria were recruited for the study. Three specimens of sputum were collected from each pulmonary TB suspect over 2 days. The sputum specimens were stained by the ZN technique recommended by the International Union against Tuberculosis and Lung Disease (IUATLD). Sputum samples of patient whose three samples were negative for acid-fast bacilli were inoculated on LJ culture media.

Laboratory procedures

The collected sputum samples were subjected to conventional microbiological tests. i.e.:- Ziehl – Nelsen's acid fast staining for recording smear positively culture test for different detection of *M. tuberculosis* as used in previous studies (Singhal and Myneedu, 2015).

Ziehl-Neelsen staining

The sputum was spread out evenly approximately 1cm x 2cm on a new clean-labeled glass slide. The smear was allowed to dry completely at room temperature and fixed by passing the slide through the flame 2 to 3 times about 5 seconds each. The whole surface of the slide was covered by 1% Ziehl's Carbolfuchsin solution. Slide was heated from underneath until vapors started rising from the stain. Staining solution was washed off with a gentle stream of running water. For decolonization, the slide was covered with Acid alcohol solution containing HCl (3%) and alcohol (97%) for three minutes or until the color had disappeared. The slide was rinsed with a gentle stream of running water. For counterstaining, 0.3% Alkaline Methylene blue was poured to cover the whole surface of the slide and left for 30 seconds. Then, rinsed with a gentle stream of running water. The slide was placed on the slide rack to dry in the air and examined under binocular microscope. The smear was focused under 10x objective and then examined with 100x objective, after putting one drop of immersion oil on the stained smear. 100 fields were examined before labeling smear as negative.

Culture Examination for *M. tuberculosis*

The collected sputum samples were cultured following NaOH modified Petroff's method (Satapathy *et al.,* 2014). Two volumes of 4% Na0H were added to one volume of sputum specimen. Then cap of container was tightened and shaken to digest. It was allowed to stand for 15 minutes at room temperature. Centrifugation was done at 3,000xg for 15 minutes. It was left for 10 minutes and supernatant was poured off. 15ml of sterile distilled water was added and sediment was re-suspended. Centrifugation at 3,000 xg for 15 minutes was done again. It was allowed to stand for 10 minutes and supernatant was decanted. Condensed water in the medium was removed by putting the media tube upside-down on spirit cotton. One drop of sediment was inoculated onto culture tube and spread over the whole surface of medium evenly. After loosening the cap of inoculated medium, the tube was laid on the slanting bed with slant facing upwards. The inoculated slants were kept in the incubator at 37^{o}c. After a few days or more of incubation when the surface of media had been dried, the caps of incubated medium were tightened and incubation continued for at most 6 to 8 weeks until the growth of M. tuberculosis occur.

Statistical Analysis

The date collected from the questionnaires was evaluated using SPSS version 16.0 statistical software (SPSS, Chicago, IL). The quantitative narration of the data obtained was done by descriptive statistics. Cross-tabulation was performed to study the relationship of two variables, and Chi Square test was used to test the generated hypothesis at $P < .05$ level of significance.

RESULTS

Several demographic factors analyzed including gender, age, literacy, social class, residential background, history of TB, public transport, BCG vaccination were found to be significant in transmission of pulmonary tuberculosis (p

< 0.05) except marital status (p=0.09) and age (p=0.212) (Table 1).

The results showed that out of 50 cases meeting diagnostic criteria of tuberculosis, 26 (52%) patients were found having active pulmonary TB. Four cases were confirmed by sputum culture (LJ medium), fourteen cases were verified by ZN staining and 8 (31%) patients were diagnosed as a positive for pulmonary tuberculosis by radiotherapy (i.e. Chest X-rays technique) (Table 2). Out of other 24 (48%) cases 13 were misclassified as having TB and 11 had a latent TB infection (LTBI).

Table 1. Demographic and social economic characteristics of study population

Sr No.	Demographic and socio economic Factors	Characteristics	Value N (%)	P value
1.	Gender	Male	32(64)	0.04
		Female	18(36)	
2.	Marital Status	Married	29(58)	0.09
		Unmarried	17(34)	
		Widow/widower	03(6)	
		Divorced	01(2)	
3.	Age	15-24	06(12)	0.212
		25-34	15(30)	
		35-44	13(26)	
		45-54	07(14)	
		55-64	08(16)	
		65+	01(02)	
4.	Education	Illiterate	13(26)	0.0001
		Pre metric	18(36)	
		Metric	12(24)	
		College level	07(14)	
5.	Monthly income	<3000	10(20)	0.0153
		3000-5000	13(26)	
		5000-10000	15(30)	
		>10000	12(24)	
6.	Residential background	Urban	18 (36)	0.0477
		Rural	32 (64)	
7.	History of TB	Present	28 (56)	0.0209
		Absent	22 (44)	
8.	People Sharing Room	Single	23(46)	0.0058
		2 Persons	12(24)	
		3 Persons	10(20)	
9.	Tuberculin test	Positive	29(58)	0.0219
		Negative	21(42)	
10.	BCG Scar	Present	40 (80)	0.0039
		Absent	10 (20)	

The 26 cases of TB comprise 6 HCWs (4 nurses, 2 ward boys) and rests of the 20 were from different walks of life (Table 3). The results showed that the ratio of pulmonary TB among HCWs was more than general population. As out of 50 cases, 40 were from general population while 10 were HCWs. And positive cases 6 were among HCWs and 20 from general population. In general population, according to socio-economic status it was clear that TB is more prevalent among those people who were belonging to lower class (i.e. 14 patients (28%) suspected for TB were laborer). The ratio among HCWs and general population was 60% and 50% respectively. The values are significant (Table 3).

Table 2. Pulmonary investigation of tuberculosis patients (N=26)

Sr. No.	Investigation technique	Number	Percentage	P value
1.	ZiehlNeelsen Staining	14	54%	
2.	Lowenstein Jensen media Culture	04	15%	0.0317
3.	Chest X-rays technique	08	31%	

Table 3. Incidence of tuberculosis in patients of various fields in Mayo hospital, Lahore. (N=50)

General criteria of socio economic group	Total no. of cases observed	Profession	Cases observed	Positive		Negative		P value
				N (%)	Total N (%)	N (%)	Total N (%)	
HCWs	10	Nurses	7	4 (57)	6 (60)	3 (43)	4 (40)	0.0001
		Ward boys	3	2 (66)		1 (34)		
General Population	40	Students	13	8 (50)	20 (50)	5 (50)	20 (50)	
		House wives	13	7 (41)		6 (59)		
		Laborers	14	5 (61)		9 (39)		

DISCUSSION

TB is a serious infection present worldwide and is the major cause of death per year from a single infection. It usually affects the lungs and causes pulmonary tuberculosis but it may be found in different organs of the body causing extra pulmonary disease (Kruijshaar and Abubakar, 2009).

In present study, out of fifty, twenty six patients were diagnosed as a positive for pulmonary tuberculosis. Fourteen patients (54%) were identified positive for TB by smear testing (i.e. ZN Staining). Only four (15%) out of twenty six were diagnosed by culturing of *Mycobacterium* on LJ media. Eight patients (31%) were diagnosed as a positive for pulmonary tuberculosis by chest X-ray.

As Acid-fast staining the most reliable test than Lowenstein Jensen culturing and radio therapy, with a sensitivity of 22% to 81%, so this test is to be used for the diagnosis of pulmonary TB (Warren *et al.,* 2002).

The sensitivity and specificity of the conventional methods, including ZN staining, culture on LJ media and X-rays were done. It was found that ZN staining is more reliable and better alternative to LJ media in combination with chest X-rays for the diagnosis of tuberculosis in human patients suspected to TB (Ndugga *et al.,* 2004; Singhal and Myneedu, 2015).

TB remains an important infectious disease in Pakistan because of poor efforts and efficiency in diagnosis and treatment of disease by physicians and doctors. Pulmonary TB has high prevalence among HCWs as compared to general population. There is rationale documentation that workers involved in autopsies and cough-inducing procedures are at greater risk of transmitting pulmonary TB. HIV-infected HCWs, if exposed to contaminated conditions of tuberculin wards, have a notably greater risk of TB, which may be dangerous if the causative agent is a drug-resistant strain. Late diagnosis of disease or the identification of drug resistance is the factor that has most frequently been linked with an increased risk of nosocomial transmission. The other major contributing factors in spreading the disease are lack of personal infection-control procedures, unhygienic conditions of admission and infection wards and lack of administration. The complete expulsion of risk among health care workers is an unrealistic goal; however the preventive measure can be taken to avoid the risk of free exposure.

In Pakistan, mostly there is poor administration in TB institutes. No vaccination is being given to the HCWs who were in direct dealing with TB suspects. Deprived condition of wards with no ventilation and low sterility of medical areas are the major contributing factors of pulmonary TB among HCWs.

CONCLUSION

Pulmonary TB is a controllable disease but it is increasing in Pakistan because of lack of knowledge and low literacy rate. Many patients have accepted it as a part of their lives and no steps are being taken to avoid it from spreading and even in many hospitals there are no isolated wards for the TB patients. Rate of pulmonary tuberculosis among HCWs are more than general population. The reason is HCWs are at direct risk of exposure to blood and other body fluids during the course of their job. Moreover, unhygienic conditions of TB infectious wards also play an important role in increasing the magnitude of this disease. Consequently, they are at risk of infection of blood borne disease like tuberculosis, which confirms that pulmonary TB is an occupational disease.

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CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

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