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Infection and Disease among household contacts of Multidrug Resistant Tuberculosis Patients in Khyber Pakhtunkhwa

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A B S T R A C T

Background: The emergence of multidrug-resistant tuberculosis (MDR-TB) occurs when tuberculosis bacteria develop resistance to isoniazid (INH) and rifampicin (RIF), key medications in its treatment regimen. Within communities, the risk of drug-resistant strains spreading from infected individuals to others is heightened by frequent and close contact among members.

Objective: The goal of this study was to investigate the tuberculous infection among household contacts of Tuberculosis patients.

Methodology: The cross-sectional study was conducted at Programmatic Management of Drug Resistant TB Unit (PMDT), Department of Pulmonology, Lady Reading Hospital, Peshawar from January 2021 to January 2022. All such cases which have been recognized MDR-TB were enrolled for medical treatment in this center and were selected as index patients. Their contacts (spouses, children, parents, siblings and other relatives) first screened verbally and then underwent GeneXpert assay. Those found positive MTB only or MTB plus Rif resistance. Data was analyzed using IBM Statistics SPSS version 27.

Results: A total of 145 enrolled MDR-TB patients were included in this study. Of these enrolled patients, a total of 1310 household contacts were analyzed for study purpose. Of these 1310 contacts, 52 (35.86%) diagnosed as tuberculosis (TB) only, while 26 (17.93%) declared as MDR-TB. The most frequent symptoms among these household were fever, cough, and chest pain.

Conclusion: It is imperative to explore diverse strategies for managing and breaking the chain of tuberculosis (TB) and multidrug-resistant tuberculosis (MDR-TB). Household contacts screening emerges as a pivotal component in this effort. Recent research has revealed that 35.86% of individuals were found to be infected solely with Mycobacterium tuberculosis (MTB), while 17.93% were identified as having MDR-TB.

Keywords: MDR-TB; Screening Program; Transmission

Introduction

Tuberculosis (TB) is a serious global health concern, that affects 10 million people annually, the majority of whom reside in low- and middle-income countries.¹ TB not only infect people but also it attack on economy of the world as on one side it effect mostly the economically young people and on other side millions of dollars required every year for its control and due to these factors many people agree that tuberculosis control is crucial for social and economic advancement, and the Millennium Development Goals reflect this belief. The World Health Organization's STOP TB Partnership has established two key objectives: firstly, to eliminate tuberculosis as a significant public health threat by 2050, and secondly, to reduce the prevalence of the disease and associated deaths by 50% from the levels recorded in 1990 by the year 2015. Achieving these goals necessitates an improvement in healthcare systems' ability to detect tuberculosis cases in the early stages. This entails enhancing methods for identifying individuals with tuberculosis sooner, allowing for prompt treatment and reducing the spread of the disease within communities. By prioritizing early detection and intervention, healthcare systems can work towards reducing the burden of tuberculosis and ultimately move closer to the WHO's targets for tuberculosis eradication and control.²

Causative organisms of TB are known as Mycobacterium tuberculosis (MTB) which may affect lungs or other parts of the body. TB of lungs is known as Pulmonary tuberculosis (PTB) and of other parts is known as Extra-pulmonary tuberculosis (EP-TB). Symptoms of TB are cough with more than 2 weeks, bleeding from the mouth, fever, weariness, decreased appetite, losing weight, night sweats, and chest discomfort.³

TB control program in every country with the help of WHO and other organization trying to control TB and it is somewhat control in few parts of the country but unfortunately it came back in other form known as Drug-resistant tuberculosis (DR-TB). Dr-TB is a form of TB, the microorganism responsible for it develops resistance to many anti-TB medications. So, it is difficult to treat DR-TB as compared to susceptible TB. Among DR-TB, Multidrug Resistant TB (MDR-TB) is the most prevalent and difficult type. The causative organisms of MDR-TB become resistant to the two most important anti-TB drugs known as Rifampicin and Isoniazid. Due to its role in the ongoing TB epidemic and rise in TB morbidity and mortality worldwide, this particular strain of DR-TB has emerged as the most dangerous menace to global health.^{4,5}

Treatment plans for DR-TB are more costly, time-consuming, less effective, and linked to side effects than those for drug-susceptible TB. This is why the global success rate of treatment for DR-TB is still around 60%, and a sizable proportion of patients pass away every

year.⁶ So, it is very important to break the cycle of disease transmission as once it infects the person it is very difficult to treat this disease.

One of the main ways to cut the chain of transmission of TB is household contact screenings of these patients. This technique helps in the diagnose TB on time which is one of the key factors in TB control program. A technique called contact screening looks for people who may have been exposed to a certain illness or condition in an effort to increase case detection.⁷ Because household contact of TB/MDR-TB patients are expected to catch this disease in comparison to the general population as they exposed to the causative organism continuously, so active case discovery may be beneficial in household contacts.⁸ Some contacts will become infected with Mycobacterium TB after being exposed to airborne droplets containing the bacteria, and some of these contacts will go on to develop illness. The duration, closeness, and infectiousness of the tuberculosis patient all affect the likelihood that a contact will contract the infection and the contact's vulnerability.⁹⁻¹² The illness may emerge as soon as six weeks or years later. Investigations into contacts are conducted in an effort to stop or identify these incidents. Contact screening can be carried out passively or actively using a variety of techniques, including symptom screening, chest radiography (CXR), sputum smear and culture examination, tuberculin skin test (TST), rapid molecular diagnostic tests like GeneXpert, and interferon- γ release assay (IGRA). Active screening methods can include CXR alone, symptom evaluation alone, or a mix of the two, carried out either simultaneously or consecutively.^{14,15}

There is an urgent need to address the formidable challenge posed by multidrug-resistant tuberculosis (MDR-TB) within communities. With MDR-TB representing a significant threat to global health due to its complex treatment, high costs, and elevated mortality rates compared to drug-susceptible TB, understanding the dynamics of transmission is paramount. Household contacts of MDR-TB patients, being at heightened risk due to close and prolonged exposure, warrant particular attention. By assessing the prevalence of TB infection among these contacts and elucidating common symptoms, this study aims to inform targeted intervention strategies for early detection, treatment initiation, and containment of MDR-TB transmission. Emphasizing the importance of comprehensive screening programs for household contacts, this research contributes to efforts aimed at curbing the spread of MDR-TB and advancing global TB control initiatives.

Objective

The present study conducted with the aim to determine the TB/MDR-TB infection among household contacts of MDR-TB patients.

Table 1. Baseline characteristics of study cases

Characteristic	MDR-TB (%)	Index TB cases (%)
Gender		
Male	63 (43.44)	16 (30.76)
Female	82 (56.55)	36 (69.23)
BCG vaccination		
Yes 129 (88.96)	31 (21.37)	98 (67.58)
No 16 (11.03)	7 (4.82)	9 (6.20)
Size of residence, n (%)		
<3 rooms	7 (4.82)	4 (7.69)
3–5 rooms	15 (10.34)	30 (57.69)
>5 rooms	4 (2.75)	18 (34.61)
Initial sputum AFB smear grade, n (%)		
1+	4 (2.75)	8 (15.38)
2+	8 (5.51)	13 (25)
3+	14 (9.65)	31 (59.61)

Methodology

A cross-sectional study was conducted from January 2021 to January 2022 at Programmatic Management of Drug Resistant TB Unit at Lady Reading Hospital Peshawar (PMDT-LRH), Pakistan. People who had lived with the TB patients in the same sleeping quarters and kitchen for at least three months before they are diagnosis as index cases were considered household contacts. This included partners, kids, parents, siblings, and other family members like uncles, grandfathers, and cousins. The sputum samples from contacts of index cases were sent to the laboratory to screen for the presence of RRD. Upon detection of rifampicin resistance through Xpert MTB/Rif testing, these cases were then registered at PMDT-LRH for treatment. Contacts whose Xpert MTB/Rif testing confirmed positive results via sputum microscopy but did not show rifampicin resistance were referred to their local DOTS (Directly Observed Treatment, Short-Course) centers for enrollment and treatment. The fundamental demographic information of the index

case, including age, gender, weight, duration of symptoms, family history of TB, smoking status, sputum smear and culture results, and chest radiograph (CXR) findings, was documented. Household contacts were documented during their enrollment and recorded in their DR-TB 01 form for screening purposes at various stages of the index case treatment. These contacts underwent screening through various methods, either during their visits to health facilities or through home visits conducted by health facilitators at their residences. All statistical analyses were conducted using SPSS software (version 27).

Results

A total of 145 MDR-TB index cases were included in this study of whom contacts were screened for study purpose. During study period a total of 1310 household contacts were screened. Clinical and demographic characteristics of the cases and their household contacts are listed in Table 1.

Table 2. Tuberculous infection and active tuberculosis among household contacts of MDR

Index TB cases	No. contacts household contacts	No. contacts with MDR cases
145	1310	26

Total of 1310 household contacts were screened during study. Among these cases, 26 were diagnosed as MDR-TB (Table 2).

The majority of individuals in contact (81.37%) were mostly female (69.65%) belongs to urban area. 77.93% are married while 57.93% are unmarried (Table 3).

Age ranges from 15 to 44 years have 779 (59.46%) of the contacts which represent the community's most vulnerable age range; however, the majority of index cases 119 (82.06%), also belonged to the same age category, or 15–44 years old (Table 2). The primary productive age group in the community (15–44 years) was impacted in both sets of instances.

Discussion

The National TB Control Programme in Pakistan oversees a comprehensive treatment protocol for multidrug-resistant tuberculosis (MDR-TB), encompassing monitoring, diagnosis, treatment, and prevention efforts. Using a phased approach, the program aims to gradually extend its coverage nationwide. There are different aspects of this program and one of the most important one is timely detection and treatment.

For timely detection it is very important to screened all household contacts of an index case. As household contacts, being a high-risk group for both tuberculosis (TB) and multidrug-resistant TB (MDR-TB), underscore the crucial importance of targeted case identification. Although not every case identified during contact investigations may directly link to the index case, timely detection and management of infectious diseases significantly reduce community transmission rates.¹⁶

The present study consists of MDR-TB enrolled cases and their household contacts for screening purpose. A total of 145 contacts were screened during study duration. Among these 63(43.44%) were male and were 82 (56.55%) female.

Numerous research has looked at how gender affects TB patients' decision to seek care, and these findings point to the necessity for a deeper comprehension of the behavioral aspects of TB control. It seems that women are more likely to put off treating their illnesses until they become too sick to take care of themselves or to seek medical attention. Review reveals that women have greater obstacles than males in getting the necessary TB treatment. This is largely due to societal perceptions of women's more limited roles in the family and community, which discourage women from asking for outside assistance.^{17,18}

Our research highlights a substantial percentage of MDR-TB cases among patients' household contacts. Out of 145 index cases, 26 are multidrug-resistant (MDR) cases. The high rate of multidrug-resistant tuberculosis (MDR-TB) among friends and family underscores the need for increased efforts in tuberculosis (TB) infection control. Others have also proposed that rigorous contact investigation can improve case detection in nations with low to moderate epidemic status levels of tuberculosis (TB). Researchers have looked into the feasibility of identifying sick people among TB patients' contacts in both high and low-incidence areas.¹⁹ On the other hand, there is strong evidence that multidrug-resistant tuberculosis (MDR-TB) can spread from person to person. Roughly half of MDR-TB cases worldwide are thought to result from primary contact. Moreover, transmission might have happened

Table 3. Baseline characteristics of study cases

Characteristics		Index cases	Number of contacts
Gender	Male	79 (54.48%)	512 (39.08%)
	Female	118 (81.37%)	798 (60.91%)
Residence	Urban	101 (69.65%)	759 (57.93%)
	Rural	96 (66.20%)	551 (42.06%)
Marital Status	Married	113 (77.93%)	863(65.87%)
	Unmarried	84 (57.93%)	447 (34.12%)

Table 4. Age distribution of contacts versus index cases (n; %)

Age (years)	Index cases	Contacts investigated	MDR-TB
<15	17 (11.72%)	92 (7.02%)	2 (7.69%)
15 – 44	119 (82.06%)	779 (59.46%)	17 (65.38%)
45 – 64	46 (31.72%)	355 (27.09%)	4 (15.38%)
>65	15 (10.34%)	84 (6.41%)	3 (11.53%)

earlier, when they were more sensitive to medication, as a significant percentage of the index patients were retreatment cases.

Moreover, 16 TB patients and 2 MDR-TB cases were found among the contacts in an Indian investigation that involved 302 contacts and 58 index cases.¹⁷ Teixeira et al. conducted a study in Brazil and discovered that although close contacts were frequently exposed to index cases, the incidence of drug-susceptible TB and MDR-TB was similar.¹⁸

To guarantee prompt test schedules and illness detection, this issue needs to be given careful consideration. Other research has indicated that this approach might have missed instances involving youngsters, who are more likely to get tuberculosis (TB) from household contacts²⁰. In order to effectively minimize transmission within homes, it is necessary to establish interventions that especially target the screening and detection of TB in children. Our research emphasizes how important it is to identify TB early in household contacts of people who have MDR-TB, which is considered to be a high-risk population.

Early detection and treatment of possible cases, in our opinion, will ultimately result in lower rates of morbidity, death, and infectious transmission within the population. Finally, to enhance the detection of TB and MDR-TB cases in high burden areas, we support focused changes to standard case finding techniques. According to the study, actively tracking down the household connections of index MDR-TB cases may be a major factor in the timely detection and management of MDR-TB infections. Putting such a strategy into practice might be more successful in preventing the spread of disease within the community and saving lives.

Conclusion

Despite a longer time of contact with the index case in patients with MDR-TB, our findings imply that among household contacts exposed to MDR-TB cases, the prevalence of tuberculosis infection and the progression to active TB are comparable.

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