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Original Article

Public Health Section

Risk Factors of Drug Resistance among Tuberculosis Patients of Prakasam District, Andhra Pradesh, India

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ABSTRACT

Introduction: India is leading in the burden of Tuberculosis (TB) according to the new report of the World Health Organisation (WHO) on the disease. Multi-Drug Resistant TB (MDR-TB) cases have been increasing in India. About half of the world's MDR-TB cases are present in India.

Aim: To assess the incidence of drug resistant TB in Prakasam district, Andhra Pradesh, India, in the second quarter of the year 2019 and to determine the risk factors that are responsible to develop drug resistance to anti-tubercular drugs in the study population.

Materials and Methods: A Community based cross-sectional study was conducted from April 1st to June 30th in Prakasam district, Andhra Pradesh. All the registered drug resistant TB cases in Prakasam district who gave consent during the study period were taken as sample. The diagnosed drug resistant TB patients were interviewed and proportions of different variables were calculated and chi-square test was used to test significance of results.

Results: Out of 209 TB patients, 88 patients were having drug resistant TB in Prakasam district. Prevalence of Drug resistant TB in Prakasam district was calculated as 5.64 per one lac population. In the second quarter of the year 2019-2020, i.e., from April 1st to June 30th, 88 new cases were identified. Incidence of Drug resistant TB in Prakasam district was calculated as 2.38 per one lac population. Male persons (76%), having the age 20-40 years (42%), 40-60 (38.7%) belonging to middle class (45.5%) and migrating for work (85%) are at more risk of developing drug resistant TB. Most of the patients are developing drug resistant TB directly (70.5%) which is an alarming signal. The rifampicin resistant patients were also developing psychological complications (22). Drug toxicity was observed in 55% of the cases.

Conclusion: Incidence of drug resistant TB was more in male persons, above 20 years of age, belonging to middle class socio-economic status and migrating for work. Most of the patients developed drug resistant TB directly without previous history of TB. Drug toxicity was observed in half of the cases. Psychological complications were observed in rifampicin resistant patients. Surveillance activity should be addressed properly to combat the risk factors.

Keywords: *Mycobacterium tuberculosis*, Revised national tuberculosis control programme, Rifampicin resistance, Tuberculosis burden

INTRODUCTION

Tuberculosis is an ancient disease caused by *Mycobacterium Tuberculosis*, involving pulmonary and extrapulmonary tissues in the body. It is a major health problem worldwide, especially in India even today [1]. The increase in drug resistant TB is hampering the progress made to reduce TB-related morbidity and mortality over the past 20 years [2]. Factors leading to the development of drug resistant TB need to be well-established to reduce the morbidity and mortality due to TB.

The bacteria are becoming resistant to Anti tuberculous treatment due to acquiring mutations in genome due to inadequate and incomplete treatment, inadequate regimens, inadequate supply/quality of drugs and poor patient adherence leading to MDR-TB. Resistance can be mono-resistance (MR) whose specimen is resistant to single first line anti-TB drug, and MDR-TB is stated if the bacteria are resistant to at least isoniazid and rifampicin, two of the most effective TB drugs. Extensive Drug Resistance (XDR), with additional resistance to flouroquinolone and a second line injectable anti-TB drug [3]. The results of treatment are poor, even though the patient takes prolonged treatment. A course of second-line drugs for MDR-TB treatment costs at least 100 times as much as Short course chemotherapy, so there is a high premium on balancing drug choice with rapid case finding and improved case management [3].

According to the report of WHO, India tops the list of having high burden of TB. WHO's 2018 Global TB Report, released in the United Nations (UN) headquarters in New York says that the morbidity and mortality due to TB can be drastically reduced by concentrating the efforts on early diagnosis, reporting and treatment. Large and persistent gaps are there in India. Huge gap of 80% (3.6 million) of under reporting is noticed in 10 countries, led by India (26%), Indonesia (11%), and Nigeria (9%). Under diagnosis and under reporting of cases of TB is the main reason for this gap [4]. About half of the MDR-TB cases are in India (24%), China (13%), and Russia (10%). There is need to mainly focus on early diagnosis and treatment of cases to drastically reduce the MDR-TB burden in India [5].

India is leading in the new and relapse cases of TB (5.7 million) which were notified globally in 2010 [4]. Total number of estimated MDR-TB cases in India was 99,000 in 2008, after China (100,000 cases) which is the second highest in the world [5]. About 2-3% of MDR-TB prevalence in new cases and 12-17% of MDR-TB prevalence in reinfection cases is present in India as per the number of drug resistance surveys conducted. Revised National Tuberculosis Control Programme (RNTCP) has a goal of providing universal access to quality diagnosis and treatment to all TB patients and also to treat at least 90% of all new and 85% of all previously treated patients [5]. The RNTCP is scaling up the number of culture and DST laboratories nationwide, along with treatment services, including Directly observed treatment short course plus for MDR-TB, second-line anti-TB drugs [5]. Inspite of the efforts to control TB and

MDR-TB in India, less number of laboratory facilities for diagnosis, inadequate management of cases, insufficient supply of second-line drugs to treat MDR cases and shortages of trained personnel is still present. Majority of MDR-TB cases were undiagnosed in India according to data from the RNTCP [5].

Drug Resistant TB can be combated by improving high quality DOTS implementation, promotion of rational use of anti-TB drugs and improving infection control measures, improving the capacity of laboratories, early diagnosis of all the drug resistant TB cases and suspecting drug resistance, if sputum is positive even after four months of treatment. Treatment of all the drug resistant TB cases should be done effectively by procurement and ensuring proper supply of TB drugs. Effective management of Human Immunodeficiency Virus (HIV) TB co-infection, follow-up of patients of drug resistant TB cases and management of drug toxicity, if any and improving the adherence to take TB drugs are the major interventions to be undertaken to reduce the drug resistance [5]. Increase of drug resistance problem in India may be due to use of anti-TB drugs without proper regulation, especially in private sector which is making the treatment of TB and MDR-TB still more difficult [5].

Rifampicin which is an effective first line anti-TB drug has developed resistance in 558,000 people out of all the MDR-TB cases, according to WHO report in 2017. MDR-TB was 82%, and 8.5% were XDR-TB. Poor detection and treatment hampered the efforts of addressing the MDR-TB, according to the report. Recently, updated MDR-TB treatment recommendations from the WHO will boost the success rate according to the report. Newer antibiotics like bedaquiline and oral drugs are given priority over injectables as they are less effective and have been associated with severe adverse effects according to new recommendations by WHOs global TB report. Data shows that the newer drugs have showed greater success in treatment and reduced morbidity and mortality rates [6].

As there are no research studies on Drug resistant TB in the district of Prakasam and this is a highest research priority of the nation, the present study was taken up to evaluate the prevalence and risk factors responsible for Drug resistance in TB patients of Prakasam district. Hence, the present study was conducted with the aim to analyse the incidence of drug resistant TB in the second quarter of 2019 in Prakasam district, Andhra Pradesh, India and also to determine the risk factors that are responsible to develop drug resistance to anti-tubercular drugs in TB patients of Prakasam District.

MATERIALS AND METHODS

A community based cross-sectional study was conducted. Study was conducted from April 1st to June 30th, 2019 in Prakasam District, Andhra Pradesh. Patient identifying information was removed prior to analysis. Research protocol was approved by Institutional Ethical Review Committee of Government Medical College, Ongole, Prakasam District (Approval number- IEC/G.M.C Ongole/2019/9). Drug resistant TB cases were confirmed by Cartridge Based Nucleic Acid Amplification Test (CBNAAT) to diagnose TB and Rifampicin resistance within 2 hours, RTPCR (Real time polymerase chain reaction) for rapid confirmation of diagnosis of *Mycobacterium Tuberculosis* (MTB) and MDR-TB and Line Probe Assay (LPA) to detect low level Isoniazid resistance. Most of the cases were detected by using CBNAAT technique, followed by RTPCR and LPA [7]. RTPCR and CBNAAT tests were performed by the technicians of the District TB Control unit under the control of District TB Control Officer, Prakasam district. For LPA, the sputum samples were sent to Intermediate Reference Laboratory, Visakhapatnam.

According to census 2011, population of Prakasam district was 33,92,764 [8]. It was standardised to the year 2019 as 36,85,898 by adding population based on population growth rate of Andhra Pradesh i.e., 1.08% per year.

The quarterly reporting system used in RNTCP enables analysis of cohorts of patients i.e., a group of patients who were registered for treatment in a specified area over a specified period of time. Under RNTCP, specified areas are TB unit, district, state and country whereas specified periods of time are four quarters of a year and one calendar year itself. A quarter is a three month period with the first quarter starting on 1st January of the year and one year is divided into four quarters (1st, 2nd, 3rd and 4th). This information helps national, state and district levels to assess the performance and monitor the implementation of the programme.

Inclusion criteria: All the registered drug resistant TB cases in Prakasam district who gave consent during the study period.

Exclusion criteria: Drug resistant cases that did not give consent and were not available at the time of study.

The registered drug resistant TB patients were included in the study in Prakasam district in the second quarter in between April 1st to June 30th 2019. They were interviewed according to predesigned and pretested questionnaire. The questionnaire was developed by the principle investigator after consultation with experts in public health and district TB officer. All the patients were informed about the purpose of the study in Telugu language and consent was taken from them. Study tools were pretested and reliability and validity were checked. A pilot study was conducted on 20 participants to analyse the study tool and discussed with district level officials, to know validity of study tool. It revealed that the study tool is a valid schedule and it had content construct validity. Reliability of the tool was tested by measuring Cronbachs alpha value. Cronbachs alpha value of the tool was measured as 0.92, indicating good internal consistency in the data and measuring, what ought to be measured.

The investigator posed questions to the participant in Telugu and filled the answers himself. Questions were probed to the participants for eliminating memory bias or recall bias. Answers to the questions were verified by physical verification of the health records such as treatment cards and medical records. The questionnaire included various risk factors like demographic, socio-economic factors (Modified BG Prasad Socio-economic Classification) [9], literacy, income, overcrowding, personal hygiene, malnutrition, history of smoking, alcohol, place of diagnosis, clinical type, disease complications, place of TB treatment, family support, treatment with how many drugs, adherence to drug intake, drug toxicity, psychological factors, awareness about sputum disposal and MDR-TB.

STATISTICAL ANALYSIS

Data was entered into an Excel spread sheet and double checked for errors. Data was analysed by using Epi Info and Excel software and depicted in proportions and cross tabulations. Chi-square test was applied to test the relationship of categorised independent, moreover dependent variables. A p-value of <0.05 was deemed statistically significant.

RESULTS

Prevalence of drug resistant TB in Prakasam district was calculated as 5.64 per one lac population. In the second quarter of the year 2019-2020, i.e., from April 1st to June 30th, 88 new cases were identified. Incidence of drug resistant TB in Prakasam district was calculated as 2.38 per one lac population. Out of 209 TB patients, registered 88 patients were having drug resistant TB in Prakasam district in the second quarter in between April 1st to June 30th 2019. Almost all the cases were pulmonary TB except one case. Majority had resistance to Rifampicin (79.55%) followed by Isonicotinic acid hydrazide or Isoniazid (INH) drug. Only one patient had drug resistance to both the drugs [Table/Fig-1].

[Table/Fig-2] depicts the risk factors associated with drug resistant cases. Among all the drug resistant cases, patients belonging to 20-40 years of age group (42%) and 40-60 (38.7%) were more in number.

Test used to detect drug resistant TB cases	N=88 (%)
RTPCR	23 (26.13%)
CBNAAT	53 (60.27%)
LPA	12 (13.60%)
Type of Infection	
Pulmonary Tuberculosis	87 (98.87)
Extra pulmonary tuberculosis	1 (1.13)
Type of Drug resistance	
Rifampicin resistant	70 (79.55%)
INH resistant	17 (19.31%)
Resistant to both Rifampicin and INH	1 (1.14%)

[Table/Fig-1]: Descriptive statistics of Drug resistant Tuberculosis (TB) cases reported in between April 1st to June 30th 2019 in Prakasam district.
RTPCR: Real time polymerase chain reaction; CBNAAT: Cartridge based nucleic acid amplification test; LPA: Line probe assay; INH: Isonicotinic acid hydrazide or Isoniazid

Risk factors	Age group	Frequency (N=88)	Percent
Socio-demographic factors	<20 years	5	5.7
	20-40 years	37	42
	40-60 years	34	38.7
	>60 years	12	13.6
	Gender		
	Male	67	76.1
	Female	21	23.9
	Occupation		
	Profession	4	4.5
	Skilled worker	63	71.6
	Unemployed	21	23.9
	Education		
	College	14	15.9
	Schooling	39	44.3
	Uneducated	35	39.8
	Marital status		
	Married	69	78.4
	Unmarried	19	21.6
	BG Prasad SE scale		
	Lower class	4	4.5
	Lower middle class	18	20.5
	Middle class	40	45.5
	Upper middle class	22	25
	Upper class	4	4.5
	Overcrowding		
	Yes	32	36.4
	No	56	63.6
	History of migration		
	Yes	75	85.2
	No	13	14.8
Personal habits	**History of smoking**		
	Yes	40	45.5
	No	48	54.5
	History of alcoholism		
	Yes	32	36.4
	No	56	63.6
	History of drug abuse		
	Yes	2	2.3
	No	86	97.7
Clinical conditions	**Past History of TB**		
	Default	6	6.8
	Failure	2	2.3
	Relapse	18	20.4
	No	62	70.5
	History of Cough		
	Yes	87	98.9
	No	1	1.1
	History of Breathlessness		
	Yes	43	48.9
	No	45	51.1
	History of Haemoptysis		
	Yes	10	11.4
	No	78	88.6
Other health conditions	**History of RVD**		
	Yes	76	86.4
	No	12	13.6
	History of DM		
	Yes	25	28.4
	No	63	71.6
	History of Malignancy		
	Yes	0	0
	No	88	100
	History of Immunosuppressive drug usage		
	Yes	0	0
	No	88	100
	Nutritional status		
	Ill nourished	49	55.7
	Moderately nourished	29	33.0
	Over nourished	10	11.4
	History of Psychological problems		
	Yes	23	26.1
	No	65	73.9
Other factors	**Do you have awareness about MDR-TB complications?**		
	Yes	67	76.1
	No	21	23.9
	Support of Family members		
	Yes	87	98.9
	No	1	1.1
	Adherence to treatment		
	Yes	82	93.2
	No	6	6.8
	History of Drug toxicity		
	Yes	48	54.5
	No	40	45.5
Present condition	**Present Sputum test result**		
	Positive	29	33.0
	Negative	59	67.0

[Table/Fig-2]: Prevalence of risk factors associated with drug resistant cases.
MDR: Multi-drug resistant; TB: Tuberculosis; RVD: Retro viral disease; DM: Diabetes mellitus

Less number of were from the age group below 20 years of age. Almost three fourths of cases (76.1%) were males. Most of the drug resistant cases belong to skilled workers group (71.6%) by occupation and had education up to school or no education. Most of the cases were from middle class (45.5%) according to modified BG Prasad classification, followed by upper middle class (25%). Overcrowding present in one-third of cases (36.4%). History of migration present in most of the cases (85.2%). Half of the patients had smoking habit and one-third had alcoholism. Drug abuse was observed in two cases.

Almost 70.5% cases had no previous history of TB and one-fifth of cases were relapses. Almost half of the cases had breathlessness and only one-tenth of the cases had haemoptysis. Eighty six per cent of them had history of retroviral disease and one-fourth had Diabetes mellitus. Half of the patients were ill nourished. One-fourth of patients had psychological problems. Most of them had awareness (76%) about MDR-TB complications. Adherence to treatment (93%) and family support (99%) was present in most of the cases. Drug toxicity was observed in 54.5% of the cases. After taking the treatment, two-thirds of cases (67%) became sputum negative and one-third of cases were still positive.

In [Table/Fig-3], association of history of different co-morbid conditions with type of drug resistance was tested by using chi-square test. Only two co-morbid conditions listed in [Table/Fig-3] i.e., history of drug toxicity and presence of psychological illness showed statistically significant association with type of drug resistance. History of drug toxicity and history of psychological illness were significantly high in Rifampicin resistant cases when compared to INH resistant cases.

History of co-morbid conditions		Resistance to which drug		Total	Chi-square (p-value)
		INH resistant (18)	Rifampicin resistant (70)		
History of drug toxicity	No	13	27	40	6.539 (0.011
	Yes	5	43	48	
History of psychological illness	No	17	48	65	4.965 (0.026
	Yes	1	22	23	
RVD	Yes	17	59	76	1.255 (0.263)
	No	1	11	12	
History of DM	No	11	52	63	1.222 (0.269)
	Yes	7	18	25	
History of nutritional status	Ill nourished	11	38	49	1.471 (0.499)
	Moderately nourished	4	25	29	
	Over nourished	3	7	10	

[Table/Fig-3]: Association of Co-morbid conditions with type of drug resistance.
RVD: Retro viral disease; DM: Diabetes mellitus; INH: Isonicotinic acid hydrazide or isoniazid
p-value <0.05 statistically significant

DISCUSSION

In the current study, it was observed that males are at higher risk of developing drug resistant TB. Many are in the working age group i.e., above 20 years of age. It can be linked with migration history and occupation history. The people who went on migration from their native area for work purpose are at risk of developing drug resistant TB. Their low educational status is not enough to take preventive measures to get protected against drug resistant TB. In the current study, the problem was seen mostly in middle socio-economic class population according to modified BG Prasad socio-economic scale. History of smoking and alcohol are also contributing risk of drug resistance TB.

These findings are consistent with the study conducted by Workicho A et al., [10]. Their study also stated that young patients as seen in present study, living in a household with only one room, history of previous treatment and being HIV infected were found to be independent predictors of MDR-TB [10]. Raaji J et al., in their study also noticed that MDR-TB was more common in 26-45 year age group and males as noticed in present study, previously treated TB case, positive history of contact with MDR-TB patient, patients previously on non-DOTS treatment, patients with associated co-morbidities and in substance abuse [11].

Pradipta IS et al., in their systematic review and meta analysis stated that the adverse drug reactions, patients 40 years and older, HIV positive were the risk factors as seen in present study and also non-adherence, previous TB disease and treatment, unemployed, lacking health insurance were the risk factors [12].

Stosic M et al., in their study, identified six significant independent risk factors, monthly income of the family, defaulting from treatment, stigma associated with TB, subjective feeling of sadness, use of sedatives as seen in the present study (psychological illness) and chronic obstructive pulmonary disease [13].

The current study revealed that, most of the cases had no previous history. They got drug resistant TB cases directly. It is an alarming signal. But, it can be linked to the history of retroviral disease and immune compromised status. Because of the presence of retroviral disease, patients got more severe form of TB directly or they are getting relapses. Almost half of the patients were ill nourished indicating the vicious malnutrition and infection cycle.

The present study also revealed that awareness about the disease is good and almost all patients adhered to the treatment and had good family support. It indicated the changing scenario in the society, which will give a hope to reach the goal to end TB by the year 2035. But, these results are in contrary to the study findings of some other study of Pradipta IS et al., conducted in different settings where non-adherence to anti-TB (anti-TB) medication is a major risk factor for poor treatment outcomes in the study [14].

Johnson J et al., in his study said that adverse drug effect as seen in the current study and default, travel to a different place; symptom relief and cost of treatment and history of relapse are the factors [15]. Drobniewski FA and Balabanova YM, in their study revealed that the reasons are failure of the patient to adhere to therapy (patient non-compliance), failure to modify the drug regimen in light of drug sensitivities as seen in the present study and failure to deal with non-compliance are the factors [16].

The present study revealed that, one-fourth of patients had psychological problems. As TB is a chronic disease, patients are developing psychological problems over a period of time. Thus, psychiatric care should also to be provided to the patients for psychological rehabilitation of the drug resistant TB patients. Rumende CM in his study also said psychiatric illness as was seen in the present study and poor compliance with the treatment are important factors in the development of acquired drug resistance [17].

In the present study, the history of drug toxicity and presence of psychiatric illness had significant association with drug resistance. Rifampicin resistance was significantly high in the patients who had history of drug toxicity and who had psychological illness when compared to others. Jaber AAS and Baharudin I, in their study revealed that 26% of patients have drug toxicity as seen in this study also and were lost to follow-up because of drug toxicity [18]. Jaber AAS et al., in their study said that 32.7% had side effects associated with treatment as observed in the present study [19]. Goble M et al., has also shown drug toxicity as seen in the present study. Fifty-one (30%) of 171 patients had adverse reactions that led to the discontinuation of one or more anti-mycobacterial medications. Twenty of these patients had serious toxic reactions to one or more drugs during the first three months of therapy [20]. Prasad R, in his study stated that non-compliant patients due to monetary lack, lack of information, side effects of drugs as seen in present study and social myths and misconceptions, often do not adhere to treatment [21].

Chuchottaworn C et al., in their study among the 145 patients with pulmonary MDR-TB, the DST results showed drug resistance to INH and RMP in all patients as seen in present study, EMB-resistance in 30 (20.7%) patients, and SM resistance in 88 (60.7%) patients [22]. The prevalence of present study (5.6/1 lac population) was compared with other studies in Andhra Pradesh. The prevalence was 1.7 to 11% in the category 1 and 2 patients in the study by Suryakumari V et al., [23] and 15% in the study conducted by

Armstrong E et al., the prevalence was 15% and 2-3% in the study of Chadha SS et al., risk factors were compared with present study [Table/Fig-4] [24,25].

Study	Place	Year	Incidence and Prevalence	Observations and Risk factors
Present study	Andhra Pradesh	2019	Incidence of 1st quarter is 2.38/1 lac. Prevalence is 5.64/1 lac	Male persons (76%), middle class (45.5 %) and migrating for work (85%) above 40 yrs are at the risk. Most of the patients are developing drug resistant TB directly. The rifampicin resistant patients were also developing psychological complications. Drug toxicity was observed in 55% of the cases.
Suryakumari V et al., [23]	Andhra Pradesh	2015	Category 1*- 4.5% Category 2*-1.7-11.1%	Prevalence is more among age group 20-39 y and among males when compared to females. Risk factors were co- infection with HIV.
Armstrong E et al., [24]	Andhra Pradesh and Chhattisgarh	2014	MDR-TB is estimated to account for 2.1% of new cases and 15% of previously treated TB cases [5].	Majority (80%) of them were males. All (80%) were adults. None HIV infected. Lost to follow-up is a challenge and community involvement may play a key role. Psychological disturbances after five months of treatment noted.
Chadha SS et al., [25]	Andhra Pradesh	2011	2-3%	Operational challenges that are resulting in the loss of patients during the MDR-TB diagnostic and treatment pathway.

[Table/Fig-4]: Trend of drug resistance among TB patients in Andhra Pradesh [23-25].
Note: Category 1: Treatment for new smear positive patients, Category 2*: Retreatment of relapsed, failure and default patients.
MDR: Multi-drug resistant; TB: Tuberculosis; HIV: Human immunodeficiency virus

Trend of drug resistance over 10 years is depicted in some studies. Kumar A et al., in their study stated that overall, MDR-TB cases gradually decreased from 2009 to 2015 in both new and previously treated cases in North India, but still, the prevalence rate was higher in North India than National prevalence rate of MDR-TB [26]. The National prevalence of MDR-TB is 3% in new cases and 12%-17% in retreatment cases [27]. Sharma N et al., showed a declining trend during the period of observation [28]. Mourya AK et al., in their study showed an increasing trend of MDR-TB in both new and previously treated cases in contrast to previous cases [29]. Suen SC et al., in their study stated that as transmission-generated MDR-TB becomes a larger driver of the MDR-TB epidemic in India, rapid and accurate MDR-TB diagnosis and treatment will become increasingly effective in reducing MDR-TB cases compared to non-MDR-TB treatment improvements [Table/Fig-5] [30].

Study	Place	Year	Observations and risk factors
Kumar A et al., [26] North India	Uttar pradesh	Year 2009- 35% 2010- 21% 2011- 25% 2012- 16% 2013- 18% 2014- 16% 2015- 13%	Overall, MDR-TB cases gradually decreased from 2009 to 2015 in both new and previously treated cases in North India, but still, the prevalence rate was higher in North India than National prevalence rate of MDR-TB. According to RNTCP, a decreasing number of MDR-TB in North India was noted from 2009 to 2015 as per the RNTCP annual status report.
Sharma N et al., Delhi [28]	Delhi	A retrospective record-based study (2009-2014) was conducted in three major drug resistance TB treatment centres of Delhi.	Showed a declining trend during the period of observation. Patients with age ≥35 y, male sex and undernourishment (body mass index <18.5 at the time of treatment initiation had a significantly increased likelihood of unfavourable MDR-TB treatment outcome (p<0.001).
Mourya AK et al., [29]	Lucknow	A continuous increasing trend of MDR-TB and non-MDR-TB was observed from 2007 to 2010. A total cases of 16 (36.4%), 18 (36.7%), 25 (39.1%) and 38 (40.8%) were identified as MDR-TB cases in 2007, 2008, 2009 and 2010, respectively.	Overall MDR-TB gradually increased from 2007 to 2010 in both new and previously treated cases in contrast to above studies which strongly highlights the need to make strategies for testing, surveillance, monitoring and management of such drug resistant cases.
Suen SC et al., [30]	Indian data	Strategies that disrupt MDR transmission by shortening the time between MDR activation and treatment are projected to provide greater reductions in MDR prevalence compared with improving non-MDR treatment quality: implementing MDR diagnostic improvements in 2017 is expected to reduce MDR prevalence by 39%, compared with 11% reduction from improving non-MDR treatment quality.	As transmission-generated MDR-TB becomes a larger driver of the MDR-TB epidemic in India, rapid and accurate MDR-TB diagnosis and treatment will become increasingly effective in reducing MDR-TB cases compared to non-MDR-TB treatment improvements.

[Table/Fig-5]: Drug resistance 10 years trend among TB patients in India [26,28-30].
MDR: Multi-drug resistant; TB: Tuberculosis; RNTCP: Revised national tuberculosis control programme

Limitation(s)

The current study was a cross-sectional study. Incidence of drug resistant TB cases was calculated based on the secondary data collected from District TB centre. Drug resistant TB cases diagnosed in private clinics and unregistered TB cases might be missed while calculating incidence. Influence of risk factors can be assessed better in case control study. Further larger studies needed to confirm results.

CONCLUSION(S)

Male persons having age above 20 years belonging to middle class (45.5%) and migrating for work are at the risk of developing drug resistant TB. Their low educational status is preventing them to take precautionary measures to get protection against TB. Most of the patients are developing drug resistant TB directly which is an alarming signal. Patients were also developing psychological complications, which needs to be addressed properly for better outcome of the patients. Further larger studies are needed to prove the association of risk factors with drug resistant TB.

Open data policy: The data was uploaded in github.com and made available in public domain after anonymising the collected data (https://github.com/DrSudhaKumari/MDRTB).

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