Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/jeza0z12

# LOSS TO FOLLOW UP CASES IN TUBERCULOSIS PATIENTS AVAILING TREATMENT AT DISTRICT TUBERCULOSIS CENTRE, BARABANKI, UP.

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**Abstract:**
Background: Tuberculosis (TB) remains a leading cause of death globally. Patients who get lost to follow-up (LTFU) during TB treatment have high risk of relapse, mortality, treatment failure and developing Multidrug resistant TB. Loss to follow-up during treatment is one of the major obstacles in the fight against tuberculosis, which has serious implications for patients, their families, communities, and health service providers. Indian government has implemented various strategies to track newly diagnosed tuberculosis (TB) cases and ensure follow-up for registered cases. Appropriate measures have been adapted to combat the spread of TB. Success of the treatment determines the effectiveness of the national TB control program. Hence, a study was aimed to investigate the factors associated with patient loss to follow-up (LTFU) during DOTS-TB treatment. This study was conducted using data from DOTS-TB registers of District Tuberculosis Centre, Barabanki, UP. Factors associated with LTFU were investigated using univariable and multivariable logistic regression. A total of 600 patients were registered for DOTS-TB treatment and eligible for inclusion between 1 April 2023 and 30 June 2025, of whom 92 (15.33%) were lost to follow-up. Conclusions: Loss to follow up pattern was seen more in urban patients, by gender more in male patients and by age groups observed more in older patients.

**Key Words:** Tuberculosis, DOTS-TB Treatment, Loss to follow up, Barabanki, UP.

**Introduction:** Mycobacterium tuberculosis (variant tuberculosis), along with other variants (e.g. bovis, africanum, microti), make up the Mycobacterium tuberculosis complex, a group of bacteria that cause clinical tuberculosis (TB) in humans [1]. Most TB cases are caused by M. tuberculosis variant tuberculosis. Cases due to other variants are less prevalent. Mycobacterium

tuberculosis is a slow-growing, chemoorganotrophic, non-motile, non-spore-forming, aerobic bacillus. Under optimal laboratory conditions at **37°C**, M. tuberculosis doubles every 24 h, taking approximately 3 weeks to form buff-coloured, rough colonies on agar plates. It is visualized via the Ziehl–Neelsen acid-fast stain whereby its thick, waxy cell wall retains carbol fuschin stain in the face of acid-alcohol washes. Biochemical tests, including positive niacin production and the ability to reduce nitrate, are used to differentiate it from other mycobacteria, although these have been superseded in many cases by PCR-based analysis of specific genetic loci ( figure-1)[2-8].

Mycobacterium tuberculosis- An Overview:[8]

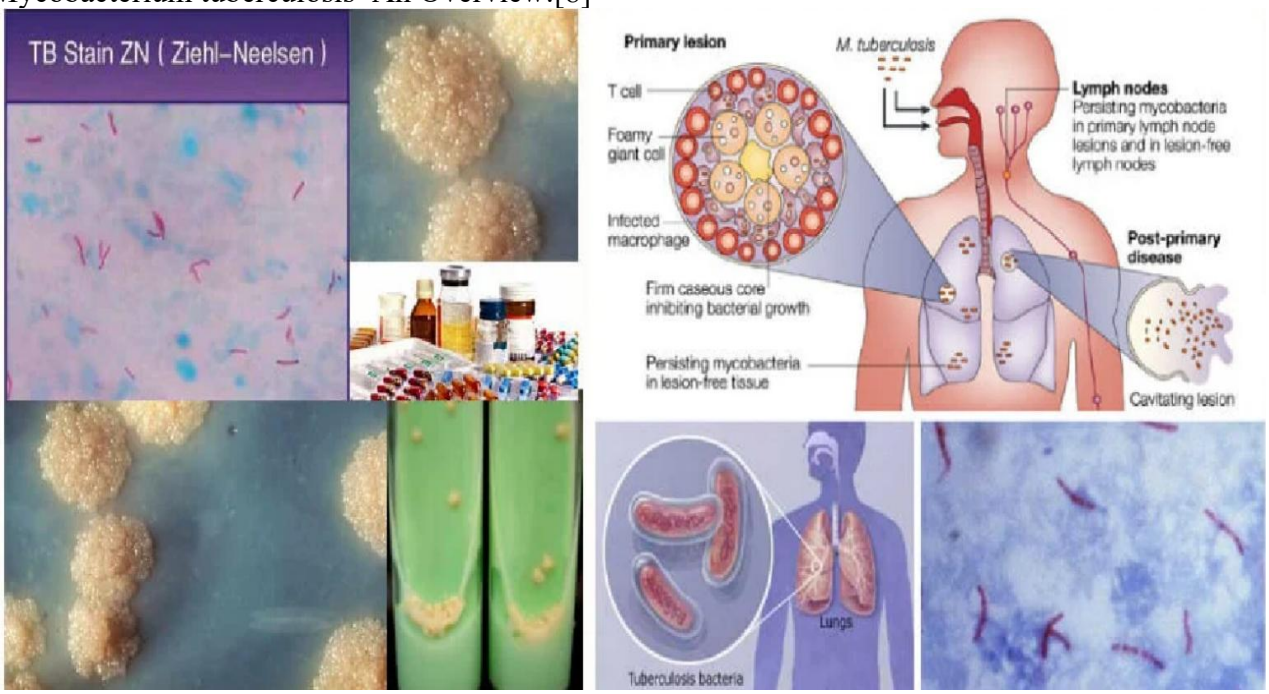



Figure-1, Notable features and Characteristic

- Biochemical Characteristics of Mycobacterium tuberculosis.

| S.N. | Biochemical Test | Results |
|---|---|---|
| 1 | 5% NaCl Tolerance | Negative (-ve) |
| 2 | 68°C Catalase Test | Negative (-ve) |
| 3 | Acid Phosphatase | Negative (-ve) |
| 4 | Amidase Test | Positive (+ve) |
| 5 | Arylsulphatase Test | Negative (-ve) |
| 6 | Growth on P-Nitrobenzoic Acid | Negative (-ve) |
| 7 | Growth on TCH (10mg/ml) | Positive (+ve) |
| 8 | Iron Uptake | Negative (-ve) |
| 9 | Neutral Red Test | Positive (+ve) |
| 10 | Nicain Test | Positive (+ve) |
| 11 | Nitrate Reduction Test | Positive (+ve) |
| 12 | Peroxidase Test | Positive (+ve) |

| | | |
|---|---|---|
| 13 | Pyrazinamidase Test | Positive (+ve) |
| 14 | Semi-Quantitative Catalase Test | Negative (-ve) |
| 15 | Tellurite Reduction Test | Variable |
| 16 | Tween 80 Hydrolysis | Negative (-ve) |
| 17 | Urease Test | Variable |

Tuberculosis (TB) is a curable disease, however, it remains one of the leading causes of death globally [8–11]. In 2022, it was the second leading cause of death globally from a single infectious agent after COVID-19. Up to 11.4million people developed TB in 2022 in the whole world [12]. The United Nations Sustainable Development Goals (SDG-3) set an ambitious target to end the TB epidemic in 2030 by reducing the TB incidence by 80% and TB deaths by 90% from the 2015 levels. Despite the progress made in TB diagnosis through use of rapid culture/molecular techniques such as Xpert MTB/RIF assay, and clinical management, the global targets (SDG-3) are off-track [13]. In 2022, TB is estimated to have caused 1.3 million deaths, a reduction of 19% since 2015, which is below the End TB Strategy target of reducing TB deaths by 75% before 2025 [14,15]. Sub-Saharan Africa and South-East Asia continue to bear the highest burden of TB deaths, accounting for 81% of deaths in 2022 [16,17].

India is the biggest contributor to the global burden of tuberculosis (TB), accounting for 27% of the 10 million incident cases, 24% of the 558,000 incident multi-drug resistant (MDR) cases, and 27% of the 1.5 million TB-related deaths annually [18]. The National Strategic Plan (NSP) for TB Elimination 2017-2025 aims to bring down the TB incidence rate to less than 44 per 100,000; the prevalence rate to less than 65 per 100,000; and the mortality to less than three per 100,000 by 2025 [19]. In 2018, at the End TB Summit held in New Delhi, the Government of India declared the vision of having a 'TB-Free' India by achieving the UN Sustainable Development Goals' TB-related targets five years in advance of the target year of 2030, hence "eliminating tuberculosis from India" by 2025 - the most ambitious target yet [20]. To achieve this target, no patient who comes under the care of the National Tuberculosis Elimination Programme (NTEP) should fall through the cracks. In reality, however, one-third of the patients being treated in the public health sector are lost between care-seeking and successful cure at multiple levels [21]. One such level for a diagnosed patient is treatment loss-to-follow-up (LTFU), defined as discontinuation of treatment for one or more month(s) after receiving it for at least one month. It was previously termed as 'treatment default' [22].

**Figure-1: Map of India showing the state-wise prevalence of MDR in new and previously treated patients [19].**

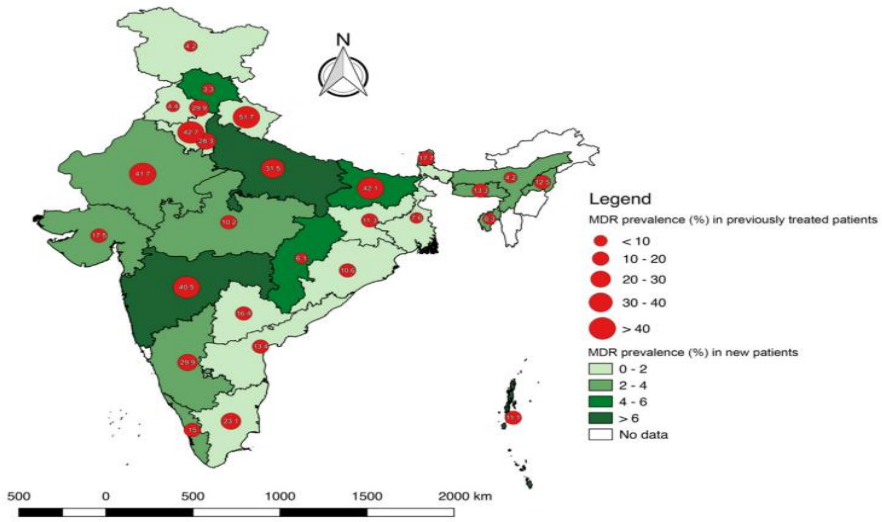
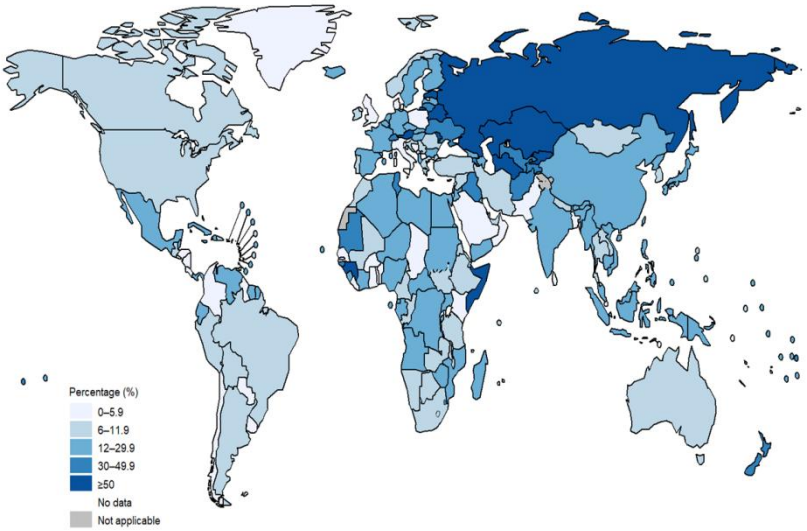


**Figure-2: Percentage of people with TB who had MDR/RR-TB, for those previously treated for TB, 2022 [19].**




Tuberculosis can be treated, prevented, and cured. Approximately 85% of people who develop TB disease can be successfully treated with a 6-month drug regimen. Since 2000, TB treatment has saved more than 60 million lives. However, despite the efforts to achieve universal health coverage (UHC), millions of people still lack access to proper diagnosis and care [23]. The directly observed therapy short course (DOTS) was implemented in 1981 in India. Despite the extensive expansion of DOTS services and the massive involvement of health extension workers (HEWs) in TB prevention and control activities, many TB patients are still failing to complete their treatment and achieve a cure [24, 25].

Loss to follow-up (LTFU) during treatment is one of the major obstacles in the fight against tuberculosis treatment and control. It presents serious implications not only for the patients themselves (including prolonged illness, the development of clinical complications, the development of drug resistance, and premature death), but it has the potential to lead to the spread and outbreaks of drug-resistant bacilli in their families, communities, and health service providers [26-29]. The proportion of LTFU varied considerably among different countries, different types of TB, and different patient populations. Research evidence reported in South Ethiopia indicated an 11.2% incidence of LTFU [18], 13.5% in Jimma, Ethiopia [30], 6.8% in China [19], 12.5% in Georgia [10], 18.1% in Brazil [11], and as high as 44.9% in Mozambique [31].

Several studies have identified various factors that contribute to patients failing to follow up on their TB treatment, including being male, advancing age, alcohol abuse among men, living in rural areas, moving within the country, distance from healthcare facilities, migration to another country, TB treatment, and weight loss [5, 9, 10, 13–16,32].

A recent study in Sandaun Province showed correlations between patients who were lost to follow-up and age, sex, category of TB treatment and HIV co-infection. The study also found that remoteness and living a long distance from health facilities were barriers to effective TB treatment [33].

Treatment behaviour is influenced by many factors such as prolonged duration of treatment, the need for multiple drugs, socio-economic factors and drug toxicity, perceived health benefits and subjective experience of illness[17-21]. Previous research reported travel expenses, traveling to treatment centres, male sex, poor patient information and communication, alcoholism and homelessness as the major determinants of non-compliance to anti TB treatment[19,20,21-24,34]. Thus, non-compliance to treatment by TB patients is a complex and multifaceted behavioural issue that needs to be understood better[25]. In spite of the provision of free-of-cost medicines under the Directly Observed Treatment-Short course (DOTS), the reported LTFU rates are high, ranging between 15-25% [15,35]. Quantitative studies have reported many factors that are associated with LTFU. However, there is a paucity of qualitative studies in India that provide an understanding of the causal pathways of a

suspected determinant leading to LTFU. The few existing qualitative studies had restricted themselves to reporting the viewpoints of either the patients or their family members or the DOTS providers [19,21-25,36,37]. Other studies, conducted outside India may have low transferability to our setting [36-38].

Incomplete anti tuberculosis treatment (ATT) results in increased transmission rates of the tubercle bacilli, delay in sputum conversion to smear-negative, morbidity, mortality and eventually rise cost to the TB control programmes[33]. It is the reason for the emergence of multi drug resistant strains of TB bacillus that emerged in the early 1990s, extensively drug resistant strains emerged in 2006 and now totally drug resistant strains emerged in 2012 in India[39]. Its management and treatment is very difficult and expensive thus over stretching the already strained resources for TB control in most developing countries[40]. Knowledge of the magnitude of LTFU and its associated factors is essential for successful TB control and the optimal delivery of healthcare services in resource-poor settings [17, 26, 29,41]. However, there are no published data on the proportion of loss to follow-up and its associated factors among patients enrolled in first-line tuberculosis treatment in the current study area. Therefore, The present study was embarked to identify the risk factors associated with lost to follow up during treatment among TB patients treated under DOTS in Barabanki District, Utter Pradesh, Northern India. The results of this study could aid in planning measures that could reduce the percentage of patients who discontinued their treatment.

## Materials and Methods

Materials:

Study Area:

A prospective study was conducted amongst the newly diagnosed Pulmonary tuberculosis (PTB) and Extra pulmonary tuberculosis (EPTB) patients, aged 18-70 years, both sexes who were enrolled under RNTCP DOTS programme of District Tuberculosis Centre, Barabanki, UP. The data was collected from April 2023 to June 2025.

### Methods:

DOTS under Revised National Tuberculosis Control Programme are an integral part of the public health system in India. TB diagnostic services and treatments are provided free of cost at DOTS centres, TB dispensaries and hospitals run by government. When a patient is diagnosed with TB, he/she is referred to the DOTS centre closest to his/her residence. At the DOTS centre, the patient is registered; a treatment card and a patient identity card are developed. The treatment card contains information on patient's demographic, treatment history; dates associated with current DOTS treatment and are maintained at the DOTS centre. The patient identity card contains information on patient's current treatment and is carried by the patient. It is updated by the DOTS centre staff. After a positive diagnosis of TB both pulmonary and extra-pulmonary, the patient is categorized to receive a particular drug regimen (Category I, II, or IV) based on the results of laboratory diagnosis and past history of TB. All the three categories of treatment consist of two phases of treatment: intensive and continuous phases. During the intensive phase, the patient comes to the DOTS centre three times a week and receives drugs under direct supervision. During the continuous phase, the patient comes to the DOTS centre once a week; receives one dose under supervision and carries home the remaining doses for the week. The above process is continued until the end of the treatment regimen.

Study Design and Data collection

A multi stratified study was conducted among 600 adult TB patients enrolled in Category- I of the treatment regime. The age group of the study cohort was 18-70 years. For the present study the data was collected within a week of starting their treatment and then followed up twice during treatment period i.e. at the end of intensive phase and in the last week of continuation phase (end of treatment). For the present investigation patients who lost to follow up formed the cases, while those who completed treatment made up the control group. Out of 600 patients, 527 (87.83%) completed their treatment and 73 (12.16%) lost to follow up during treatment. As per World Health Organisation definition of lost to follow up is defined as "A TB patient whose treatment was interrupted for 2

consecutive months or more" and treatment completed as"A TB patient who completed treatment without evidence of failure but with no record to show that sputum smear or culture results in the last month of treatment and on at least one previous occasion were negative, either because tests were not done or because results are unavailable"[24].

A structured questionnaire was used to collect information on basic socio-demographic data, type of TB, family history of disease, socio-economic status etc. TB register and treatment cards of patients were reviewed at each follow up for treatment details such as drug regularity, number of doses taken by the patients and time of lost to follow up were obtained from treatment cards.

The purpose and procedure of the study was explained to all the patients prior to data collection and a written consent was obtained from each patient who volunteered for the study. The study protocol was duly approved by the institutional ethical clearance committee.

Dependent variable: Patients whose tuberculosis treatment status was lost to follow- up were defined as discontinuing treatment for two or more consecutive months (8 weeks) for any reason without medical consent [18].

Operational definitions of treatment outcomes were according to WHO's guidelines.[8]

Smear-positive pulmonary tuberculosis: Any patient with two posi- tive smears or at least one positive smear along with a chest X-ray suggestive of pulmonary tuberculosis.

Smear-negative pulmonary tuberculosis: Patients with three consecutive negative smears were reevaluated after a course of antibi- otics. If the patient did not respond to the antibiotic treatment and the radiologic changes are suggestive of pulmonary tuberculosis, they were considered to have smear-negative pulmonary tuberculosis.

Extra-pulmonary tuberculosis: TB that affects organs other than the lungs.[7].

Independent variables: Independent variables that were fully recorded in DOTs-TB register and was included in the final analysis, which included the variables of Year Diagnosed, Standard of Treatment, Gender, Occupational Status, Place of Residence, Close Contact Examination, Referral Status, Type of Diagnosis Enforcement, Type of TB, Patient Referral Status, Diabetes Mellitus Status, HIV Status, Drug Source. The year diagnosed is the year when the respondent first received a TB diagnosis through molecular rapid tests, X-rays, and Mantoux which were classified into 2023 and 2025 (April – June). Standards of Treatment were respondents who were given treatment in accordance with the National Guidelines for Medical Services for Tuberculosis Management; Gender was classified into male and female; Employment status was classified into working and not working; Place of residence was categorized into Semarang City and Outside Semarang City; Close contact examination was classified into close contact examination or no close contact examination; Referral status was categorized into referral patients or patients who come alone to health services for TB tests; Methods of diagnosis were categorized into diagnosis of TB clinically or bacteriologically; The type of TB was classified into pulmonary TB or extrapulmonary tuberculosis; Patient status was categorized into whether new patient.

Statistical analysis: The data was presented in frequency and percentage based on a LTFU status. Chi-square analysis was performed to determine the relationship between the independent and dependent variables. P-value <0.05 was considered statistically significant. The independent variable, which has a p-value lower than 0.25, was included in the multivariable analysis. The final model was analyzed using Binary Regression Logistics Backward LR. All analyzes were performed by SPSS 26.1 (IBM Corporation, NY, USA).

**Results:**

During the study period, a total of 600 new patients were registered for DOTS-TB treatment. Of these, 432 (72%) were under age group of 18-30 years. It has also found that, 252 (42%) male and 180 (30%) female were were under age group of 18-30 years. A total of 355 ( 59.16%) were male and 245 (40.83%) were female in this study (table-1 Fig-1). All TB patients were confirmed bacteriologically.

**Table-1: Socio-Economic and Demographic Distribution of Study population.**

| Variables | N=600 | ( %) | | |
|---|---|---|---|---|
| Gender | | | | |
| Male | 355 | 59.16% | | |
| Female | 245 | 40.83% | | |
| Age (Years) | Male | Female | Male | Female |
| 18-30 (n=432/ 72%) | 252 | 180 | 42% | 30% |
| 31-50 (n=116/19.33%) | 71 | 45 | 11.83 % | 7.5% |
| 51-70 (n=52/8.66%) | 32 | 20 | 5.33% | 3.33% |
| Marital status,( n=416/69.33%) | 231 | 185 | 38.5% | 30.83% |
| Unmarried | 124 | 60 | 20.66 % | 10% |
| Married,(184/30.66%) | | | | |
| Members in household | | | | |
| <5 | 322 | 53.66% | | |
| >5 | 278 | 46.33% | | |
| Occupation | | | | |
| Employed | 302 | 50.33% | | |
| Unemployed (including students and housewives) | 196 | 32.66% | | |
| Self-employed/Daily wager | 102 | 17% | | |
| Education | | | | |
| Higher secondary and above | 388 | 64.66% | | |
| Primary | 70 | 11.66% | | |
| Illiterates | 142 | 23.66% | | |
| Alcohol consumption status | | | | |
| Yes | 144 | 24% | | |
| No | 456 | 76% | | |
| Smoking status | | | | |
| Yes | 202 | 33.66% | | |
| No | 398 | 66.33% | | |
| Family History of TB Yes | 208 | 34.66% | | |
| No | 392 | 66.33% | | |
| Socio-economic status | | | | |
| Upper Income | 56 | 9.33% | | |
| Middle class | 243 | 40.5% | | |
| Poor | 301 | 50.16% | | |
| Waiting time at health centre | | | | |
| <30 minutes | 335 | 55.83% | | |
| > 30 minutes | 265 | 44.16% | | |
| Living status | | | | |
| With family | 489 | 81.5% | | |
| Alone/with friends | 211 | 35.16 | | |

**Figure-1: Distribution of age and sex in study population**

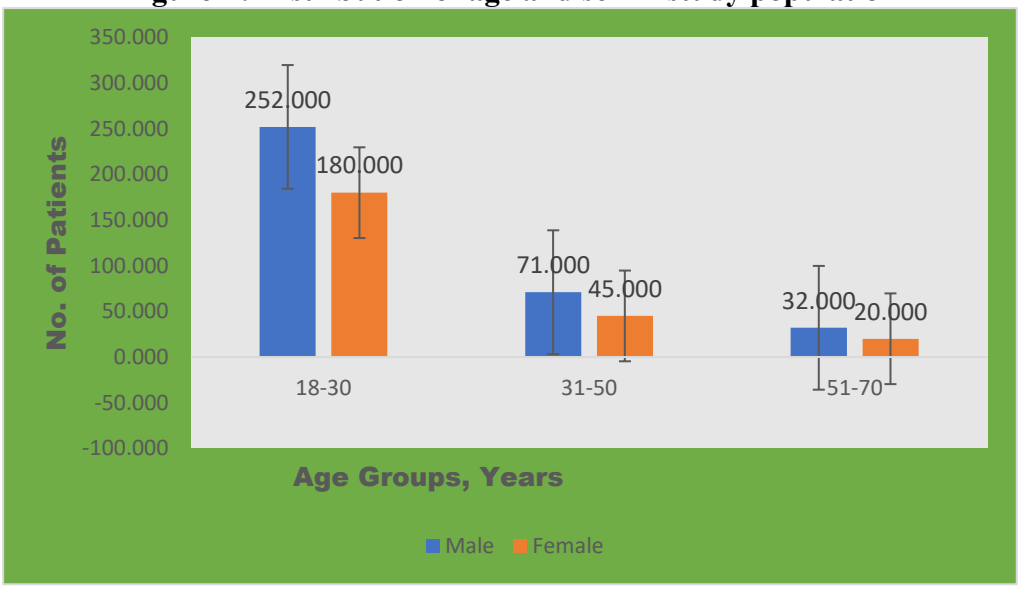
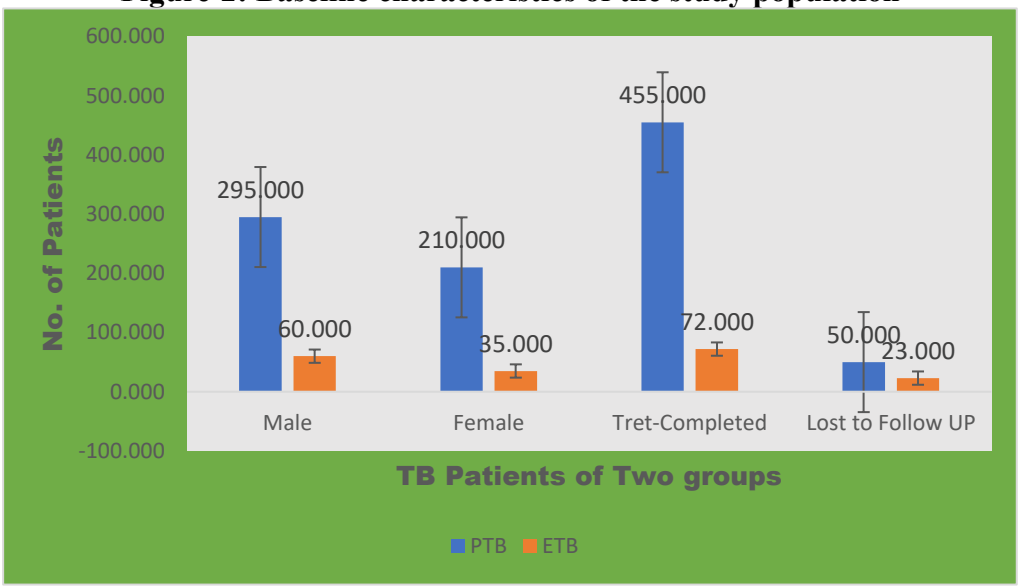



**Table- 2: Baseline characteristics of the study population:**

| Type of TB | Enrolled Treatment N=600 | forcompleted | | Lost to follow up | |
|---|---|---|---|---|---|
| | Male | Female | (%) | N | ( %) |
| PTB (n=505) | 295 | 210 | 455 (90.09%) | 50 | (9.90%) |
| EPTB (n=95) | 60 | 35 | 72(75.78%) | 23 | (24.21%) |
| Total (n=600) | 355 | 245 | 527(87.83%) | 73 | (12.16%) |

**Figure-2: Baseline characteristics of the study population**




As shown in Table-2 and figure-2, the study cohort consisted of 600 TB patients, out of which 527(87.83%) completed their treatment and 73 (12.16%) lost to follow up. Among the TB patients who completed their treatment, 455 (90.09%) had pulmonary TB and 72 (75.78%) had extra-pulmonary TB. Among the lost to follow up cases 50 (9.90%) suffered from pulmonary TB, and 23(24.21%) had extra-pulmonary TB. It was also observed that the success rate was 87.8 %. Male

TB patients had a treatment success rate of 82.2 % while females had a significantly higher treatment success rate of 88.7 %. (AOR = 1.228 95 % CI, 1.024–1.472, P= 0.026).

Descriptive analysis of the investigated cohort showed that 432(72%) were in their most economically productive age group(18-30 Years). Less than half 231(38.5%) were males,185 (30.83%) female were married. Almost two-third 388(64.66%) were having secondary and higher education, 196 (32.66%) were unemployed and had ( Smokers were 202 (33.33%) and alcoholics were 144 (24%). Patients belonging to middle class socio economic status were 243(40.5%). Majority 489(81.5%) were living with their families and 322 (53.66%) had a family size of less than 5 members in a household. 208(34.66%) had a family history of the disease. [Table-1, presents the socio-demographic characteristics of the study cohort].

Univariate analysis of these factors as shown in table-3, revealed the significant association of default with occupation, smoking, alcohol consumption, marital status and socio-economic status. It was shown that patient who were employed in jobs and those who were self-employed were likely to have 2.68 times and 2.4 more risk of lost to follow up than those who were unemployed. Similarly smokers and alcoholics had 2.38 and 3.22. times increased risk of being non-compliant to treatment as compared to non-smokers and non- alcoholics. Patients belonging to poor socioeconomic status had 4.12 times high risk of leaving their treatment in between in comparison to middle class patients. Married patients were 2.84 times more likely to be lost to follow up than unmarried ones. However no significant association had been shown by sex, age, education, living status, waiting time at health centre, and members in household with lost to follow up in treatment.

**Table-3: Univariate logistic regression analysis between socio-demographic factors and defaulting**

| Variables | UOR | 95% CI | | p-value |
|---|---|---|---|---|
| | | Lower bound | Upper bound | |
| SEX Male<br>Female | 1.97<br>0 | 0.813 | 4.76 | 0.134 |
| Age 18-30 years<br>31-50 years | 0.761<br>0 | 0.31 | 1.87 | 0.552 |
| Marital status<br>Married Unmarried | 2.84<br>0 | 1.09 | 7.42 | 0.032 |
| Members in household<br><5<br>>5 | 1.73<br>0 | 0.731 | 4.08 | 0.213 |
| Occupation<br>Unemployed (including students and housewives) Self-employed/Daily wagerJob | 0.31<br>0.75<br>0 | 0.115<br>0.228 | 0.832<br>2.47 | 0.02 |
| Education<br>Higher secondary and above<br>Primary<br>Illiterates | <br>0.53<br>0.99<br>0a | <br>0.21<br>0.29 | <br>1.38<br>3.38 | <br>0.195<br>0.987 |
| Alcohol consumption status<br>Yes No | 3.22<br>0 | 1.36 | 7.65 | 0.008 |
| Smoking status Yes No | 2.38<br>0 | 0.1 | 5.68 | 0.05 |
| Family History of TBYes No | 0.84<br>0a | 0.37 | 1.93 | 0.68 |

| | | | | | |
|---|---|---|---|---|---|
| Socio-economic status | Middle class<br>Poor | 0.4<br>0a | 0.17 | 0.95 | 0.04 |
| Waiting time at health centre<br><30 minutes<br>> 30 minutes | | 1.76<br>0 | 0.77 | 4.02 | 0.181 |
| Living status | With family<br>Alone/with friends | 0.97<br>0a | 0.27 | 3.53 | 0.964 |

**Table-4: Factor loadings of principal component analysis with varimax rotation.**

| Variables | Component | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| Age | | 0.55 | | |
| Sex | 0.825 | | | |
| Marital status | | -0.67 | | |
| Livingstatus | -0.43 | | | |
| Smoking status | 0.681 | | | |
| Alcohol consumption status | 0.784 | | | |
| Waiting timeat health centre | | | | 0.91 |
| Family history of TB | | | 0.734 | |
| Socio-economic status | | 0.64 | | |
| No.of members in household | | | -0.66 | |
| Occupation | -0.54 | | | |
| Education | | 0.796 | | |
| Variance | 20.29 | 15.71 | 11.92 | 8.98 |

Kaiser-Meyer-Olkin Measure of Sampling Adequacy: 0.644 Bartlett's Test of Sphericity $p<0.01$, Cumulative R2=56.9

Table-4, shown the clustering of socio-demographic characteristics of TB patients. The Kaiser-Meyer-Olkin statistic, a measure of sampling adequacy (KMO-0.712) indicated that the pattern of correlations was adequate and factor analysis would yield distinct and reliable factors. Significant Bartlett's test for sphericity (<0.001) revealed existence of relationship between the variables included in the factor analysis and acceptability of factor model. ccording to the criterion of an eigenvalue greater than 1.0, four factors were extracted in the exploratory factor analysis. The cumulative percent of variance accounted by these three factors was 56.9%. For each factor, variables with factor loading greater than 0.4 were retained in the model. Factor 1 consisted of variables like Sex, living status, smoking alcohol and occupation and largest proportion of total variance (20.29%). Factor 2 comprised of age, marital status, socio-economic status and education with 15.71% variance. Family history of TB and number of members in household characterize the factor 3 and explained 11.2% of the variance. Factor 4 consisted of waiting time at health centre with 8.9% variance in the model.

**Table-5 And Figure-3: Distribution of TB patients according to treatment outcome.**

| variables | N/% (N=600) |
|---|---|
| Cured | 439/73.16% |
| Treatment Completed | 527/87.83% |
| Treatment | 88/14.66% |

| | |
|---|---|
| Failure | |
| Lost to follow Up | 73/12.16% |
| Died | 0/0.0% |
| Not evaluated | 0/0.0% |

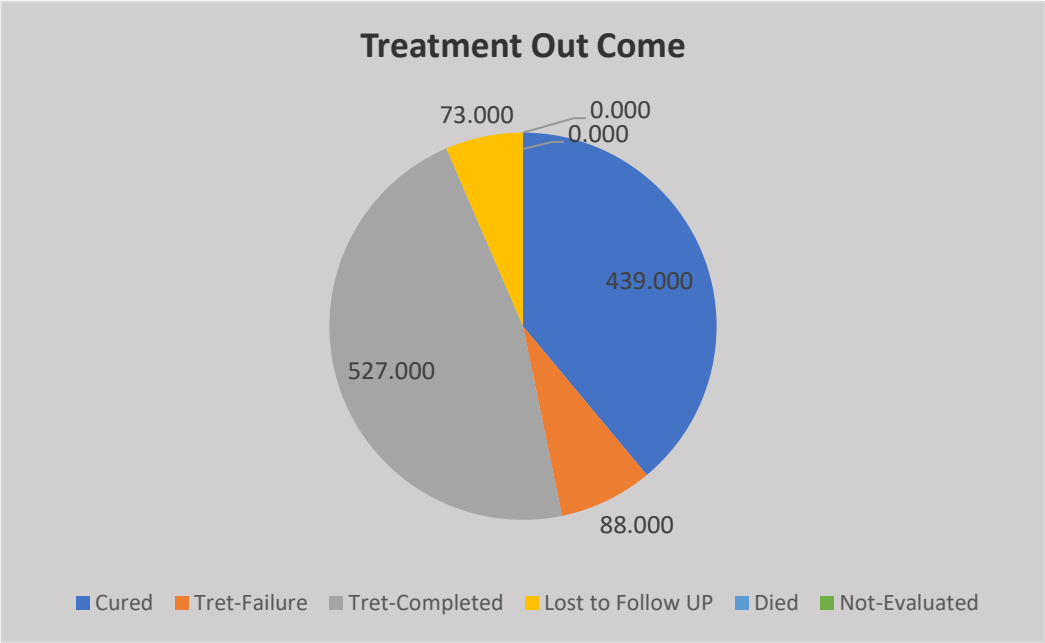



**Figure-3, illustrating the treatment out comes.**

Overall treatment success rate was 83.8 %. Male TB patients had a treatment success rate of 82.2 % while females had a significantly higher treatment success rate of 86.7 %. (AOR = 1.228 95 % CI, 1.024–1.472, P= 0.026). Treatment outcome varied across age groups, ranging from 76.8 % to 96.6 %. The younger age group ≥18 had a 9.2 times higher success rate significantly associated with successful treatment outcome [ table-5 and fig-3]. Distance could be a factor for the treatment success rate for socioeconomically weaker, female, housewife patients. In this study 31.83% patients were registered for treatment due to <2 km distance( table-6).

**Table-6:Distance to diagnosing and referring facility (km)**

| Distance =KM | N=600 | % |
|---|---|---|
| <2 | 191 | (31.83) |
| 2–4 | 160 | (26.66) |
| 5–9 | 109 | (18.16) |
| 10–14 | 97 | (16.16) |
| ≥15 | 43 | (7.16) |
| Median (IQR) | 7.0 (0.0–18.0) | |

**Discussion:**

World Health Organisation places high emphasis on achieving high compliance levels than finding new cases[25]. Non-compliance increases the likelihood of developing multi-drug resistance TB (MDR-TB) and extreme-drug resistant TB (XDR-TB). This will further increase the burden of a disease that is already very great and increases the costs of its management[36].

The present study has documented a lost to follow up rate of 12.16%. This finding is comparable to other studies conducted in Mumbai, India[21] and Nepal[27]where the non-compliance rates were 16% and 16.1% respectively. Previous investigations conducted worldwide among patients receiving

DOTS treatment had reported non adherence rates ranging from 5% in Malawi, to 29.8% in Zambia [18. 29].

In the context of published literature, the present study findings were in line with some and inconsistent with others. Among demographic factors, it was found that gender, age, total no. of members in household and education were in risk factors of non-compliance. This finding was in line with many other studies [30- 32]. Logistic regression analysis in search for factors strongly associated with default revealed that marital status, occupation, smoking, alcoholism and poor socio-economic status act as potential risk factors. Patients who were married had a higher risk of lost to follow up compared to those who were single. A possible explanation could be family responsibility and associated lack of money and time which may have reduced their attention to health care. The Present study finding was contrary to studies in Kenya and China where patients who were singles had higher risk of defaulting compared to patients who were married [33,34]. However, this study finding was similar to a study in Bangalore, India and Benin city, Nigeria which indicated a statistically significant association between patients who were married and lost to follow up [37, 39].

A significant effect of being employed on patients' compliance was found, corroborating the findings of a previous study [20]. The researcher reported that non-compliant patients were more likely to be workers. This was attributed to the fact that the travelling time for an employed patient represents a time absent from work. Coupled with the fact that some employers may not take kindly to the frequent long periods during which TB patients need to attend health facilities for treatment, means that long-term treatments such as that for TB may pose huge problems for such individuals [23]. In the present study, the possible explanation for non-compliance among employed patients could be because they belonged to lower socio-economic strata and they were the sole bread earning members of their family.These factors may put a lot of stress on them, to the extent that as soon as they begin to feel better, they will choose to return to work to continue to providefor their families. However, in the present study females and students constituted majority of unemployed group, due to time available to go to DOTS centre to take doses on proper time, the unemployed patients were more towards complying with the treatment. However a study conducted in South India, found no association between treatment compliance and employment status[44].

Most of the patients in the studied population were also poor and this makes it difficult for them to afford the cost of transport and other essential needs during the treatment. For such patients, motivation to continue with treatment decreased over time and the moment they begin to see improvement in their condition, lost to follow up from treatment was the most appealing option. Similar observations were shown in a study[43].

It was also found that the alcohol consumption during the treatment period to be a risk factor for non-compliance. Alcohol consumption was extremely predominant among lower socio-economic class individuals in this area and combined with deprivation of adequate nutrition was likely to lead to severe reactions like vomiting and nausea, thus promoting non-compliance to TB treatment among patients. Another possible explanation could be the improvement in one's health status as they progress through the phases of TB treatment. It was likely that as patients take longer on treatment, they may reverted back to their drinking habits possibly because they feel their health status had improved as opposed to those who have just started [33-39].

The present study results were consistent with previous investigations. Alcoholism had been reported as a significant factor of patient non-compliance among tuberculosis patients receiving DOTS treatment in Mumbai, India and Denver, USA [37, 39]. Innovative strategies are urgently needed for managing this problem.There was immense need for continuous, effective and reinforcing health education to the patient and his family. Male alcoholics need to be counseled and repeatedly motivated from the starting of the treatment. Time and efforts should be invested during treatment as these factors could easily be identified without additional inputs[32].

Smoking was also found to be positively associated with lost to follow, among newly diagnosed patients. A similar finding was observed among TB patients receiving standard TB regimen in Mumbai, India, Saudi Arabia and among TB patients receiving DOTS therapy in New York City, USA

[39-44]. None of the previous studies have suggested a possible reason why smoking was positively associated with lost to follow up during the treatment.
Our study findings revealed that waiting time at health centre and living status did not had a significant association with non-compliance. These findings were in agreement with a previous studies [4-44]. This conflicts results from other studies that showed significant associations [41-43]. It was thus possible that although this may be an important factor among this population, but the study did not had sufficient sample size to detect any association.
Four factors extracted from principal component analysis showed that variables in each clusters were interlinked with each other and cumulatively affects treatment compliance. So rather than considering them as an independent factors these should be treated in a nested way. However, further studies with different research design need to be conducted to explore interwoven relationship between factors which hinders compliance to the treatment.

**Conclusion:**
This study has demonstrated few of the factors which influence lost to follow up in TB treatment. Although medicines were provided free, the burden of cost to travel to the treatment facility could be a disabling factor in completing treatment. In congruence with this, low socio-economic status, family liabilities and burden of losing income from work on male patients contributed to non-compliance. Improved education for patients, their families and the general population may improve compliance, effective solutions addressing travel related concerns, modification of lifestyle behaviours and emphasizing on motivating patients to come to the DOTS centre to receive therapy which are essential to treatment completion among TB patients in an rural setting like Barabanki, UP., India.

**Reference:**
1. Fukunaga R, Glaziou P, Harris JB, Date A, Floyd K, Kasaeva T. Epidemiology of tuberculosis and progress toward meeting global targets - worldwide, 2019. MMWR Morb Mortal Wkly Rep. 2021;70(12):427–30.
2. Riojas MA, McGough KJ, Rider-Riojas CJ, Rastogi N, Hazbón MH. Phylogenomic analysis of the species of the Mycobacterium tuberculosis complex demonstrates that Mycobacterium africanum, Mycobacterium bovis, Mycobacterium caprae, Mycobacterium microti and Mycobacterium pinnipedii are later heterotypic synonyms of Mycobacterium tuberculosis. Int J Syst Evol Microbiol. 2018 Jan;68(1):324-332. https://doi.org/10.1099/ijsem.0.002507
3. Central TB Division, Directorate General of Health Services, Ministry of Health and Family Welfare, Government of India: Revised National Tuberculosis Control Programme. National Strategic Plan for Tuberculosis Elimination 2017-2025. Central TB Division (ed): Central TB Division, Nirman Bhawan, New Delhi, India; 2017. https://www.tbcindia.gov.in/WriteReadData/National%20Strategic%20Plan%202017- 25.pdf.
4. Nicholson TJ, Hoddinott G, Seddon JA, Claassens MM, van der Zalm MM, Lopez E, et al. A systematic review of risk factors for mortality among tuberculosis patients in South Africa. Syst Rev. 2023;12(1):23.
5. . WHO. Use of high burden country lists for TB by WHO in the post-2015. Geneva: WHO; 2015. Accessed and cited in November 2019. Available from: https://www.who.int/tb/publications/global_report/high_tb_ burdencountrylists2016-2020.pdf
6. World Health Organization. Global tuberculosis report 2023. Geneva: WHO, 2023.
7. Mundra A, Deshmukh PR, Dawale A: Magnitude and determinants of adverse treatment outcomes among tuberculosis patients registered under Revised National Tuberculosis Control Program in a Tuberculosis Unit, Wardha, Central India: A record-based cohort study. J Epidemiol Glob Health. 2017, 7:111-8. 10.1016/j.jegh.2017.02.002
8. Gordon SV and Parish T. Microbe Profile: Mycobacterium tuberculosis: Humanity's deadly microbial foe. Microbiology; 2018;164:437–439

9. Global Tuberculosis Programme: Global Tuberculosis Report 2021. Global Tuberculosis Programme (ed): World Health Organization, Geneva; 2021. https://www.who.int/publications/i/item/9789240037021
10. Kant S, Singh AK, Parmeshwaran GG, Haldar P, Malhotra S, Kaur R: Delay in initiation of treatment after diagnosis of pulmonary tuberculosis in primary health care setting: eight year cohort analysis from district Faridabad, Haryana, North India. Rural Remote Health. 2017, 17:4158.
11. Ahmad S, Velhal G: Study of treatment interruption of new sputum smear-positive TB cases under DOTS strategy. Int J Med Sci Public Health. 2014, 3:977-81.
12. Karanjekar V, Lokare P, Gaikwad A, Doibale M, Gujrathi V, Kulkarni A: Treatment outcome and follow-up of tuberculosis patients put on directly observed treatment short-course under Rural Health Training Center, Paithan, Aurangabad in India. Ann Med Health Sci Res. 2014, 4:222-6.
13. Pandit S, Dey A, Chaudhuri AD, et al.: Five-years experiences of the Revised National Tuberculosis Control Programme in northern part of Kolkata, India. Lung India. 2009, 26:109-13.
14. Krishnan A, Kapoor SK: Involvement of private practitioners in tuberculosis control in Ballabgarh, Northern India. Int J Tuberc Lung Dis. 2006, 10:264-9.
15. Jaiswal A, Singh V, Ogden JA, et al.: Adherence to tuberculosis treatment: lessons from the urban setting of Delhi, India. Trop Med Int Health. 2003, 8:625-33.
16. Jayachandran V: A case study on tuberculosis treatment defaulters in Delhi: Weak health links of the community with the public sector, unsupported migrants and some misconceptions. Annals of Tropical Medicine and Public Health. 2014, 7:124.
17. Shiotani R, Hennink M: Socio-cultural influences on adherence to tuberculosis treatment in rural India . Glob Public Health. 2014, 9:1239-51.
18. Shringarpure KS, Isaakidis P, Sagili KD, Baxi RK, Das M, Daftary A: "When treatment is more challenging than the disease": a qualitative study of MDR-TB patient retention. PLoS One. 2016, 11:e0150849.
19. Velavan A, Purty AJ, Shringarpure K, et al.: Tuberculosis retreatment outcomes and associated factors: a mixed-methods study from Puducherry, India. Public Health Action. 2018, 8:187-93.
20. Chida N, Ansari Z, Hussain H, Jaswal M, Symes S, Khan AJ, Mohammed S: Determinants of default from tuberculosis treatment among patients with drug-susceptible tuberculosis in Karachi, Pakistan: a mixed methods study. PLoS One. 2015, 10:e0142384.
21. Martins N, Grace J, Kelly PM: An ethnographic study of barriers to and enabling factors for tuberculosis treatment adherence in Timor Leste. Int J Tuberc Lung Dis. 2008, 12:532-7.
22. Hasker E, Khodjikhanov M, Sayfiddinova S, et al.: Why do tuberculosis patients default in Tashkent City, Uzbekistan? A qualitative study. Int J Tuberc Lung Dis. 2010, 14:1132-9.
23. Munro SA, Lewin SA, Smith HJ, Engel ME, Fretheim A, Volmink J: Patient adherence to tuberculosis treatment: a systematic review of qualitative research. PLoS Med. 2007, 4:e238.
24. Rosenstock IM: Historical origins of the Health Belief Model . Health Education Monographs. 1974, 2:328-
25. Garrido Mda S, Penna ML, Perez-Porcuna TM, et al.: Factors associated with tuberculosis treatment default in an endemic area of the Brazilian Amazon: a case control-study. PLoS One. 2012, 7:e39134.
26. Muture BN, Keraka MN, Kimuu PK, Kabiru EW, Ombeka VO, Oguya F: Factors associated with default from treatment among tuberculosis patients in Nairobi province, Kenya: a case control study. BMC Public Health. 2011, 11:696. 10.1186/1471-2458-11-696
27. Franke MF, Appleton SC, Bayona J, et al.: Risk factors and mortality associated with default from multidrug- resistant tuberculosis treatment. Clin Infect Dis. 2008, 46:1844-51. 10.1086/588292
28. Dodd PJ, Yuen CM, Sismanidis C, Seddon JA, Jenkins HE. The global burden of tuberculosis mortal- ity in children: a mathematical modelling study. Lancet Glob Health. 2017;5(9):e898–906.

29. Nliwasa M, MacPherson P, Gupta-Wright A, Mwapasa M, Horton K, Odland JØ, et al. High HIV and active tuberculosis prevalence and increased mortality risk in adults with symptoms of TB: a system- atic review and meta-analyses. J Int AIDS Soc. 2018;21(7):e25162.
30. Odone A, Amadasi S, White RG, Cohen T, Grant AD, Houben RMGJ. The impact of antiretroviral therapy on mortality in HIV positive people during tuberculosis treatment: a systematic review and meta-analysis. PLoS One. 2014;9(11):e112017.
31. Sullivan A, Nathavitharana RR. Addressing TB-related mortality in adults living with HIV: a review of the challenges and potential solutions. Ther Adv Infect Dis. 2022;9:20499361221084163.
32. Ngari MM, Rashid MA, Sanga D, Mathenge H, Agoro O, Mberia JK, et al. Burden of HIV and treatment outcomes among TB patients in rural Kenya: a 9-year longitudinal study. BMC Infect Dis. 2023;23(1):362.
33. Volmink J, Garner P. Directly observed therapy for treating tuberculosis. Cochrane Database Syst Rev. 2006;(2):CD003343.
34. Jiang Y, Chen J, Ying M, Liu L, Li M, Lu S, et al. Factors associated with loss to follow-up before and after treatment initiation among patients with tuberculosis: A 5-year observation in China. Front Med (Lausanne). 2023;10:1136094.
35. Belay GM, Wubneh CA. Childhood tuberculosis treatment outcome and its association with HIV co-infection in Ethiopia: a systematic review and meta-analysis. Trop Med Health. 2020;48:7.
36. Birhane M, Mekonnen S, Dingeta T, Teklemariam Z. Loss to follow-up tuberculosis treatment and associated factors among adults attending at public health facilities in Warder District, Somali Regional State, Eastern Ethiopia. Front Public Health. 2023;11:1151077.
37. Kizito KW, Dunkley S, Kingori M, Reid T. Lost to follow up from tuberculosis treatment in an urban informal settlement (Kibera), Nairobi, Kenya: what are the rates and determinants?. Trans R Soc Trop Med Hyg. 2011;105(1):52–7.
38. Walker IF, Shi O, Hicks JP, Elsey H, Wei X, Menzies D, et al. Analysis of loss to follow-up in 4099 multidrug-resistant pulmonary tuberculosis patients. Eur Respir J. 2019;54(1):1800353.
39. Lima SVMA, de Araújo KCGM, Nunes MAP, Nunes C. Early identification of individuals at risk for loss to follow-up of tuberculosis treatment: A generalised hierarchical analysis. Heliyon. 2021;7(4):e06788.
40. Wikman-Jorgensen PE, Morales-Cartagena A, Llenas-García J, Pérez-Porcuna TM, Hobbins M, Ehmer J, et al. Implementation challenges of a TB programme in rural northern mozambique: evalua- tion of 2012-2013 outcomes. Pathog Glob Health. 2015;109(5):221–7.
41. Abdullahi OA, Ngari MM, Sanga D, Katana G, Willetts A. Mortality during treatment for tuberculosis; a review of surveillance data in a rural county in Kenya. PLoS One. 2019;14(7):e0219191.
42. Lumu I, Musaazi J, Semeere A, Handel I, Castelnuovo B. Survival and predictors of mortality after completion of TB treatment among people living with HIV: a 5-year analytical cohort. BMC Infect Dis. 2023;23(1):238.
43. Birhane M, Mekonnen S, DingetaT,Teklemariam Z. Loss to follow-up tuberculosis treatment and associated factors among adults attending at public health facilities in Warder District, Somali Regional State, Eastern Ethiopia. Front Public Health. 2024;12:1161077.
44. Mishra P, Sharma RK,Yadav R, RaoVG, Nigam S, Lingala MA, et al. Reasons for loss to follow-up (LTFU) of pulmonary TB (PTB) patients: a qualitative study among Saharia, a particularly vulnerable tribal group of Madhya Pradesh, India. PLoS One. 2021;16(12):e0261152.