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Research Article

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Prevalence and Associated Factors of Tuberculosis Among Tea Estate Workers in Thyolo and Mulanje Districts, Malawi: A cross-sectional study

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ABSTRACT

Background: Tuberculosis remains one of the major health problems in the tea gardens of tea growing countries worldwide. International Labour Organization recognizes TB as an occupational disease. Early diagnosis of people with TB helps to cut transmission of the disease and also lead to improved treatment outcomes. The World health organization launched the End TB strategy which aims at identifying all TB patients and putting them on treatment. Thyolo and Mulanje are the tea growing districts which has a high burden of TB and HIV in Malawi. There is paucity of data of TB burden among tea estate worker in Malawi. Therefore, this study was conducted to determine the prevalence and associated factors of TB among tea estate workers in Thyolo and Mulanje districts in Malawi.

Methods: A cross-section study was conducted in the tea estates of Thyolo and Mulanje targeting 1,068 estate tea workers. Multi stage random sampling was used to obtain a sample size of 1,068 study participants. Socio-demographic, employment and clinical data was collected using a structured questionnaire. Chest x-ray and gene x-pert machine were used to test the participants for TB. Ethical clearance was obtained from National Health Sciences Research Committee, letter of authorization was obtained from Tea Association of Malawi, and district councils of Thyolo and Mulanje and data analysis was conducted using SPSS version 25.

Results: A total of 976 participants were included in the study representing 91.4% response rate. The prevalence of TB was found to be 1.84% which translates to 1840 TB cases per 100,000 population of the tea estate workers. Level of education (P=0.012), type of employment (p=0.019), HIV status (p=0.046) and history of TB among household contact (p=<0.001) were factors associated with TB infection.

Conclusion: Prevalence of TB among tea estate workers is high yet not included among high-risk group to be targeted for TB interventions in Malawi. Therefore, this calls for policy makers to strengthen prevention and control strategies among tea estate workers so to contribute to global agenda of ending TB by 2030.

List of Abbreviations

BMI	:	Body Mass Index
COPD	:	Chronic Obstructive Pulmonary Disease
NHSRC	:	National Health Sciences Research Committee
ODK	:	Open Data Kit
TAM	:	Tea Association of Malawi
TB	:	Tuberculosis

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Keywords: Prevalence, Tea estate, Tuberculosis, Malawi

Introduction

Tuberculosis (TB) is a preventable and usually curable disease however, in 2022, it was the world's second leading cause of death from a single infectious agent, after coronavirus disease (COVID-19), it also caused almost twice as many deaths as HIV/AIDS. It is estimated that over 10 million people continue to fall ill with TB every year with an estimated death of 1.4 million [1]. Geographically, the African region accounted for 25% of the global TB cases. Although the global TB incidence is seen to be declined, it is not declining fast enough to reach the 2020 milestone of 20% reduction, thus calling for concerted efforts to accelerate interventions that aims at detecting cases that are still in the community [2]. Malawi is one of the 30 countries with high burden of TB/HIV worldwide [2]. In 2021, the National TB and Leprosy Elimination program (NTLEP) reported that 14,304 TB cases were diagnosed representing an incidence of 141 cases per 100,000 populations.

Tuberculosis disproportionately affects the poorest and most vulnerable populations, including individuals with the highest dust exposures in the workplace [3]. In a study conducted in Taiwan by Shieh et al, which was evaluating the pulmonary function and respiratory symptoms in people working in different stages of tea processing, it was found that ball-rolling yielded the highest inhalable dust level, panning yielded the highest respirable dust level, and withering yielded the lowest levels of both dusts [4]. Ball-rolling also yielded the highest coarse fraction (defined as inhalable dusts minus respirable dusts), which represented exposures from nose to tracheobronchial tract.

Tea processing factories as any other factories that produces dust pose a high risk of developing respiratory diseases including Tuberculosis to the workers as a result of the damage caused to the lungs. Tea processing involves exposure to smoke as biomass which contributes to increased morbidity and mortality rates from chronic lung diseases and Tuberculosis (Kodgule et al. 2012). The retrospective study that was conducted by Kilale et al. conducted in four health facilities in and around the tea farming in Mufindi district in Tanzania found that there was a high TB case notification in that area [5].

In Assam area in India, the study Chelleng PK et al. found that tea garden workers had a high risk of Pulmonary Tuberculosis more especially among garden workers with family history of Tuberculosis [6]. While in Bangladesh is was found that garden workers with low socio-economic factors were highly affected by Tuberculosis and also had various misconceptions and stigma towards Tuberculosis and poor knowledge regarding its cause, transmission and prevention [7]. In the study of Medhi et al., where they were looking at health problems and nutritional statuses of tea garden population of Assam in India they found that out of the many health problems the tea workers had, respiratory infections including tuberculosis were significant [8]. Housing or living standards was observed by Sitienei (2012) to have an impact the transmission of TB.

Malawi is one of the tea growing countries in the world which also has a high burden of TB and HIV in the sub-Saharan Africa. Currently. Thyolo and Mulanje are the tea growing districts which has also a high burden of TB and HIV in Malawi. The tea estates occupy 33% and 30% of the total land surface area in Thyolo and Mulanje respectively (Mulanje Social Economic Profile 2017 - 2022); Thyolo District Council District Development Plan-2017-2022). In 2020, Thyolo and Mulanje districts had a TB case notification rate of 77 cases per 100,000 populations and 90 cases per 100,000 populations respectively (District Health Information System). No study has been conducted to determine the burden of TB in the tea estates of Malawi. Therefore, this study was conducted to determine the prevalence and factors associated with TB among tea estate worker in Thyolo and Mulanje Districts in Malawi.

Methodology

Study Type

We conducted a cross-sectional study to determine the prevalence and factors associated with. TB among the tea estate workers. It further aimed at determining at the proportions of bacteriologically and clinically diagnosed TB cases among the tea estate workers and to evaluate factors associating or influencing the development of TB disease among tea estate workers.

Study Setting

The study was conducted in the 9 sampled tea estates of Thyolo and Mulanje districts in Southern part of Malawi. The area was chosen because it has well established tea farming companies with vast tea growing fields and large tea processing factories. The abundance of the tea farming companies provided an opportunity of obtaining an adequate sample size whose findings could be inferred on the workers working in the tea farming elsewhere in Malawi.

Study Population

The study population in this study was tea estate workers who were randomly selected from tea estates in Thyolo and Mulanje districts. These workers were defined as those that work in the tea gardens (plucking tea) or in the tea factory (processing tea). All tea estate workers providing services other than defined, for example drivers, mechanics, security guards, cooks, health workers and all administrative staff were excluded from the study. These workers were excluded because they were not directly exposed to tea

Sample Size and Sampling Procedure

The sample size was calculated using the confidence level of 95%, with the margin of error of 3%, and the population proportion of 50% was 1,068 [9]. The sample size was calculated using an online sample calculator at https://www.calculator.net/sample-size-calculator.html. Random sampling was used to purposively obtain 4 and 5 tea estates from 12 and 15 tea estates in Mulanje and Thyolo districts respectively. This means a total of 9 tea estates participated in the study in the two districts. The 9 tea estates were randomly selected by first listing the 12 tea estates in Mulanje district and the 15 tea estates in Thyolo district in alphabetical order and assigning a number to each tea estate in ascending order. Microsoft excel random number generation function was used to independently select 4 and 5 random numbers for Mulanje and Thyolo districts respectively.

The randomly selected numbers were then crosschecked with the developed list of tea estates to obtain the name of the estate corresponding to the randomly generated numbers. The sample of 1,068 participants was proportionally distributed to the sampled 9 tea estates based on the number of workers in each sampled tea estate. A list of study participants was obtained by randomly selecting estate workers in the sampled tea estates using Microsoft excel random number generation function. The surnames of the tea estate workers were listed in ascending alphabetical order and assigned numbers in ascending order. The randomization gave an equal opportunity to all tea estate workers of participating in the study.

Data Collection Tools and Techniques

Data was collected from the sampled study participants by trained research assistants that were recruited to collect data in this study. As a semi-structured questionnaire administered digitally using open data kit (ODK) by trained research assistants was used. Data was also collected through observation by physically checking in the participant's health passport book. Data was also generated through screening of the study participants for TB. The four TB cardinal signs and symptoms of cough, fever, weight loss and night sweats were used to symptomatically screen study participants. All study participants were either referred for digital chest x-ray examination and presumptive TB patients who can produce sputum samples had their samples run on gene-xpert machine. The digital x-ray machine and the gene-xpert platform were both housed in a mobile diagnostic van (point of care screening for TB). The findings of x-ray examination were available on spot as research team consisted of Clinicians (from mobile diagnostic unit) responsible for interpretation of the digital x-ray images. The gene-xpert results were available between 2 hours. The research assistants were trained in the general overview of the study, data collection using ODK by going through the questionnaire and the ethical considerations of the study participants. The data collection questionnaire was pretested prior to data collection in a tea estate that was not sampled to participate in the study.

Data Management

The collected data which was predominantly quantitative was cleaned, coded and entered into an SPSS database to ensure that only valid and complete data is used in the analysis to obtain reliable and credible results.

Data Analysis

The cleaned and coded data was analyzed using SPSS version 25 to generate tables that showed demographic characteristics of participants, prevalence of TB, proportions of bacteriologically diagnosed and proportions of clinically confirmed/intention. Chi-square analysis was done to determine participant factors that were associated with developing TB disease.

Ethical Considerations

Ethical clearance to conduct the study was obtained from the National Health Sciences Research Committee (NHRSC) approval number 3152 approval number. Consent was also obtained from each study participant after explaining the aims of the study to ensure that they make an informed choice.

Results

Socio-Demographic Characteristics

A total of 976 participants participated in the study representing 91.4% response rate. The participants were predominately males 742(76%) and majority 327(33.5%) were between the age group of 35 to 44 years with least 24(2.5%) in the 65 years and above age group. In terms of level of education 466(47.7%) attended primary education with 102(10.5%) being without formal education. Majority of the participants 552(56.6%) reside outside the estate compound (villages) while the remaining reside within the estate compounds. The highest proportion of participants 634(65.0%) were temporary workers and 342(35.0%) were permanent workers of the tea estates. The results show that 580(59.4%) of the participants work in the tea factory while 396(40.6%) work in the tea field (Table 1).

Table 1: Socio-demographic characteristics of participants

Variable Name	Categories	Frequency n (%), N=976
Age	18 – 24	40 (4.1%)
	25 - 34	241 (24.7%)
	35 – 44	327 (33.5%)
	45 - 54	239 (24.5%)
	55 - 64	105 (10.8%)
	65 above	24 (2.5%)
Sex	Female	234 (24.0%)
	Male	742 (76.0%)
Level of Education	Didn't go to school	102 (10.5%)
	Primary	466 (47.7%)
	Secondary	374 (38.3%)
	Tertiary	34 (3.5%)
Place of residence	Estate Compound	424 (43.4%)
	Village	552 (56.6%)
Household size	1-4	592 (60.7%)
	5 above	384 (39.3%
Smoking history	Yes	210 (21.5%)
	No	766 (78.5%)
Alcohol consumption	Yes	428 (43.9%)
	No	548 (56.1%)
History of working in mine	Yes	13 (1.3%)
	No	963 (98.7%)
Type of Employment	Permanent	342 (35.0%)
	Temporary	634 (65.0%)
Working department	Factory (processing)	580 (59.4%)
	Field (plucking)	396 (40.6%)
Working hours per day	8 hours	919 (94.2%)
	Above 8 hours	57 (5.8%)

Health-Related Characteristics of the Study Participants

Of 976 participants, 183 (18.8%) were documented to be HIV positive. Majority of the participants 856(87.7%) had a normal

body mass index (BMI) of 18.5 – 24.9 with 11(1.1%) having the BMI of below 18.5 (underweight). With regards to underlying chronic medical conditions (3)0.3% of participants had diabetes, 22(2.2%) had asthma, 12.1% had chronic obstructive pulmonary disease. Seventy-four (7.6%) had been contacts of TB patients (Table 2).

Table 2: Health-related characteristics of the participants

Variable	Category	Frequency (%) N=976
HIV status	Positive	183 (18.8%)
	Negative	690 (70.7%)
	Not Known	102 (10.6%)
Nutritional status (BMI)	Normal	856 (87.7%)
	Overweight	109 (11.2%)
	Underweight	11 (1.1%)
Diabetes	Yes	3 (0.3%)
	No	973 (99.7%)
Cancer	Yes	0 (0)
	No	976 (100%)
Asthma	Yes	22 (2.2%)
	No	954 (97.7%)
COPD	Yes	12 (1.2%)
	No	964 (98.8%)
History of TB (Household Contacts)	Yes	74 (7.6%)
	No	902 (92.4%)

Prevalence of Tuberculosis Among Tea Estate Workers

The study findings show that the prevalence of Tuberculosis among tea estate workers involved in tea plucking and processing is 1.8% which translates to 1,844 TB cases per 100,000 population. The prevalence is higher among tea estate workers in Thyolo district 2.1% translating to 2,060 TB cases per 100,000 population (Table 3).

Table 3: Diagnosed Tuberculosis Cases

District	Number of Participants	Confirmed TB Cases	Prevalence (%)
Mulanje	442	7	1.6
Thyolo	534	11	2.1
Total	976	18	1.8

Classification of TB Cases

Among the 18 diagnosed TB cases 17(94.4%) were bacteriologically confirmed and 1(5.6%) was clinically diagnosed /intention to treat cases (Table 4)

Table 4: Classification of Tuberculosis cases

District	Bacteriologically diagnosed	Clinically diagnosed	Total
Mulanje	7	0	7
Thyolo	10	1	11
Total	**17 (94.4%)**	**1 (5.6%)**	**18 (100%)**

Factors Associated with Tuberculosis Among Tea Estate Workers

Different factors of the tea estate workers were assessed to find out whether they have an association to development of Tuberculosis. There was significant association between level of education (P=0.012), type of employment (p=0.019), HIV status (p=0.046), history of TB among household contact (p=<0.001) and development of TB. The study findings showed that factors which are usually considered to be associated with TB did not have any association history at all. Such factors are history of smoking (p=0.941), history of working in a mine (p=0.619) alcohol consumption (p=0.165), nutritional status (p=0.90) and history of diabetes with (0.812). (Table 5).

Table 5: Factors associated with Tuberculosis

Factor		Diagnosed TB Cases (N=18)	P-value
Age of Participant	18 – 24 years	0 (0)	0.056
	25 – 34 years	0 (0)	
	35 – 44 years	7 (38.9%)	
	45 – 54 years	9 (50.0%)	
	55 – 64 years	2 (11.1%)	
	65 years above	0 (0)	
Sex	Female	5 (27.8%)	0.703
	Male	13 (72.2%)	
Level of Education	Didn't go to school	2 (11.1%)	0.012
	Primary	5 (27.8%)	
	Secondary	8 (44.4%)	
	Tertiary	3 (16.7%)	
History of smoking	Yes	4 (22.2%)	0.941
	No	14 (77.8%)	
Alcohol consumption	Yes	5 (27.8%)	0.165
	No	13 (72.2%)	
History of working in a mine	Yes	0 (0)	0.619
	No	18 (100%)	
Place of residence	Estate compound	11 (61.1%)	0.127
	Village	7 (38.9%)	
Type of employment	Permanent	11 (61.1%)	0.019
	Temporary	7 (38.9%)	
Working department	Factory (tea processing)	14 (77.8%)	0.110
	Field (tea plucking)	4 (22.2%)	

HIV status	Positive	7 (38.9%)	0.046
	Negative	11 (61.1%)	
	Not known	0 (0)	
Nutritional status (BMI)	Normal	16 (88.9%)	0.90
	Overweight	2 (11.1%)	
	Underweight	Underweight	
Diabetes	Yes	0 (0)	0.812
	No	18 (100%)	
Asthma	Yes	1 (5.6%)	0.341
	No	17 (94.4%)	
COPD	Yes	0 (0)	0.633
	No	18 (100%)	
History of TB (Household Contacts)	Yes	7 (38.9%)	<0.001
	No	11 (61.1%)	

Discussion

We conducted a cross-sectional study to determine the prevalence and factors associated with TB among tea estate workers. The prevalence of TB was 1.84% which is higher than national prevalence of 1.014% (1014 cases per 100,000 population). Increased burden of TB has also been reported in similar studies conducted elsewhere which shows TB to be a burden in the tea gardens. In Dibrugarh district in India 4,789 out of the total 11,997 TB cases, representing 40.0% were recorded in the tea gardens alone in a period of 4 years [10]. Studies from elsewhere agree with this finding that TB is a burden in the tea gardens [10,6]. This study being the first in the tea estates of Malawi lays a foundation for deliberations on how the tea estates in Malawi can contribute to the global plan to end TB by 2030 which Malawi is a signatory. Therefore, there is need to strengthen preventive and control TB strategies among this population.

The study also assessed factors that might be associated with TB disease among the tea estate workers. The results shows that level of education has an association with suffering from TB among tea estate workers. The existing literature supports the fact that lower education is associated with high burden of TB disease as assimilation of TB information such as; signs and symptoms, prevention and control measures is low and decision making in health care seeking is also delayed. On the other hand, lower education is highly associated with low socio-economic status which is also a pre-disposing factor of TB [11].

In this study, the type of employment of a participant was found to be associated with TB disease, this was defined as either being a permanent worker or a temporary worker of the estate. The findings show among the 18 TB patients, 11(61.1%) were permanent workers and 7 (38.9%) were temporary workers. Furthermore, permanent workers are likely to find a shelter within the estate which are usually overcrowded. Normally, in tea estates and similar institutions permanent workers works routine shifts thereby having prolonged exposure to tea. Furthermore, permanent workers have a privilege of being accommodated in institutional houses which are in clusters and overcrowded. Primary data and studies have revealed that estate houses in the compounds are very congested with small rooms and no proper ventilation [10]. Another possible explanation of this association might be that the patients share one common source of transmission which might be at the workplace or place of residence, however this study fell short of establishing the reasons.

Our findings also show that HIV status of the participants was associated with TB disease, The TB/HIV co-infection rate was found to be 38.9%, which is likely not significantly different from the World Health Organization estimate of 42.0% TB/HIV in the sub-Saharan Africa [12]. Studies have shown that a significant association between being HIV positive and suffering from TB [13,14]. Considering that assessment of this variable was through documented evidence in the health profile book, it might be that this co-infection has been under reported for fear of prejudice, stigma and discrimination as some use two different health profile book, one for HIV care while the other for other medical conditions. There is need to strengthen integrated TB/HIV services in our routine care since there is high TB/HIV co-infection rate.

History of TB among household contacts has in this study been found to be associated with TB disease, from the findings 38.9% of the diagnosed patients had a history of TB among the household contacts. Several studies have suggested that proximity to infectious TB patients puts close contacts at a higher risk of being infected [13,15]. In line with what has been suggested in different studies, 94.4% of the TB cases diagnosed in this study are bacteriologically diagnosed TB cases which are regarded as most infectious. Hence the need to strengthen screening services for TB contacts among tea estate workers.

This study did not establish any association between tobacco smoking despite that 22% of the diagnosed TB patients had a history of smoking. This might be attributed to small percentage of smoker that were found in this study. However, the metanalysis of 24 studies conducted by Bates and colleagues, on the effects of smoking on TB, showed that the relative risk was high among smokers compared to non-smokers [16]. The findings of this study did not establish any association between alcohol consumption and TB disease, 27.8% of the diagnosed patients in this had a history of alcohol consumption. A systematic review of 3 cohort and 18 case control studies concluded that the alcohol increases the risk of active tuberculosis more especially when the consumption is greater than 40 g per day [17,18].

This study did not find any TB patient who was malnourished or was suffering from diabetes hence it could not establish any association the two. However, several studies have malnutrition and diabetes as risk factors for developing TB disease [17,19,13,20]. The findings of this study do not in any way discredit this existing knowledge, as they might have arisen due to a small proportion of TB cases diagnosed from the study participants [21-23].

Limitations and Constraints

The study only involved tea estate workers that directly deal with tea (plucking and processing) leaving out other workers

who might be point of source for TB transmission. There is need for further study that will involve all workers of the tea estates. The number of diagnosed TB patients was small to enable the identification of risk factors among tea estate worker hence only the association between factors and TB disease was established.

Recommendations

Based on the findings of the study there is need to consider tea estates as partners in TB/HIV prevention and control program. Deliberate policies or guidelines should be put in place that will ensure tea estates workers benefitting from routine and targeted TB/HIV screening. Further studies should be conducted that should involve all workers of the tea estate to determine the burden among all tea estate workers as the cadres left out in the study might be point of source for TB transmission, comparative studies can also be considered to determine risks factors associated with TB.

Conclusion

This study confirmed that the burden of TB in the tea estates is high concurring with other studies. With these results there is need to involve or consider tea estates as a partner when designing and implementing TB/HIV prevention and control strategies. Therefore, this calls for policy makers to strengthen prevention and control strategies among tea estate workers so to contribute to global agenda of ending TB by 2030

Declarations

Ethics approval and consent to participate

Ethical clearance to conduct the study was obtained from the National Health Sciences Research Committee (NHRSC) approval number 3152. Authorization letters was obtained from the Tea Association of Malawi, the Mulanje and Thyolo district councils through the district research committees. Consent was also obtained from each study participant after explaining the aims of the study to ensure that they make an informed choice. Participants that showed interest to participate in the study voluntarily signed a consent form after being explained to of the contents. No participant was forced to take part in the study and were given an option to withhold their participation at any stage of the study. All respondents were assured of anonymity and confidentiality of the given information.

Consent for publication

This manuscript does not contain individual person's data in any form such as individual details, images or videos, therefore consent for publication was not required.

Availability of data and materials

Data and materials for the study are available upon request.

Competing interests

The Authors declare no conflict of interest.

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Authors' contributions

BIC and EF conceptualized and designed the study. JM and TMwenyenkulu, HK, KM and SC provided inputs to the manuscript and funding acquisition. TM. BM, BWN, FS, MROC, LL, PN and AJ refined the study design and contributed to the development of the study protocol. JM, HK, MB, MROC, FS and KM supervised data collection. SEM devised the data analysis plan. SEM analysed and interpreted the data. All authors read and approved the final manuscript.

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References

1. Global tuberculosis report. 2023. https://reliefweb.int/report/world/global-tuberculosis-report-2023.
2. Global tuberculosis report. 2021. https://www.who.int/publications-detail-redirect/9789240037021.
3. Gottesfeld P, Reid M, Goosby E. Preventing tuberculosis among high-risk workers. The Lancet Global Health. 2018. 6: e1274-e1275.
4. Shieh T-S, Chung J-J, Wang C-J, Tsai P-J, Kuo Y-C, et al. Pulmonary function, respiratory symptoms, and dust exposures among workers engaged in early manufacturing processes of tea: A cohort study. BMC Public Health. 2012. 12: 121.
5. Kilale AM, Mfinanga SG, Kunda J, Lema L, Chonde TM, et al. Epidemiology of Tuberculosis in a tea farming area in Mufindi district. Tanzania Journal of Health Research. 2001. 3: 2.
6. Chelleng pradeep kumar, Devi K, Borbora D, Chetia M, Saikia A, Mahanta J, Narain K. Risk factors of pulmonary tuberculosis in tea garden communities of Assam, India. The Indian Journal of Medical Research. 2014. 140: 138-141.
7. Biswas BK, Barua PC, Razzaque SMA, Anam K, Saha AK, et al. Profiles of Tuberculosis Affected Workers in the Selected Tea Garden Areas of Bangladesh. 2015. 39: 7.
8. Medhi GK, Hazarika NC, Shah B, Mahanta J. STUDY OF HEALTH PROBLEMS AND NUTRITIONAL STATUS OF TEA GARDEN POPULATION OF ASSAM. INDIAN JOURNAL OF MEDICAL SCIENCES. 2006. 60: 7.
9. Naing L, Nordin RB, Abdul Rahman H, Naing YT. Sample size calculation for prevalence studies using Scalex and ScalaR calculators. BMC Medical Research Methodology. 2022. 22: 209.
10. Sonowal CJ. Tuberculosis Burden in the Tea Gardens of Assam: A Discussion on the Risk Factors and Social Determinants. STUDIES ON ETHNO-MEDICINE. 2020. 14.

11. Gelaw SM. Socioeconomic Factors Associated with Knowledge on Tuberculosis among Adults in Ethiopia. Tuberculosis Research and Treatment,2016. 2016: 1-11.
12. WHO-HTM-TB-2015.19-eng.pdf. (n.d.).
13. Narasimhan P, Wood J, MacIntyre CR, Mathai D. Risk Factors for Tuberculosis. Pulmonary Medicine. 2013. 1-11.
14. Wondmeneh TG, Mekonnen AT. The incidence rate of tuberculosis and its associated factors among HIV-positive persons in Sub-Saharan Africa: A systematic review and meta-analysis. BMC Infectious Diseases. 2023. 23: 613.
15. Pinto PFPS, Teixeira CSS, Ichihara MY, Rasella D, Nery JS, et al. Incidence and risk factors of tuberculosis among 420 854 household contacts of patients with tuberculosis in the 100 million Brazilian Cohort (2004–18): A cohort study. The Lancet Infectious Diseases. 2023. S1473309923003717.
16. Bates MN, Khalakdina A, Pai M, Chang L, Lessa F, Smith KR. Risk of tuberculosis from exposure to tobacco smoke: A systematic review and meta-analysis. Archives of Internal Medicine. 2007. 167: 335-342.
17. KL, EJ, Bg W, CD, MR. Drivers of tuberculosis epidemics: The role of risk factors and social determinants. Social Science & Medicine (1982). 2009. 68.
18. Lönnroth K, Williams BG, Stadlin S, Jaramillo E, Dye C. Alcohol use as a risk factor for tuberculosis – a systematic review. BMC Public Health. 2008. 8: 289.
19. Kapata N, Chanda-Kapata P, Michelo C. The social determinants of tuberculosis and their association with TB-HIV co-infection in Lusaka, Zambia. Medical Journal of Zambia. 2013. 40.
20. Yasmin S, Sau M, Patra M, Sinha N, Baur B. Poverty, undernutrition and morbidity: The untold story of tea-garden workers of Alipurduar district, West Bengal. Journal of Family Medicine and Primary Care. 2022. 11: 2526.
21. Hassan MR, Bennoor KS, Rahman MF, Mahmud AM, Hossain MA, et al. Incidence of pulmonary tuberculosis in garments workers of Dhaka City, Bangladesh. Bangladesh Medical Research Council Bulletin. 2025. 31: 7-14.
22. Moitra S, Thapa P, Das P, Das J, Debnath S, et al. Respiratory Morbidity among Indian Tea Industry Workers. The International Journal of Occupational and Environmental Medicine. 2016. 7: 148-155.
23. Rambiki E, Dimba A, Banda P, Ng'ambi W, Banda K, et al. The prevalence of pulmonary tuberculosis among miners from the Karonga, Rumphi, Kasungu and Lilongwe Districts of Malawi in 2019. Malawi Medical Journal. 2020. 8.