Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/jptcp.v30i18.3431

PREVALENCE AND TREATMENT OUTCOME OF TUBERCULOSIS PATIENTS ACROSS DIFFERENT AGE GROUPS AND GENDER AT DISTRICT LAHORE: A RETROSPECTIVE APPROACH

Amna Akhtar[1], Riffat Mushtaq[2], Asma Shahzadi[3], Jabeen Ijaz[4], Munazza Rashid[5], Nadeem Masih[6*]

[1,3]Charge Nurse, Lahore General Hospital, Punjab - Pakistan
[4]Charge Nurse, Mayo Hospital, Lahore - Pakistan
[5]Nursing Supervisor, Ittefaq Hospital, Lahore - Pakistan
[6]Sr. Nursing Instructor, Aligarh College of Nursing and Allied Health Sciences, Lahore - Pakistan

[*]**Corresponding Author:** Nadeem Masih
[*]Sr. Nursing Instructor, Aligarh College of Nursing and Allied Health Sciences, Lahore - Pakistan
Email: nadeemmasih01@gmail.com

ABSTRACT

Pakistan is one of the nations most plagued by tuberculosis (TB), and the incidence of TB is declining too slowly to fulfill the goal set by the End TB Strategy. Both pulmonary and extra-pulmonary forms of tuberculosis can present with symptoms like fever, chills, coughing, and weight loss. The purpose of the study was to determine the treatment outcomes and prevalence of pulmonary tuberculosis among patients diagnosed in the district Lahore. A retrospective, observational strategy was used in district Lahore, Pakistan, from January to February 2023 to gather data on patients who were diagnosed and treated between 2018 and 2022. In total, 15,567 patients with drug-sensitive tuberculosis (DS-TB) residents of district Lahore were treated. The information was collected from a number of sources, such as TB registrations, treatment cards, test registries, and laboratory request forms. Tables and graphics were used to present the results of the data analysis, which was done with SPSS and Microsoft Excel. There were 15,567 participants in total, of which 98.64% were new cases and 1.36% had received prior treatment. Males were more likely than females to have tuberculosis. 2021 saw a rise in TB cases, with 2018 being the lowest number of cases ever reported. As people aged, the percentage of TB cases fell. According to the diagnostic, 20.98% of the patients had TB that was positive for pulmonary smear, while 39.41% had TB that was negative for pulmonary smear. Moreover, extra-pulmonary TB affected 39.60% of the patients. Between the study period and the end, there was a considerable increase in the annual number of patients with PCD, EP TB, and PBC diagnoses. Depending on the year and type of TB, the overall treatment success rates were 93.9% for PBC patients, 98.76% for PCD cases, and 97.85% for EP cases. Timely culture and drug susceptibility testing are crucial in limiting the establishment of drug-resistant strains of the disease, which emphasizes the significance of early disease detection. Better diagnostic procedures have the potential to increase the effectiveness of therapy and are essential to the global fight against tuberculosis.

INTRODUCTION

According to the World Health Organization [1], tuberculosis (TB) is one of the top 10 infectious pathogen-caused deaths worldwide. If a person with tuberculosis is in close contact with 10 other people for a year, two of them may get active tuberculosis [2]. Between 2000 and 2019, the global incidence rate of tuberculosis (TB) declined by an average of 1.7% year, with a recent spike of 2.3% annually from 2018 to 2019. But the End TB Strategy's goal of a 20% decrease between 2015 and 2020 cannot be achieved at this rate of decline. According to the World Health Organization's (WHO) 2019 report, the total decline from 2015 to 2019 was 9%, which was less than the desired decrease. Pakistan is the fifth most TB-affected country out of 30 according to the WHO. 369,548 cases of tuberculosis have been diagnosed in Pakistan, as per a World Health Organization data from 2019. This year's number represents a 651 rise over 2017's total of 368,897 cases [3]. Based on available data, the estimated incidence and mortality rates of tuberculosis were 265.0 and 562.0 per 100,000 individuals, respectively, with 340 being the death rate [4].

Pulmonary tuberculosis (PTB) and extra-pulmonary tuberculosis (EPTB) are the two primary forms of tuberculosis (TB). While EPTB can affect any area of the body, PT predominantly affects the lungs [5]. The primary body organs that may be impacted by extra-pulmonary tuberculosis (TB) include the lymphatic system, pleura, central nervous system, and bones and joints [6]. Nonetheless, tuberculosis can be fatal if the infection is not treated [7].

The organisms in the respiratory tract of a person who has tuberculosis are released into the air when they cough, sneeze, shout, or scream; droplet nuclei containing TB organisms travel through the mouth or nose, enter the upper respiratory system, enter the bronchia, and ultimately reach the lung's alveoli, where they can infect a healthy person who breathes them in [8].

Malnutrition and overcrowding have a strong correlation, but there are other factors that may raise the risk of contracting tuberculosis. Living circumstances, smoking, drinking, and a history of tuberculosis are other important risk factors [9]. It was demonstrated that women were more prone to tuberculosis than men were, most likely as a result of the influence of feminine hormones. It has also been shown that age increases the prevalence of tuberculosis [10].

Although a productive cough and chest pain are common indications of the infection, about 25% of individuals do not have any symptoms [11]. However, patients with EPTB may also have PTB-like symptoms, such as fever, weight loss, and night sweats [12].

A thorough medical examination combined with additional testing, such as microbiological tests, medical imaging, immune response tests, histopathology, and surgical biopsy, which may strongly suggest TB as the diagnosis, can be used to diagnose tuberculosis (TB) in patients whose test sample contains bacilli [13]. Chest x-rays (CXRs) should be followed by a diagnostic assessment to establish a diagnosis. A bacteriological investigation should be performed to analyze any aberration in CXR anomaly that is compatible with tuberculosis (TB) [14]. PTB radiography is complicated and difficult to diagnose. First and foremost, it's critical to comprehend and differentiate between latent and active tuberculosis. Lung consolidation and cavity lesions are indicators of active tuberculosis, which increases the likelihood of infection dissemination [15].

Sputum smear microscopy (SSM) counts the number of mycobacteria present in a patient's sputum samples and is the gold standard approach for diagnosing pulmonary tuberculosis (TB). Smear microscopy has a high specificity despite having a low sensitivity. Moreover, sputum and other suitable specimens can be used to simultaneously detect Mycobacterium tuberculosis (MTB) and drug-resistant tuberculosis (DR-TB) using the GeneXpert MTB/RIF assay, a molecular diagnostic tool with improved sensitivity and specificity. Results from the GeneXpert assay can be achieved in less than two hours thanks to its use of polymerase chain reaction (PCR) methodology. Even in cases where a Mycobacterium tuberculosis culture is negative, a clinical diagnosis of tuberculosis (TB) can be obtained on the basis of signs and symptoms alone. The World Health Organization (WHO) has approved gold standard techniques for the detection of multidrug-resistant tuberculosis (MDR-TB), and commercial liquid culture equipment offer quick and precise results [16].

Latent TB can be detected with either the IGRA or the Mantoux test; the Mantoux test is more suitable for Low Countries and is less costly. Conversely, the Mantoux test is less accurate than the IGRA test.

RESEARCH OBJECTIVE

To investigate the prevalence pulmonary bacterial confirmation (PBC), pulmonary clinical diagnosis (PCD) and extra pulmonary diagnosis (EP) of tuberculosis, as well treat comes in district Lahore between 2018 and 2022.

MATERIAL AND METHODS

This study used a retrospective, hospital-based, observational approach with secondary data collected from TB registers of all confirmed DS-TB patients who had been previously notified between 2018 and 2022 in district Lahore, Punjab from January to February 2023. In this study, we included all cases of Drug-sensitive tuberculosis (DS-TB) cases that were confirmed between January 2018 and December 2022 and previously diagnosed by clinical signs and symptoms together with Acid-Fast Bacilli (AFB) smear, X-ray /CT examination, pathological examination, X-ray/CT examination, and culture.

Most local government and commercial TB diagnostic centers offer the Ziehl-Neelsen (ZN) test. All samples of Presumptive TB patients negative on ZN-smear for TB bacilli are sent to the laboratories in Lahore. Out of the patients who met the selection criteria, the study comprised 15,567 individuals with DS-TB.

All patients diagnosed with tuberculosis, whether through clinical or microbiological means, were included in this study regardless of the type of TB (pulmonary or extra- pulmonary). Patients without confirmed TB results were excluded from the study. The laboratory's "request for examination" forms were used to obtain patient data such as sample types, age, sex, address, HIV status, and previous history of anti-TB drugs. Data of all enrolled TB patients were collected from the TB register, treatment cards, and test registers.

Two static software's were applied to analyze the information: Microsoft Excel (Microsoft Office Professional Plus 2016) and statistical package for social sciences (SPSS). Tables and graphics were then created to represent the data.

The confidentiality of each participant was maintained while permission was taken from the management of TB control program to utilize the data only for data analysis.

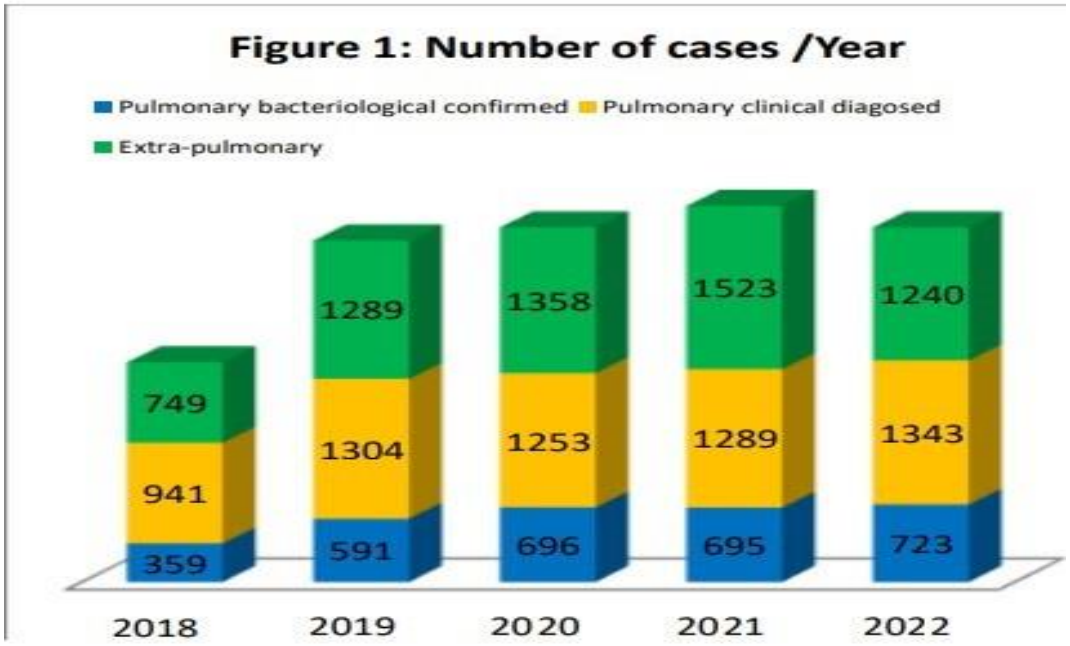
RESULTS

Table 1: Distribution of all TB cases according to the type

Type of TB	*Total*	*Percent*
PBC	3266	20.98%
PCD	6136	39.42%
EP	6165	39.60%
Total Cases	*15567*	*100*

PBC= Pulmonary Bacteriologically confirmed, PCD= Pulmonary Clinically diagnosed, EP= Extra Pulmonary

A total of 15,567 individuals with known ages and sexes were included from 13 TB sites in District Lahore between January 2014 and December 2019; of these, 15,356 (98.64%) were new patients and 211 (1.36%) were patients undergoing retreatment (See table 1).



According to the current analysis, most cases were reported in 2021, and the lowest number was reported in 2015. Fig:1 show that since 2018, the total number of cases has increased significantly.

Table 2: Age Group of the Respondents

Age Group (Y)	*Gender*		*Total (%)*
	Male (%)	*Female (%)*	
0-4	1382	1119	2,501 (16%)
5-14	2735	2331	5,066 (32.5%)
15-24	1182	1522	2,704 (17.3%)
25-34	820	973	1,793 (11.5%)
35-44	514	537	1,051 (6.7%)
45-54	427	438	865 (5.5%)
55-64	448	334	782 (5%)
>65	575	230	805 (5.1%)
Total	8083 (51.92%)	7484 (48.08%)	15567

The table 2 reveals that male TB patients were higher than female TB patients. The study also found that there were 3.8% more cases of TB in males (N=599) than in females.

Table 3: TB Patients by the diagnostic site from 2018- 2022

Diagnostic site	2018 n (%)	2019 n (%)	2020 n (%)	2021 n (%)	2022 n (%)	Total
PBC	371 (11.36%)	635 (19.44%)	737 (22.57%)	755 (23.12%)	768 (23.52%)	3266
PCD	941 (15.34%)	1304 (21.25%)	1253 (20.42%)	1290 (21.02%)	1348 (21.97%)	6136
EP	750 (12.17%)	1289 (20.91%)	1360 (22.06%)	1525 (24.74%)	1241 (30.13%)	6165

PBC= Pulmonary Bacteriologically confirmed, PCD= Pulmonary Clinically diagnosed, EP= Extra Pulmonary

The annual trends in the registration of TB patients by diagnostic site indicated that each year the number of PBC TB patients registered for treatment increased from 371 (11.36%) to 768 (23.52%). A statistically marked increase was also observed in PCD patients enrolled for anti-TB treatment, from 941 (15.34%) to 1348 (21.97%). Comparatively, the number of extra-pulmonary tuberculosis cases has also shown a statistically significant increase from 750 (12.07%) to 1241 (20.13%). (Table 3).

Table 4: Gender-wise yearly Trend of Tuberculosis in District Lahore

Gender	2018	2019	2020	2021	2022	Average
Male	1077(52.23%)	1702(52.73%)	1733(51.73%)	1806(50.59%)	1765(52.57%)	1616
Female	985 (47.77%)	1526(47.27%)	1617(48.27%)	1764(49.41%)	1592(47.42%)	1496
Total	2062	3228	3350	3570	3357	15567

Table 4 shows that the maximum number of male and female cases was diagnosed in 2021, while the minimum number of patients was diagnosed in 2018. During the five-year study, an average of 1,616 males and 1,496 females were infected with tuberculosis each year.

Table 5: Treatment Outcome of Pulmonary Bacteriologically Confirmed Patients

Treatment outcome of Pulmonary Bacteriologically confirmed patients							
Diagnostic Year	Total No. of cases	Cured n (%)	Treatment completed n (%)	Treatment failed n (%)	lost to follow-up n (%)	Died	Treatment success n (%)
2018	371	195 (52.5)	149(40.1)	3(0.8)	20 (5.3)	4(1.0)	344 (92.7)
2019	635	334 (52.6)	259(40.7)	9(1.4)	16 (2.5)	17(2.6)	603 (94.9)
2020	737	512 (69.4)	190(25.7)	3(0.4)	16 (2.1)	16(2.1)	702 (95.2)
2021	755	563 (74.5)	143(18.9)	2 (0.2)	24 (3.1)	23(3.0)	706 (93.5)
2022	768	496 (64.5)	226(29.4)	4 (0.5)	23 (2.9)	19(2.4)	722 (94.0)
Total	**3266**	**2100 (64.2)**	**967(29.6)**	**21(0.6)**	**99 (3.0)**	**79 (2.5)**	**3097 (93.9)**

Of the 3266 PBC patients enrolled, 2,100 (64.2%) had been declared cured successfully, while 967 (29.6%) had completed their anti-TB treatment, 21 (0.6%) cases had failed treatment, 99 (3.0%) had been lost to follow-up, and 79 (2.4%) had died.

Table 6: Treatment Outcome of Pulmonary Clinically Diagnosed Patients

Treatment outcome of Pulmonary clinically diagnosed patients							
Diagnostic Year	Total No. of cases	Cured n (%)	Treatment completed n (%)	Treatment failed n (%)	Lost to follow-up n (%)	Died n (%)	Treatment success n (%)
2018	941	------	924 (15.2)	0	17(1.8)	0	924 (98.1)
2019	1304	------	1283 (21.2)	0	11(0.8)	10(0.7)	1283 (98.3)
2020	1253	------	1239 (20.4)	0	4(0.3)	10(0.8)	1239 (98.8)
2021	1290	------	1278 (21.0)	0	7(0.5)	5(0.3)	1278 (99.0)
2022	1348	------	1335 (22.0)	0	9(0.7)	4(0.6)	1355 (99.1)
Total	**6136**	------	**6059(98.7)**	**0**	**48(0.7)**	**29(0.4)**	**6059 (98.7**

Out of the 6,136 PCD cases studied, the vast majority of patients, 6059 (98.76%), successfully completed their treatment regimen. The overall treatment success rate for PCD cases was 98.76%. However, a small percentage (0.78%) was lost to follow-up, and a slightly larger group (0.42%) died before completing the course; no incidence of unsuccessful treatment was reported.

DISCUSSION

According to the study, 39% of the patients had EPTB, whereas 60% of the patients had PTB. Our results are in good agreement with those of a study [17], which discovered that PTB and EPTB were present in 63.3% and 36.7% of patients, respectively. Our findings also align with previous research carried out in Ethiopia, where PTB and EPTB prevalence was found to be 67.4% and 32.3% in the study by Shargie & Lindtjørn, 2005 [18], and 71.7% and 28.3% in the study by Tessema et al., 2009 [21]. Thus, in terms of the prevalence of PTB and EPTB, our results are in line with earlier studies carried out in Ethiopia.

In the course of our study, PTB+ was identified in 20% of cases, PTB-in 39%, and EPTB in 39% of cases. Similar findings (Hirpa et al., 2013; Tessema et al., 2009) [19] in the northern region of Ethiopia also showed substantial EPTB cases and poorer notification rates for PTB+ patients. PTB+ patient proportion was much lower than the national average of about 40% reported by WHO during 2015 and 2016 [20].

The percentage of TB cases with bacteriological confirmation differs significantly in this region from the 48 percent national norm (WHO, 2019) [21]. According to certain studies, PTB prevalence declines with altitude, despite the fact that height has no effect on the incidence of EPTB (Pérez-Guzmán et al., 2014) [22].

Although the fundamental causes are still unknown, there are currently a number of likely causes: Overprescribing anti-TB medications and the disease's zoonotic transmission [23]. It is said that private healthcare facilities lack the tools and expertise needed to correctly identify smear-negative PTB and EPTB; 15% of all EPTB cases and 97.3% of PTB smear-negative people, according to estimates, received the incorrect diagnosis [24]. According to an analysis conducted by Fatima et al. (2019), a significant proportion of pediatric TB cases were reported by private practitioners, with the majority of children (89%) receiving a clinical diagnosis.

Furthermore, it was discovered that children accounted for 48.61% of all recorded TB cases in the 0–14 age range. The rates of pediatric tuberculosis notification for children aged 0–4 and 5–14 were 33.07 percent and 669.92 percent, respectively, exceeding the 13 percent national estimate. When possible, bacteriological diagnostic techniques that are quick and accurate should be utilized rather than clinical diagnosis to confirm tuberculosis in children [25]. Over the duration of the current investigation, there was a consistent increase in the treatment success rate. When compared to all TB patients, a higher percentage of EPTB patients (97.85%) than PTB patients (96.33%) had successful treatment. Compared to smear-positive PTB patients (93.90%), up to 98.76% of smear-negative PTB patients received effective treatment. Our study's remarkable success rate of 96% for patients with sputum smear-positive and smear-negative PTB exceeded that of studies conducted in Ethiopia (Endris et al., 2014) at 94.8%, in China (Tola et al., 2019) at 92.5%, and in China (Wen et al., 2018), all of which produced success rates that were lower than ours [26, 27, 28].

CONCLUSION

The study's overall TB death rate was low, which may have been brought about by improved hospital care, access to cutting-edge mycrobacteriology labs, and TB patient therapy. For TB control initiatives, loss to follow-up (LTFU) is a serious problem since it might result in bacterial resistance and TB epidemics. Our research found that the prevalence of LTFU was 1.62%, but there was no association between LTFU and early risk indicators, such as smear-negative PTB or EPTB. The reason for the lower frequency of LTFU in our study could be attributed to the effective implementation of DOT measures in the region, such as defaulter supervision, tracing systems, and health education campaigns. The higher treatment success rate in the Lahore district could be

attributed to various factors, including better patient understanding and access to healthcare, enhanced DOTS performance, and increased consumption of TB control services.

REFERENCES

1. WHO. (2021). Global tuberculosis report 2021.
2. Narasimhan, P., Wood, J., MacIntyre, C. R., & Mathai, D. (2013). Review Article Risk Factors for Tuberculosis. Risk Factors for Tuberculosis, 2013.
3. WHO. (2019). GLOBAL TUBERCULOSIS REPORT 2019. World Health Organization. https://doi.org/10.16309/j.cnki.issn.1007- 1776.2003.03.004.
4. NTP. (2019). NATIONAL TB CONTROL PROGRAM PAKISTAN ANNUAL REPORT 2019. 76. https://ntp.gov.pk/wp-content/uploads/2020/10/Annual Report TB Pakistan 2019.pdf
5. Sepkowitz, K. A. (1996). How contagious is tuberculosis? Clinical Infectious Diseases, 23(5), 954– 962.
6. Bennett, J. E., Dolin, R., & Blaser, M. J. (2014). Mandell, douglas, and bennett's principles and practice of infectious diseases: 2-volume set (Vol. 2). Elsevier Health Sciences.
7. Xie, X., Li, F., Chen, J.-W., & Wang, J. (2014). Risk of tuberculosis infection in anti-TNF-α biological therapy: From bench to bedside. Journal of Microbiology, Immunology and Infection, 47(4), 268–274.
8. Sultana, R., Jacobson, K. R., Victor, T. C., Warren, R. M., Streicher, E. M., Calver, A., Sloutsky, A., Kaur, D., Posey, J. E., Plikaytis, B., Oggioni, M. R., Gardy, J. L., Johnston, J. C., Rodrigues, M., Tang, P. K. C., Kato-Maeda, M., … Murray, M. (2013). Genomic analysis identifies targets of convergent positive selection in drug-resistant Mycobacterium tuberculosis. In Nature Genetics (Vol. 45, Issue 10, pp. 1183–1189). https://doi.org/10.1038/ng.2747
9. Patel, S., Parsyan, A. E., Gunn, J., Barry, M. A., Reed, C., Sharnprapai, S., & Horsburgh Jr, C. R. (2007). Risk of progression to active tuberculosis among foreign- born persons with latent tuberculosis. Chest, 131(6), 1811–1816.
10. Cailhol, J., Decludt, B., & Che, D. (2005). Sociodemographic factors that contribute to the development of extra-pulmonary tuberculosis were identified. Journal of Clinical Epidemiology, 58(10), 1066–1071.
11. Lawn, S. D., & Zumla, A. I. (2011). Tuberculosis. Lancet (London, England), 378(9785), 57–72. https://doi.org/10.1016/S0140-6736(10)62173-3
12. Möller, M., & Hoal, E. G. (2010). Current findings, challenges and novel approaches in human genetic susceptibility to tuberculosis. Tuberculosis, 90(2), 71– 83.
13. Steingart, K. R., Henry, M., Ng, V., Hopewell, P. C., Ramsay, A., Cunningham, J., Urbanczik, R., Perkins, M., Aziz, M. A., & Pai, M. (2006). Fluorescence versus conventional sputum smear microscopy for tuberculosis: a systematic review. The Lancet Infectious Diseases, 6(9), 570–581.
14. WHO. (2013). Systematic screening for active tuberculosis: principles and recommendations. World Health Organization.
15. Nachiappan, A. C., Rahbar, K., Shi, X., Guy, E. S., Mortani Barbosa Jr, E. J., Shroff, G. S., Ocazionez, D., Schlesinger, A. E., Katz, S. I., & Hammer, M. M. (2017). Pulmonary tuberculosis: role of radiology in diagnosis and management. Radiographics, 37(1), 52–72.
16. Kuhn, J. E. (2013). Current Concepts. Current Sports Medicine Reports, 12(5), 311–315. https://doi.org/10.1249/jsr.0000000000000000
17. Alem, Y., & Gebre-Selassie, S. (2017). Treatment Outcome of Tuberculosis Patients in Selected Health Centres in Addis Ababa: a Five-Year Retrospective Study. Journal of Lung Health and Diseases, 1(1).
18. Shargie, E. B., & Lindtjørn, B. (2005). DOTS improves treatment outcomes and service coverage for tuberculosis in South Ethiopia: a retrospective trend analysis. BMC Public Health, 5(1), 1–11.

19. Tessema, B., Muche, A., Bekele, A., Reissig, D., Emmrich, F., & Sack, U. (2009). Treatment outcome of tuberculosis patients at Gondar University Teaching Hospital, North-west Ethiopia. A five-year retrospective study. BMC Public Health, 9(1), 1–8.
20. WHO. (2016). Global tuberculosis report. Geneva: World Health Organization, 1–214.
21. Pérez-Guzmán, C., Hernández-Cobos, S., Vargas, M. H., del Rosario Arellano-Macías, M., García-Ituarte, A. Z., & Serna-Vela, F. J. (2014). Clinical and epidemiological features of extra-pulmonary tuberculosis in a high incidence region. Salud Pública de México, 56(2), 189–196.
22. Berg, S., Schelling, E., Hailu, E., Firdessa, R., Gumi, B., Erenso, G., Gadisa, E., Mengistu, A., Habtamu, M., & Hussein, J. (2015). Investigation of the high rates of extra-pulmonary tuberculosis in Ethiopia reveals no single driving factor and minimal evidence for zoonotic transmission of Mycobacterium bovis infection. BMC Infectious Diseases, 15(1), 1–10.
23. Ehlers, V. J., & Aragaw, G. S. (2014). An audit of diagnosis and treatment of tuberculosis in Ethiopia. African Journal of Primary Health Care & Family Medicine, 6(1), 1–6.
24. Fatima, R., Yaqoob, A., Qadeer, E., Hinderaker, S. G., Ikram, A., & Sismanidis, C. (2019). Measuring and addressing the childhood tuberculosis reporting gaps in Pakistan: The first ever national inventory study among children. PloS One, 14(12), e0227186.
25. Endris, M., Moges, F., Belyhun, Y., Woldehana, E., Esmael, A., & Unakal, C. (2014). Treatment Outcome of Tuberculosis Patients at Enfraz Health Center, North- west Ethiopia: A Five-Year Retrospective Study. Tuberculosis Research and Treatment, 2014, 726193. https://doi.org/10.1155/2014/726193
26. Tola, A., Minshore, K. M., Ayele, Y., & Mekuria, A. N. (2019). Tuberculosis Treatment Outcomes and Associated Factors among TB Patients Attending Public Hospitals in Harar Town, Eastern Ethiopia: A Five-Year Retrospective Study. Tuberculosis Research and Treatment, 2019, 1503219. https://doi.org/10.1155/2019/1503219
27. Wen, Y., Zhang, Z., Li, X., Xia, D., Ma, J., Dong, Y., & Zhang, X. (2018). Treatment outcomes and factors affecting unsuccessful outcome among new pulmonary smear positive and negative tuberculosis patients in Anqing, China: a retrospective study. BMC Infectious Diseases, 18(1), 104. https://doi.org/10.1186/s12879- 018-3019-7
28. Gebrezgabiher, G., Romha, G., Ejeta, E., Asebe, G., Zemene, E., & Ameni, G. (2016). Treatment outcome of tuberculosis patients under directly observed treatment short course and factors affecting outcome in southern Ethiopia: a five-year retrospective study. PloS One, 11(2), e0150560.