Original article

EPIDEMIOLOGICAL CHARACTERISTICS OF TUBERCULOSIS AND TREATMENT OUTCOME FROM 2019 TO 2023 IN GANDAKI PROVINCE OF NEPAL

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ABSTRACT

Introduction:

Tuberculosis is a one of the major public health problem globally which with rank in top ten diseases and a significant public health problem in Nepal as well as global and it continues to pose a serious threat to the health of the population and development of the country. This study aimed to assess epidemiological characteristics of tuberculosis patients and their treatment outcomes in Gandaki Province.

Methods:

A retrospective descriptive epidemiological study was conducted in the Gandaki Province of Nepal. The data were obtained from the Health Management Information System (HMIS) and the eTB system of Gandaki Province of Nepal from 2019 to 2023. Patient information from 11,532 individuals was screened, with incomplete or incorrect data excluded from the analysis. The analysis was conducted using SPSS version 22 and QGIS version 3.38.1 to understand the epidemiology of tuberculosis in the area over the past five years.

Results:

From 2019 to 2023, a total of 11,532 tuberculosis patients were reviewed in Gandaki Province, showing an increasing trend in annual TB cases. Kaski and Nawalparasi East districts reported the highest cumulative numbers, with 2,999 cases (26.01%) and 2,536 cases (21.99%) respectively. About 62.79% of the patients were male, with the most affected age group being 15 to 55 years. Nearly three-fourths of the cases were pulmonary TB. The proportion of HIV-positive TB patients increased from 0.90% in 2019 to 2.11% in 2023. March to June was peak months for TB notifications. The number of death and treatment failure cases was gradually increasing over the period. The proportion of retreatment cases of TB had increased over the period from 1.64% in 2019 to 3.48% in 2023. In the same period, there was increasing trend in proportion of DR TB cases i.e. 10.65% to 18.69% by 2023.

Conclusion:

This study highlights the increasing trend of tuberculosis cases in Gandaki Province, with over one-third diagnosed at private health facilities. A significant number of cases were reported between March and June and more than one per cent of TB patients being HIV-positive. The trend of retreatment and drug-resistant TB cases has risen from 2019 to 2023. Strengthening active case finding in rural areas, among the elderly and vulnerable groups is essential. The National TB program should effectively implement the DOTS strategy for medication adherence and adopt a public-private mix approach for early TB diagnosis.

Keywords: Epidemiological, Tuberculosis, Treatment Outcome, Gandaki Province, Nepal

INTRODUCTION

Tuberculosis is one of the most infectious diseases cause by a single infectious agent (Mycobacterium tuberculosis). It poses a significant public health problem in Nepal as well as globally and continues to pose a serious threat to the mankind.[1–3] It mainly affects poor and vulnerable populations.[4] The highest number of new TB cases occurred in the South East Asia (45%) followed by Africa (24%), Western Pacific regions (17%), Eastern Pacific (8.6%), Americas (3.2%) and Europe (2.1%) [5]. Globally in 2024, 8.2 million people were newly diagnosed with TB disease, of which 4.51 million (55%) were men, 2.706 (33%) million women and 0.98 million (12%) children. TB caused an estimated 1.25 million deaths (95% UI: 1.13–1.37 million), with 161,000 of those deaths occurring among people with HIV [1,5].

The TB burden and case notification rates in Nepal vary across provinces and regions over time. The National Tuberculosis Prevalence survey 2019 indicated that approximately 117,000 people are living with TB in Nepal. Similarly, 69,000 individuals developed TB in 2019 [6]. Drug-resistant TB (DR-TB) threatens global TB control and is a major public health concern in several countries as well as in Nepal [5,7,8]. The same report indicates that Nepal bears a high burden of drug resistance, with estimated MDR TB/RR incidence rates reaching around 28,000 in 2022 [5,6,9].

According to the National TB prevalence survey, more than 30,000 active TB cases are missing per year. It shows estimated TB cases to be much higher than what is being expected now, thus further increasing the gap between estimated cases and notified cases. In addition, 17000 people continue to die each year. According to the National Tuberculosis Program (NTP), it is estimated that 112 new TB cases occur in Nepal out of which 80 TB cases are missed daily [6,10]. In 2023/24, a total of 40,775 cases of TB were notified and registered at the National Tuberculosis Control Program in Nepal and 2766 TB cases were notified in Gandaki Province [10,11].

Older individuals have a higher risk of developing active TB, and the growing number of aging populations in both developed and developing countries may exacerbate this burden [12–14]. Additional measures should be taken to address the various risks associated with TB exposure, such as the rise in multidrug-resistant (MDR) TB [15,16], comorbidities with non-communicable diseases (e.g., HIV and diabetes mellitus) [17,18], and the impacts of alcohol and tobacco abuse [3,19]. Improving access to high-quality TB care is crucial in the effort to eradicate TB [20]. This study aimed to reflect the epidemiological characteristics of tuberculosis patients and their treatment outcomes in Gandaki Province, and to explore the scientific and effective implementation of the TB program in the Gandaki Province.

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METHODOLOGY

Study Design and Site

This is a retrospective descriptive epidemiological study was conducted in the Gandaki Province of Nepal. Gandaki Province includes three ecological zones: the southern plains (Terai), the middle mountains (Pahad), and the upper Himalayan region (Himal). These zones feature diverse characteristics, including mountainous, hilly, and plains regions, as well as both urban and rural areas, the features contribute to the areas representative significance of the study.

Figure 1: Study Map Area

Data Resource

The data were obtained from the Health Management Information System (HMIS) and the eTB system of Gandaki Province. This data included information on age, sex, district, types of TB, HIV status, smoking status, time series, referral for TB diagnosis, trends in retreatment TB cases and drug-resistant TB reported in Gandaki Province from 2019 to 2023. Patient information from 11,532 individuals was screened, with incomplete or incorrect data excluded from the analysis.

Inclusion& Exclusion Criteria

Inclusion Criteria: Tuberculosis patients with complete information, including age, sex, type of TB, HIV status, smoking status, referral for TB diagnosis, and drug-resistant TB.

Exclusion Criteria: Tuberculosis patients with missing or incomplete basic information, such as smoking status, HIV status, referral for TB diagnosis, or drug-resistant TB.

Participants and Ethical Considerations

This study utilized data from existing national HMIS and eTB systems. Since aggregated data were used, participants were not involved in setting the research question or outcome measures for the investigation. As a result, ethical approval and participant consent were not required for this study. However, administrative approval was obtained from the Health Directorate of Gandaki Province.

Statistical information

This study describes the epidemiological methods, case notification trends, and various factors such as age, sex, types of TB, HIV status, smoking status, retreatment trends, drug-resistant tuberculosis trends, time series, and treatment outcomes of reported tuberculosis patients in Gandaki Province from 2019 to 2023. The data were extracted sheet in Microsoft Excel. Data were extracted for the Nepali fiscal years FY 2076/77 BS (2019 AD), FY 2077/78 BS (2020 AD), FY 2078/79 BS (2021 AD), FY 2079/80 BS (2022 AD), and FY 2080/81 BS (2023 AD). The analysis was conducted using IBM SPSS version 22 and QGIS version 3.38.1 to understand the epidemiology of tuberculosis in the area over the past five years.

RESULTS

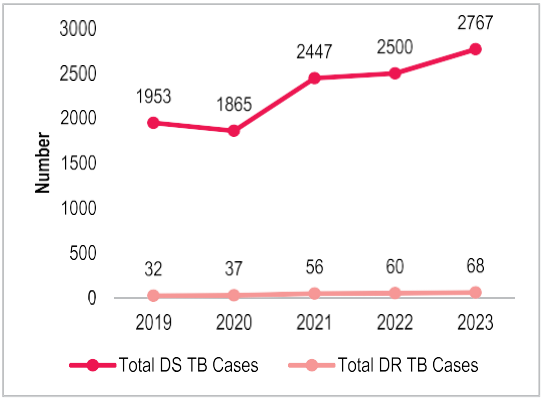

Figure 2: Number of DS and DR tuberculosis reported per year in Gandaki Province from 2019 to 2023, (n=11532)

Figure 2 shows the total number of DS TB cases reported in Gandaki province from 2019 to 2023 which was 11532 with an average annual reported incidence rate of 92.66 per 100000. The reported TB cases showed an increasing trend every year except during the COVID period when cases were slightly decreased. Immediately after post-COVID it was sharply increased in 2021.

Table 1: Basic characteristics of tuberculosis patients in Gandaki Province from 2019 to 2023 (n=11532)

Characteristics	Frequency	Proportion (%)
District		
Gorkha	1028	8.91
Manang	7	0.06
Mustang	42	0.36
Myagdi	264	2.29
Kaski	2999	26.01
Lamjung	608	5.27
Tanahu	1412	12.24
Nawalparasi East	2536	21.99
Syangja	1248	10.82
Parbat	343	2.97
Baglung	1045	9.06
Gandaki Province	11532	
Sex		
Female	4291	37.21
Male	7241	62.79
Age		
0-4 Years	104	0.90
5-14 Years	328	2.84
15-24 Years	1877	16.28
25-34 Years	1800	15.61
35-44 Years	1488	12.90

45-54 Years	1548	13.42
55-64 Years	1747	15.15
≥ 65 Years	2640	22.89
Type of TB		
PBC	6444	55.88
PCD	1700	14.74
EP	3388	29.38

Table 1 shows that during the last 5 years, the highest proportion of TB cases was reported in the Kaski district with 26% of total cases reported. The number of TB cases reported was higher in male than in female with the sex ratio of 1.67:1. Child TB cases (0-14 years) reporting was 3.74%.

Table 2: Smoking and HIV status of tuberculosis patients in Gandaki Province from 2019 to 2023 (n=11532)

Characteristics	Number of TB Patients				
	2019	2020	2021	2022	2023
Smoking Status					
Total TB Registered	1953	1865	2447	2500	2767
Total Current Smokers	128	162	194	165	224
Proportion (%) of Smokers among TB	**6.55**	**8.29**	**9.93**	**8.45**	**11.47**
HIV Status					
Total TB Registered	1953	1865	2447	2500	2767
Total HIV Tested	1562	1578	2340	2469	2744
Proportion (%) of HIV testing among TB registered	79.98	84.61	95.63	98.76	99.17
Total HIV Positive	14	25	34	25	33
Proportion (%) of HIV Positive	**0.90**	**1.60**	**2.18**	**1.60**	**2.11**

Table 2 showed that proportion of smokers among TB cases was in increasing trend from 6.55% in 2019 to 11.47% in 2023. Out of total TB cases registered, proportion of HIV testing had increased over the period (from 80% in 2021 to 99% in 2023).

Figure 3 shows that among the total diagnosed TB patients, more than 50% of TB patients were self-referral while 32.77% were referred by the private sector, 7.79% of them were referred by community and 2.58% referral through contact tracing in past 5 years period.

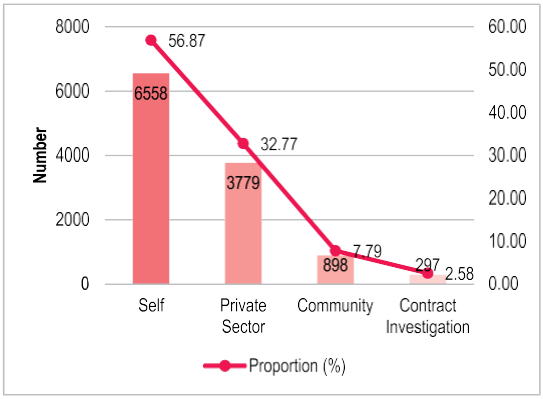

Figure 3: The cumulative reported of referral tracking status of diagnosis of tuberculosis patients in Gandaki Province from 2019 to 2023

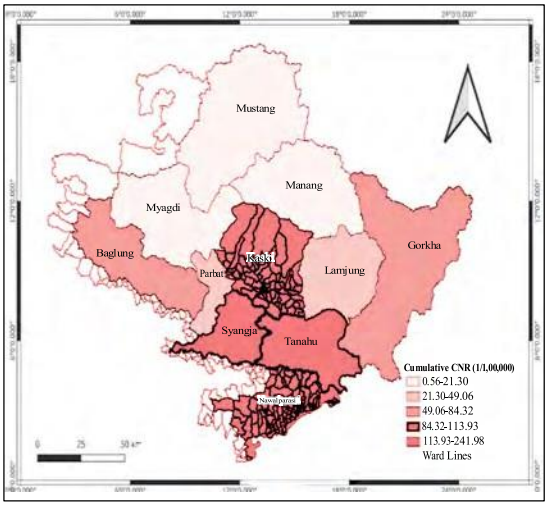

Figure 4: The geographical distribution of tuberculosis cumulative reported case notification rate in Gandaki Province from 2019 to 2023

Figure 4 shows that from 2019-2023, the cumulative reported case notification rate of TB was more than 113 per 100000 in Kaski and Nawalparasi East districts. While in Myagdi, Mustang and Manang districts, the case notification rate was below 21 per 100000 populations in the same period.

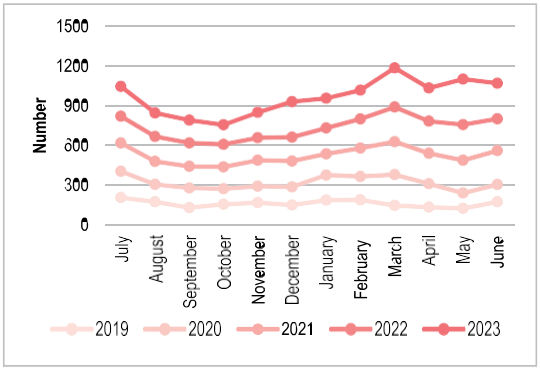

Figure 5: Time distribution of tuberculosis patients in Gandaki Province from 2019 to 2023 (n=11532)

Table 3: Treatment outcome status of tuberculosis patients in Gandaki Province from 2019 to 2023 (n=9358)							
Treatment outcome status	Number of TB Patients						
	2019	2020	2021	2022	2023	Total	Proportion (%)
Cured	8	903	829	1245	1138	4123	44.06
Completed	789	864	857	1003	895	4408	47.10
Failed	1	19	23	27	42	112	1.20
Died	14	87	91	81	106	379	4.05
Loss to follow	18	37	40	61	41	197	2.11
Not Evaluated	20	32	29	27	31	139	1.49
Total Registered	850	1942	1869	2444	2253	9358	

Figure 5 shows that TB cases were reported in all months with high notification in months of March to June. The combined cumulative numbers of reported TB cases over the 5 years showed there was up and down trend in different months throughout the year with the highest peak of disease reported was in the month of March while the lowest case reported was during September and October months.

Table 3 showed that among the total cumulative number of TB patients registered for outcome in the past 5 years, the proportion of treatment success (either cured or completed the full course of treatment) was 91.16%. The trend showed that the number of deaths, and failure cases were gradually increasing over the period.

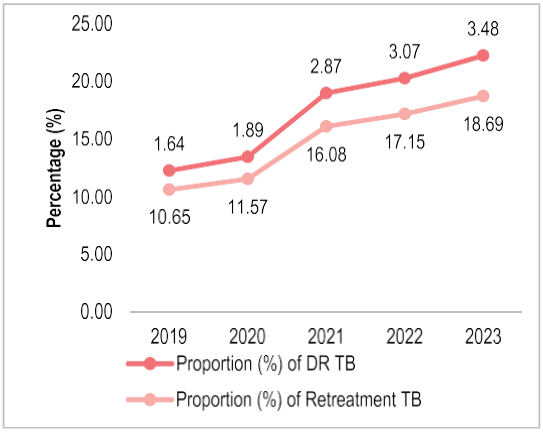

Figure 6: Trend analysis of DS retreatment TB and DR TB in Gandaki Province from 2019 to 2023

Figure 6 shows analysis of the trend from 2019 to 2023, the proportion of retreatment cases of TB had increased over the period from 1.64% in 2019 to 3.48% in 2023. During the COVID period (2019-2020) proportion of retreatment cases and DR cases were low but sharply increased in the post COVID period.

DISCUSSION

Our study reveals several important trends and emerging concerns. Over this five-year period (2019-2023), a total of 11,532 TB cases were documented, indicating a rising trend in annual case notifications. This increase could reflect either improved case detection or a genuine rise in TB incidence. Notably, Kaski and Nawalparasi East districts contributed the highest cumulative caseloads, accounting for 26.01% and 21.99% of total cases respectively. These figures may suggest localized hotspots of transmission or disparities in health service access and coverage. A gender disparity was evident, with males comprising approximately 62.79% of TB patients. This aligns with global patterns where men are generally more affected, possibly due to a combination of biological, behavioral, and socio-cultural factors. [21,22]. Other reason for the lower prevalence in female might be due to social context. Women in Nepal may face barriers to accessing TB diagnosis and treatment due to social and cultural factors like stigma, limited mobility, and a lower likelihood of seeking care as a result, women may be underdiagnosed. Similar findings were found in the study done in China which shows reveals a significantly higher incidence in males than in females[23-25]. Similar result was found in a study where the number of registered incidences was higher in men than in women [3, 26, 27,28]. The majority of cases were observed among individuals aged 15 to 55 years, highlighting the burden of TB among the economically productive age group and underlining the socio-economic impact of the disease.

TB affects all age groups, but the highest burden is often seen in adults, which is consistent with global patterns. In our study majority of the tuberculosis

patients were of above 65 years [28]. Older adults are more likely to have other chronic health conditions that can exacerbate TB and lead to higher mortality rates. The elderly population need to be screened for TB earlier considering their low immune system. In contrast to our finding, a study done by Zhan X found the highest proportion of PTB patients (20.2%) were between 40 and 50 years old [23].

Pulmonary TB remained the predominant form, comprising nearly three-fourths of the total cases, which is consistent with national and global data. However, of growing concern is the increasing proportion of TB-HIV co-infection, which rose from 0.90% in 2019 to 2.11% in 2023. This trend calls for strengthened TB-HIV collaborative activities, including routine screening and integrated care services. Seasonal variation was also noted, with a peak in TB notifications occurring between March and June. This could be influenced by environmental, occupational, or health-seeking behavior patterns and warrants further investigation to inform targeted interventions.

Moreover, the data reflect a gradual increase in TB-related deaths and treatment failure rates over the years, signaling potential gaps in treatment adherence, drug resistance, or patient follow-up mechanisms. Retreatment cases also showed a notable rise, from 1.64% in 2019 to 3.48% in 2023, indicating challenges in sustaining treatment success. Equally concerning is the upward trend in drug-resistant (DR) TB cases, which nearly doubled from 10.65% in 2019 to 18.69% in 2023. This underscores the urgent need for enhanced diagnostic capacity, drug susceptibility testing, and tailored treatment regimens to combat the spread of DR-TB. These findings emphasize the necessity for intensified TB control efforts, focused surveillance, and context-specific strategies to address the evolving TB burden in Gandaki Province. One key limitation of this study is its reliance on secondary data. As such, the accuracy and completeness of the findings depend on the quality of the original data collected and recorded by health facilities.

Regarding types of TB, the PBC cases are high; our study found that more than half (55.88%) of the patients had PBC and 14.74% had PCD and 29.38% had extra pulmonary TB. Similar evidence was found in NTC Fact sheet report where more than 70% of TB cases was pulmonary [29]. Supporting the evidence, study done by Sah SK in Nepal found four-fifth (80.9%) TB patients investigated were pulmonary positive and one-fifth (19.1%) extra pulmonary [30].

In contrast to our finding, study done by Simieneh A, et al found 49.3% had extra pulmonary TB followed by 33.3% smear negative pulmonary TB patients and 16.8% smear positive pulmonary. The differences might be that was hospital based study, so more number of extra pulmonary tuberculosis patients were detected [31].

Smoking is a significant risk factor for tuberculosis (TB) and can impact both the likelihood of developing the disease and the outcomes for those who are infected. Our study showed that the proportion of smokers among TB cases were in increasing trend from 6.55% in 2019 to 11.47% in 2023. As patient who smoke have a high chance of relapse so, it is utmost important to modify lifestyle related behaviour like smoking, tobacco-use; thus cases are increasing [15, 32] Similar finding was found in the study done in Bangladesh and Pakistan by Marshall AM shows the prevalence of smoking in the TB patient population was 8% [33]. Co-morbidity is higher among the tuberculosis patients as they have low immune system. Our study found status of HIV among tuberculosis patients was more than 1% which resembles with the study done by Ubal Leonardo which shows 1.45% of TB patients were HIV positive [24]. Similar findings were found in the study which shows 1.9% and 2.8% had HIV [30,34]. The test rate should be increased to detect the HIV status as, majority of TB patients had HIV and due to HIV; they have low immunity thus they can have had TB too. Diagnosis of HIV should be emphasized among all TB patients.

In most of the developing country where private sectors are growing and providing health services; the large number of tuberculosis patients are hold by private sectors. Our study found 32.7% TB were referred by Private HFs which corresponds with the NTCC Fact sheet which shows more than one-fourth of TB patients were referred by private sectors [29]. All the private health facilities should be emphasized, all health personnel should be provided with training for the proper diagnosis and treatment of tuberculosis [7,35]. Our study found TB

cases were increasing annually. After the COVID pandemic , the case notification rate has gradually increased worldwide and nationally which is also supported by the NTCC fact sheet 2023 and WHO global TB report which shows the TB cases increasing trend from 2020 to 2023 [5,29]

In terms of monthly distribution, the highest cumulative number of cases was reported in March and September during the survey period from 2011 to 2021, with 10.3% and 10.4%, respectively, and the lowest cumulative number of cases was reported in January during the survey period. Usually the diagnosis of TB is higher in March-June month as, in the winter season the flu and common cold symptoms resemble TB so, people refused to visit health facility for TB detection [23]. A comprehensive analysis showed that September and December were the two peak points of the disease throughout the year, with December being the highest peak (9.62% of the total) [26]. In terms of seasonality, January and February are usually the troughs each year. They peaked in March and showed a volatile downward trend, reaching a low point in October; and then rose, reaching another small peak at the end of the year, followed by a rapid decline [27].Treatment success rate is good in our study and death rate is also high. Early diagnosis and a nutritious diet should be focused to decrease the death rate.

DR TB cases are in increasing trend in Nepal [29] Retreatment cases trend was found to be increased from 1% in 2015 to 1.6% in 2017. Most of the re-treatment cases were usually converted to MDR-TB (Multi-Drug Resistant Tuberculosis) [36] greatest number of MDR/RR-TB cases identified at re-treatment resulted from initial MDR/RR-TB that was inappropriately treated as DS-TB. [37,38] Non-adhering to medication has increased drug resistant TB. It is of utmost important to properly treat during first phase to reduce drug resistant.

Policies should also prioritize the TB services to improve access in high-burden districts such as Kaski and Nawalparasi East. The seasonal peak in TB notifications may guide policymakers in allocating resources and conducting awareness campaigns during high-risk months. Finally, investment in real-time data reporting and surveillance systems is essential to improve data quality and enable evidence-based decision-making.

CONCLUSION

This study highlights an increasing trend in the number of tuberculosis patients in Gandaki Province, with the majority of reported cases being male. The highest case notification rates were observed in the Kaski and Nawalparasi East districts. Over one-third of TB patients were diagnosed at private health facilities. A significant number of TB cases were reported between March and June. More than one percent of HIV positive among TB patients and Nine out of the ten TB patients had successful TB treatment outcome in Gandaki province. The trend of retreatment and drug-resistant TB cases has increased from 2019 to 2023. The study could help identify key periods with high TB case notifications and provide a reference for timely diagnosis, prevention, and control measures.

CONFLICT OF INTEREST

None

RECOMMENDATIONS

- Active case finding should be strengthened in rural areas, among the elderly population and in other key vulnerable groups.
- The National TB program should effectively implement the DOTS strategy for medication adherence and adopt a public-private mix approach for the early diagnosis of TB.
- All TB patients should be routinely screened and tested for HIV infection.

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