

## ORIGINAL ARTICLE

## PREVALENCE OF ANEMIA AMONG TUBERCULOSIS PATIENTS IN NEPAL: AN OBSERVATIONAL CROSS-SECTIONAL STUDY

Surya Kc<sup>1\*</sup> Amrita Paudel<sup>2</sup><sup>1</sup>Department of Medicine, Maharajgunj Medical Campus, Institute of Medicine, Kathmandu, Nepal<sup>2</sup>Jahrulal Islam Medical College and Hospital, Kishoreganj, Bangladesh

## ABSTRACT

**Introduction:** Tuberculosis is an infectious disease caused by *Mycobacterium tuberculosis*. Anemia is a common co-morbidity among people with TB and is associated with a poor prognosis. Tuberculosis is one of the deadliest diseases and a major burden on the healthcare system in Nepal. The prevalence of anemia in tuberculosis is high, which range from 20% to 64%. The objective of the study is to determine the prevalence of anemia among tuberculosis patients in Nepal, focusing on its severity (mild and moderate) and morphological types (microcytic, normocytic, and macrocytic).

**Method:** A retrospective cross-sectional study was conducted among the new case of pulmonary tuberculosis patients who were diagnosed at OPD over four years period. Data was collected from the hospital record system after obtaining ethical approval from the Institutional Review Committee. Previous cases of tuberculosis, HIV co-infected, hematological, and kidney patients were excluded. Serum hemoglobin, demographic variables, and red blood cell parameters were obtained from the Hospital Record System. Anemia was defined based on WHO guidelines, and its severity was categorized as mild, moderate, or severe. Morphological classification was done using RBC indices. Convenience sampling was used. Point estimate and 95% confidence interval were calculated.

**Results:** Among 320 tuberculosis patients, the prevalence of anemia was 235 (73.75%) (95% confidence interval: 68.60–78.25). Most patients with anemia (78.7%) had mild anemia, followed by 16% with moderate anemia and 5% with severe anemia. Normocytic normochromic anemia was the most common morphological pattern (51.25%), followed by microcytic anemia (36%) and macrocytic anemia (10%). Anemia was more prevalent in females (63.8%) compared to males (36.2%) and was higher in older adults, with 69% of anemic patients aged 65 years or older. A majority of patients with anemia (73%) were from lower socioeconomic backgrounds, and 65.1% were malnourished with a BMI below 18.5 kg/m<sup>2</sup>.

**Conclusion:** The occurrence of anemia among tuberculosis patients in Nepal was found to be high, consistent with findings from numerous studies worldwide

**Key words:** Anemia; Prevalence; Tuberculosis

<https://doi.org/10.3126/jmmihs.v10i1.77691>

\*Corresponding Author: Surya Kc, Maharajgunj Medical Campus, Institute of Medicine, Kathmandu, Nepal

Email: [surya.kc.14473@gmail.com](mailto:surya.kc.14473@gmail.com)

Received 5 february 2025 ; Received in Revised form 25 february 2025; Accepted 26 March 2025

## INTRODUCTION

Tuberculosis (TB) is the leading cause of mortality from a single infectious agent globally. The World Health Organization (WHO) reported that in 2023, approximately 8.2 million people were newly diagnosed with TB, the highest number recorded since global TB monitoring began in 1995.<sup>1</sup> TB is caused by *Mycobacterium tuberculosis* and primarily affects the lungs (pulmonary TB), though it can also manifest in other organs (extrapulmonary TB). Tuberculosis is a major health problem in Nepal with a prevalence of around 117,000 affected according to the Nepal Tuberculosis prevalence study (2018-19) with an annual incidence of 245 per 100,000 population.<sup>2</sup> Globally, tuberculosis (TB) and anemia are public health problems related to high morbidity and mortality. The prevalence of anemia in pulmonary tuberculosis is reported ranging from 20 to 94%.<sup>3,4</sup>

Anemia is functionally defined as the inability of erythrocyte mass to deliver oxygen in sufficient amounts to peripheral tissues.<sup>5</sup> The effects of anemia are diverse among people with TB such as a risk factor for the development of TB and is associated with TB complications including lung injury and poor prognosis such as poor sputum conversion 2 months after TB treatment initiation and also an increased risk of deaths.<sup>6,7,8,9</sup>

The major hematological abnormality seen in patients with tuberculosis is anemia. The underlying pathogenesis of anemia in patients with tuberculosis is suppression of erythropoiesis by inflammatory markers, nutritional deficiency, and malabsorption syndrome.<sup>10,11</sup> The objective of this study was to find out the prevalence of anemia in new cases of tuberculosis.

## METHODS

## Study Design

A retrospective cross-sectional study was conducted among a new case of tuberculosis who were diagnosed at a hospital equipped with a DOTS (Directly Observed Treatment Short Course) center. Data were collected on new cases of Tuberculosis attending the OPD and DOTS center of the hospital over the past 4 years from the hospital record system. Ethical approval was obtained from the research ethics committee of the Institutional Review Committee (IRC)[Approval number: 475[6-11] E2 081/082].

## Sample Size

$$n = \left( \frac{Z}{e} \right)^2 PQ = 312$$

Where:

n = sample size

Z = Z-value (1.96 for 95% confidence)

p = prevalence (0.718 for 71.8%), The prevalence used in this study was based on the study conducted in India among Tuberculosis patients.<sup>3</sup>

E = margin of error (0.05)

Although the calculated sample size was 312, a total of 320 cases were identified.

## How to Cite

Kc, S., & Paudel, A. Prevalence of Anemia Among Tuberculosis Patients in Nepal: An Observational Cross-Sectional Study. *Journal of Manmohan Memorial Institute of Health Sciences*, 10(1), 15–17. <https://doi.org/10.3126/jmmihs.v10i1.77691>



### Data collection

Demographic profiles, hemoglobin levels, and RBC indices were extracted from the hospital record system. These data were entered into Microsoft Excel 2016. Anemia was defined according to WHO guidelines as hemoglobin levels less than 12 g/dL for women and 13 g/dL for men.<sup>12</sup> The severity of anemia was further classified as:

Mild: 11.9–11 g/dL for women, 12.9–11 g/dL for men

Moderate: 10.9–8 g/dL

Severe: <8 g/dL

The morphological classification of anemia was as follows:

Microcytic: MCV < 80 fl

Normocytic: MCV = 80–95 fl

Macrocytic: MCV > 95 fl

### Statistical analysis

Data completeness was ensured, and duplicates were removed. Statistical analysis was performed using Microsoft Excel and IBM SPSS Statistic version 23.0.

## RESULTS

Out of 320 patients, anemia was observed in 235 individuals (73.43%). Among those, 78.75% had mild anemia, 16.2% had moderate anemia, and the remaining had severe anemia, which was the least common as shown in Table 1

**Table 1: Prevalence based on severity of anemia**

Severity of anemia	Number	Percent
Mild	185	78.7
Moderate	38	16.2
Severe	12	5.1

**Table 2 : Socio-demographic Characteristis of the repondets**

Characteristics	Number	Percent
Age		
≤ 64	73	31.0
> 64	162	69.0
Sex		
Male	85	36.2
Female	150	63.8
Socio-Economics Stttatus		
Lower	171	72.8
Middle	64	27.2
BMI		
<18.5	153	65.1
18.5- 24.9	82	34.9

Table 2 provides information regarding demographic characteristics. Out of 235 individuals with anemia, 36.2% of the patients were male, and 63.8% were female. The majority (69%) were in the 65+ age group, while 31% were aged 15-65. A large proportion (73%) belonged to a lower socioeconomic status. Additionally, 65% of the patients were underweight, with a BMI under 18.5.

**Table 3: Morphological pattern of RBC**

Morphological pattern	Number	Percent
Normocytic normochromic anemia	120	51.1
Microcytic microchromic anemia	86	36.6
Macrocytic anemia	24	10.2
Dimorphic	5	2.1

Table 3 shows the distribution of anemia on RBC indicates, with normocytic normochromic anemia being the most common at around 51%, followed by microcytic anemia at 36% and macrocytic anemia at 10%.

## DISCUSSIONS

The prevalence of anemia among tuberculosis patients in our study was 73.43%, conducted on 320 TB patients. This is notably higher than the prevalence reported in a systematic review and meta-analysis, which estimated it to be around 61.53%<sup>9</sup>. A systematic review and meta-analysis conducted in Africa reported a prevalence of 73%, closely aligning with the findings of our study.<sup>13</sup> Similarly, a study in India among pulmonary tuberculosis patients reported a prevalence of 71.8%.<sup>3</sup>

In this study approximately half of the TB patients with anemia were aged 65 years or older. Previous studies have also identified age as a significant risk factor for anemia in pulmonary tuberculosis patients. Aging is associated with prolonged chronic diseases, inadequate nutrition, reduced marrow cellularity, and decreased vitamin B12 levels<sup>14</sup>. Although folate deficiency has been observed in many TB patients, the incidence of megaloblastic anemia remains low, at 10%.<sup>3</sup>

Our study found that anemia was more prevalent among female TB patients (74.5%) compared to male patients (25.4%). Similar results were observed in a systematic review conducted in Africa.<sup>13</sup> However, some studies have reported a higher prevalence of anemia in males compared to females.<sup>3</sup>

The majority of patients in our study (51.8%) had mild anemia, as mild anemia is frequently reported as the most common form of anemia in tuberculosis.<sup>15</sup> However, the prevalence of mild anemia in our study is higher compared to the prevalence of 34% reported in previous systematic reviews and meta-analyses.<sup>9,13</sup>

Most patients in our study exhibited normocytic normochromic anemia. Similarly, a study conducted in Korea reported that 72% of TB patients had normocytic normochromic anemia, making it the most prevalent type among pulmonary tuberculosis patients.<sup>13,16</sup> In contrast, other studies have found microcytic hypochromic anemia to be the dominant morphological pattern at TB diagnosis.<sup>17,18</sup> The higher proportion of normocytic anemia in our findings may be attributed to the predominance of anemia of chronic disease.<sup>9,15</sup>

In our study, 107 (59.1%) TB patients with anemia were malnourished, with a BMI below 18.5 kg/m<sup>2</sup>. A study in India reported a similar association between lower BMI and anemia in pulmonary TB patients [3]. Additionally, anemia was more prevalent among patients from lower socioeconomic backgrounds, consistent with findings from a study conducted in India.<sup>3,19</sup>

Nutritional deficiencies, malabsorption, and anemia of chronic disease commonly cause anemia in TB. The primary treatment for anemia in TB involves addressing the underlying inflammatory process. In cases of severe anemia, iron therapy should be considered only after the inflammation has subsided, as iron supplementation during the active phase of the disease can promote microbial proliferation.<sup>20</sup> Iron therapy is recommended for patients with persistent anemia that does not resolve with anti-tuberculosis treatment.<sup>21</sup>

The prevalence determined in this study is done in a single center with a convenient sampling method. So, this may not reflect the overall burden of anemia during pregnancy in a larger population.

## CONCLUSIONS

Anemia is highly prevalent among tuberculosis patients, with normocytic anemia and mild anemia being the most common types. Given the strong association between anemia and adverse TB outcomes, addressing anemia through nutritional support, timely iron supplementation, and managing chronic inflammation could reduce mortality and enhance the quality of life for TB patients.

This research underscores the importance of a multidisciplinary approach in TB management, incorporating nutritional, hematological, and socio-economic factors for comprehensive care.

## REFERENCES

1. National TB Prevalence Survey 2018-19 [Internet]. Available from: [https://www.who.int/docs/default-source/nepal-documents/policy-brief.pdf?sfvrsn=37b5881c\\_2](https://www.who.int/docs/default-source/nepal-documents/policy-brief.pdf?sfvrsn=37b5881c_2)
2. National TB Prevalence Survey(2018-19) -Factsheet [Internet]. Available from: <https://nepalntp.gov.np/wp-content/uploads/2020/03/TBPS-Factsheet-English.pdf>

3. Mukherjee, A., Kaeley, N., Dhar, M., Kumar, S. & Bhushan, B. Prevalence, characteristics, and predictors of tuberculosis-associated anemia. *J. Fam. Med. Prim. Care.* 8, 2445–2449 (2019).
4. Kahase D, Solomon A, Alemayehu M. Evaluation of peripheral blood parameters of pulmonary tuberculosis patients at St Paul's hospital millennium medical college, Addis Ababa, Ethiopia: Comparative study. *J. Blood Med.* 2020;11:115–121. doi: 10.2147/JBM.S237317.
5. Adzani M, Dalimoenthe NZ, Wijaya I. Profile of anemia on lung tuberculosis at Dr. Hasan Sadikin General Hospital and community lung health center bandung. *Althea Med. J.* 2016;3(1):137–140.
6. Luo M, Liu M, Wu X, Wu Y, Yang H, Qin L, et al. Impact of anemia on prognosis in tuberculosis patients. *Ann. Transl. Med.* 2022;10(6):329. doi: 10.21037/atm-22-679.
7. Isanaka S, Mugusi F, Urassa W, Willett WC, Bosch RJ, Villamor E, et al. Iron deficiency, and anemia predict mortality in patients with tuberculosis. *J. Nutr.* 2012;142:350–357. doi: 10.3945/jn.111.144287.
8. Kourbatova EV, Borodulin BE, Borodulina EA, Rio C, Blumberg HM, Leonard MK, et al. Risk factors for mortality among adult patients with newly diagnosed tuberculosis in Samara, Russia. *Int. J. Tuberc. Lung Dis.* 2006;10(11):1224–1230.
9. Barzegari S, Afshari M, Movahednia M, Moosazadeh M. Prevalence of anemia among patients with tuberculosis: A systematic review and. *Indian J. Tuberc.* 2019;66(2):299–307. doi: 10.1016/j.ijtb.2019.04.002.
10. Morris CD, Bird AR, Nell H. The hematological and biochemical changes in severe pulmonary tuberculosis. *QJ Med.* 1989;73:1151–9.
11. Schwenk A, Macallan DC. Tuberculosis, malnutrition and wasting. *Curr Opin Clin Nutr Metab Care.* 2000;3:285–91. doi: 10.1097/00075197-200007000-00008.
12. Alsalmi MA, Almalki HM, Alghamdi AA, Aljasir BA. Knowledge, attitude and practice of blood donation among health professions students in Saudi Arabia; A cross-sectional study. *Journal of family medicine and primary care.* 2019 Jul 1;8(7):2322-7
13. Abaynew Y, Ali A, Taye G, Shenkut M. Prevalence and types of anemia among people with tuberculosis in Africa: a systematic review and meta-analysis. *Scientific Reports.* 2023 Apr 3;13(1).
14. Hoffbrand AV, Pettit JE. 3rd ed. United Kingdom: Blackwell Science; 1993. *Essential Haematology*; pp. 209–377.
15. Dasaradhan T, Koneti J, Kalluru R, Gadde S, Cherukuri S priya, Chikattimalla R. Tuberculosis-Associated Anemia: A Narrative Review. *Cureus [Internet].* 2022 Aug 7;14(8).
16. Lee S, Kang Y, Lee S, Yoo C, Kim Y, Han S. The prevalence and evolution of anemia associated with tuberculosis. *J Korean Med Sci.* 2006;21:1028–32. doi: 10.3346/jkms.2006.21.6.1028
17. Abdelkareem, Y., Hashim, A. M. & Abdelazeem, H. Hematological changes in pulmonary tuberculosis. *Al-Azhar Assiut Med. J.* 13, 4 (2015).
18. Mulenga, C. M., Kayembe, J. N. & Kabengele, B. O. Anemia and hematologic characteristics in newly diagnosed pulmonary tuberculosis patients at diagnosis in Kinshasa. *J. Tuberc. Res.* 5, 243–257 (2017).
19. Bharati P, Shome S, Chakrabarty S, Bharati S, Pal M. Burden of anemia and its socioeconomic determinants among adolescent girls in India. *Food and Nutrition Bulletin.* 2009 Sep;30(3):217-26
20. Lanser L, Fuchs D, Kurz K, Weiss G. Physiology and inflammation driven pathophysiology of iron homeostasis-mechanistic insights into anemia of inflammation and its treatment. *Nutrients.* 2021 Oct 22;13(11):3732.
21. Cercamondi CI, Stoffel NU, Moretti D, Zoller T, Swinkels DW, Zeder C, Mhimbra F, Hella J, Fenner L, Zimmermann MB. Iron homeostasis during anemia of inflammation: a prospective study of patients with tuberculosis. *Blood, The Journal of the American Society of Hematology.* 2021 Oct 14;138(15):1293-303.

## AUTHORS CONTRIBUTION

Surya Kc conceived the study, developed a proposal, and research tool, and conducted the study. Amrita Paudel and Surya Kc both were involved in data analysis, report writing, data collection, data editing, finalization of report, and manuscript preparation.

## COMPETING INTEREST

The authors declare no competing interest.