![MEDDOCS Open Access Publisher]

Open Access | Research Article

Prevalence of Anemia among Tuberculosis Patients in Nepal: An Observational Cross-Sectional Study

Surya KC[1]*; Sarita KC[2]

[1]MBBS, Maharajgunj Medical campus, Kathmandu, Nepal.

[2]Ministry of Government of Nepal, Kathmandu, Nepal.

*Corresponding Author(s): Surya KC

Maharajgung Medical Campus, Institute of medicine, Kathmandu, Nepal.

Tel: +9779867023052; Email: surya.kc.14473@gmail.com

Abstract

Introduction: Tuberculosis is an infectious disease caused by mycobacterium tuberculosis. Anemia is a common co-morbidity present among people with TB, and it is associated with poor prognosis. Tuberculosis is one of the deadliest disease and a major burden on the healthcare system in Nepal. Prevalence of anemia in tuberculosis is high, reporting range from 20-64%.

Objectives: The objective of this 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).

Materials and methods: A retrospective cross-sectional study was conducted among the new case of pulmonary tuberculosis patient who were diagnosed at OPD over a period of four years from hospital record system over after obtaining ethical approval form the institutional Review committee. Previous case of tuberculosis, HIV co-infected, hematological and kidney patient were excluded. Serum hemoglobin, demographic variables, red blood cell parameters were obtained from 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 (78.75%) 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 (74.5%) compared to males (25.4%) 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 59.1% were malnourished with a BMI below 18.5 kg/m².

Conclusion: The prevalence of anemia among tuberculosis patient in Nepal was found to be high, consistent with findings from numerous studies worldwide.

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 [1]. 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 [2]. Globally, Tuberculosis (TB) and anemia are public health problems related with high morbidity and mortality. The prevalence of anemia in pulmonary tuberculosis reported to ranging from 20 to 94% [3,4].

Anemia is functionally defined as insufficiency of erythrocyte mass to deliver oxygen in sufficient amount to peripheral tissues [5]. 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 [6-9].

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 [10, 11]. The objective of this study was to find out prevalence of tuberculosis in patient who are new case of tuberculosis.

Methods

Study design

A retrospective cross-sectional study was conducted among tuberculosis patient at a hospital with DOTS (Directly Observed Treatment Short Couse) facility. Data were collected on new case of Tuberculosis attending OPD and DOTS center of the hospital over past 4 years from hospital record system after obtaining ethical approval.

Inclusion and exclusion criteria

Inclusion criteria:

a. All new cases of tuberculosis diagnosed with sputum microscopy, GeneXpert, or histopathological examination.

b. Those who were 18 years or older, were included in the study.

A "new case" of tuberculosis was defined as a patient who had never received treatment for tuberculosis or had taken Antitubercular Therapy (ATT) for less than one month [12].

Exclusion criteria:

a. Previously treated cases (categorized as relapse, treatment failure, lost to follow-up, or those with an unknown outcome history after recent treatment or an unknown previous TB treatment history),

b. HIV co-infected patients, and individuals with comorbid hematological or kidney diseases were excluded from the study.

Sample Size

$n = (Z^2 * p * (1 - p)) / E^2$

$n = (1.96^2 * 0.718 * (1 - 0.718)) / 0.05^2$

n= 312

Where:

n = sample size

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

p = prevalence (0.718 for 71.8%)

E = margin of error (0.05)

Prevalence used in this study was based on the study conducted in India among Tuberculosis patients [3]. All though calculated sample size was 312, a total of 320 cases were identified.

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 [WHO]. 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 [WHO]

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 IMB SPSS Statistic version 23.0.

Result

Table 1 provides proportion of severity of anemia based on WHO guidelines in a tuberculosis. Out of 312 patients, anemia was observed in 235 individuals (73.43%). Among those, 78.75% had mild anemia, 16% had moderate anemia, and the remaining had severe anemia, which was the least common.

Table 2 provides information regarding demographic characteristics, 34% of the patients were male, and 64% 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 shows the distribution of anemia based on RBC indices, with normocytic normochromic anemia being the most common at around 51%, followed by microcytic anemia at 36%, and macrocytic anemia at 10%.

Table 1: Prevalence based on severity of anemia.

Severity of anemia	Number (%)
Mild	79.06
Moderate	16.25
Severe	5

Table 2: Socio-demographic factor.

Characteristics		Number (%)
Age	65+	55.93
	15-64	43.75
Gender	Male	64.06
	Female	34.06
Socio-economics Status	Middle	26.87
	lower	72.81
BMI	<18.5	65
	24.9	35
	>25	0

Table 3: Morphological pattern of RBC.

Morphological pattern	Number (%)
Normocytic normochromic anemia	51.25
Microcytic microchromic anemia	36.87
Macrocytic anemia	10
Dimorphic	1.87

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% [9]. A systematic review and meta-analysis conducted in Africa reported a prevalence of 73%, closely aligning with the findings of our study [13]. Similarly, a study in India among pulmonary tuberculosis patients reported a prevalence of 71.8% [3].

In our 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 [14]. Although folate deficiency has been observed in many TB patients, the incidence of megaloblastic anemia remains low, at 10% [15].

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 [13]. However, some studies have reported a higher prevalence of anemia in males compared to females [3].

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 [16]. 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 [9,13].

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 [17,13]. In contrast, other studies have found microcytic hypochromic anemia to be the dominant morphological pattern at TB diagnosis [18,19]. The higher proportion of normocytic anemia in our findings may be attributed to the predominance of anemia of chronic disease [16,9].

In our study, 107(59.1%) TB patients with anemia were malnourished, with a BMI below 18.5 kg/m². A similar association between lower BMI and anemia in pulmonary TB patients was reported by study in India [3]. Additionally, anemia was more prevalent among patients from lower socioeconomic backgrounds, consistent with findings from a study conducted in India [20,3].

Anemia in TB is commonly caused by nutritional deficiencies, malabsorption, and anemia of chronic disease. 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 [21]. Iron therapy is recommended for patients with persistent anemia that does not resolve with anti-tuberculosis treatment [22].

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.

References

1. NATIONAL TB PREVALENCE SURVEY, 2018-19.

2. NATIONAL TB PREVALENCE SURVEY (2018-19) -FACTSHEET.

3. Mukherjee A, Kaeley N, Dhar M, Kumar S, Bhushan B. Prevalence, characteristics, and predictors of tuberculosis associated anemia. J Fam Med Prim Care. 2019; 8: 2445-2449.

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.

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: 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: 329.

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.

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: 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: 299–307.

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.

12. World Health Organization. Tuberculosis. WHO Report 2012 Geneva, Switzerland.

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; 13.

14. Hoffbrand AV, Pettit JE. 3rd ed. United Kingdom: Blackwell Science; 1993. Essential Haematology. 209–377.

15. Karyadi E, Schultink W, Nelwan RH, Gross R, Amin Z, Dolmans WM, et al. Poor micronutrient status of active pulmonary tuberculosis patients in Indonesia J Nutr. 2000; 130: 2953–8.

16. Dasaradhan T, Koneti J, Kalluru R, Gadde S, Cherukuri S Priya, Chikatimalla R. Tuberculosis-Associated Anemia: A Narrative Review. Cureus. 2022; 14.

17. 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.

18. Abdelkareem Y, Hashim AM, Abdelazeem H. Hematological changes in pulmonary tuberculosis. Al-Azhar Assiut Med J. 2015; 13: 4.

19. Mulenga CM, Kayembe JN, Kabengele BO. Anemia and hematologic characteristics in newly diagnosed pulmonary tuberculosis patients at diagnosis in Kinshasa. J Tuberc Res. 2017; 5: 243–257.

20. Bentley ME, Griffiths PL. The burden of anemia among women in India. Eur J Clin Nutr. 2003; 57: 52–60.

21. Baillie FJ, Morrison AE, Fergus I. Soluble transferrin receptor: a discriminating assay for iron deficiency. Clinical & Laboratory Haematology. 2003; 25: 353–7.

22. Cercamondi CI, Stoffel NU, Moretti D, et al. Iron homeostasis during anemia of inflammation: a prospective study of patients with tuberculosis. Blood. 2021; 138: 1293–1303.