

# A Cross-sectional Study of Morphological Types of Anemia in Pulmonary Tuberculosis Patient and Associated Risk Indicators in a Selected Hospital of Dhaka City, Bangladesh

Forhad Monjur, and Farhana Rizwan

**Abstract**—Tuberculosis (TB) is a leading cause of morbidity and mortality in developed and developing countries and anemia is a common symptom for any chronic disease worldwide, although burden is highest in developing countries like Bangladesh, where malnutrition and chronic infections are prevalent. A cross-sectional study was performed on 121 TB patients in the year of 2011 in a renowned Hospital of Chest Disease in Dhaka city of Bangladesh. Socio-demographic indicators and clinical data were obtained from hospital record and structured questionnaire was used. Anthropometric measurements were done by the standard technique and categorized as per World Health Organization guideline. Purposively selected participants were consecutively screened for anemia with a full blood count. Hemoglobin was detected by cyanide free Sodium Lauryl Sulphate Hemoglobin detection method. Anemia was defined by WHO criteria. It was found that the proportion of anemia among the TB patient was 75.2%. Female were more affected (80%) than male (20%). Normocytic Normochromic anemia was more (64.8%) in TB patients and the rests were Microcytic Hypochromic anemia. Anemia is significantly higher in malnourished than normal TB patients ( $p=.001$ ). Significant association was found between anemia and symptoms of TB such as, weight loss, cough before diagnosis, coughing time etc. There was no significant relationship was observed between age, sex, marital status and place of residence with anemia ( $P>.05$ ).

According to this study, it was found that an alarming number of TB patients also suffering from anemia which may worsen the disease condition.

**Keywords**—Pulmonary Tuberculosis, Anemia, Developing Countries.

## I. INTRODUCTION

IN 1882, Robert Koch discovered the infectious agent (*Mycobacterium tuberculosis*) of tuberculosis (TB) disease. Now a day, TB continues to be a devastating and widespread

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public health problem. in developing countries The updated report of World Health Organization (WHO) reveals that about 9.4 million new TB cases occurred in 2008 worldwide, of whom 3.6 million are women [1]. Current trends suggest that TB will still be among the 10 leading causes of global disease burden in the year 2020 and it was also estimated that approximately 1000 million people will become newly infected and 36 million will die between 2002 and 2020 [2]-[3].

Globally TB cases are skewed heavily toward low-income and emerging economies. The highest prevalence in Asia, where China, India, Bangladesh, Indonesia, and Pakistan collectively make up over 50% of the global burden [4]-[7]. Bangladesh ranks 6th among 22 high burden countries. Among 25 high priority Multi-Drug Resistant (MDR) and Extensively Drug Resistant (XDR) TB countries, Bangladesh places 9th in the World [4]. The highest incidence rate of TB are in Africa (83/100000), more specifically sub-Saharan Africa (290/100000). Approximately 6 million of the 8 million TB cases occur predominantly in the economically most productive (15- to 49-year-old) age group [5].

On the other hand, anemia is a common complication of pulmonary tuberculosis and the reported prevalence ranging from 16-76% in different studies [8]. Though the precise mechanism of anemia in pulmonary tuberculosis is not clearly known, but anemia of inflammation as well as of Fe deficiency has been implicated but it is difficult to distinguish and both are common in developing countries [9]. As pulmonary tuberculosis is a chronic infective disease occurring predominantly in socio-economically deprived populations so both anemia may coexist simultaneously [10].

According to estimates from the WHO, two billion individuals suffer from anemia in the world [11]. The highest prevalence of anemia exists in the developing world where its causes are multifactorial, ranging from micronutrient deficiencies such as iron, folate, vitamin B12 to infectious diseases such as malaria and worm infections [12].

To our knowledge, both anemia and tuberculosis are major public health problem of Bangladesh. Anemia is common among all age-groups, and both sexes are affected. Bleeding, chronic disease such as tuberculosis and malignancy play an

important role for developing anemia. Malnutrition as a contributing factor is probably underestimated [13]-[15]. So, this study was designed to find out the association between pulmonary TB and the anemia. Several studies have been conducted internationally and also in Bangladesh addressing the indicators associated with pulmonary tuberculosis. However, only a few studies have shown the correlation between anemia and pulmonary TB.

## II. MATERIALS AND METHODS

### A. Study Design

A cross sectional study was designed to find out the proportion of anemia in pulmonary TB patients and associated risk indicators at the year of 2011. The study was conducted at National Institute of Chest Diseases and Hospital (NICDH), Dhaka, Bangladesh. All kind of chest diseases including tuberculosis are treated here. A total of 121 patients of both indoor and outdoor suffering from various type of TB aged 15 years or more were taken as a study population. Patients who are suffering other chronic diseases or taking drug for the correction of anemia or multi drug resistant TB patients were excluded from the study. Purposive sampling was done. World Health Organization (WHO) has recommended cut-off points of hemoglobin levels for various population groups for determining the presence of nutritional anemia [11]. According the WHO, hemoglobin concentration was taken less than 13 g/dL in men and 12 g/dL in women to determine the anemia [16].

### B. Study Procedure

Data were collected by face to face interview using a structured questionnaire including the anthropometric measurements. Height and weight were measured by locally manufactured measuring spring tape and analog weighting machine. BMI was calculated. Blood samples (3-5 ml) were collected from all participants via venipuncture. All tests above were carried out within 5 hours after collection. Hemoglobin, Mean Cell Volume (MCV), Mean Cell Hemoglobin (MCH), Mean Cell Hemoglobin Concentration (MCHC), Red Cell Distribution Width (RDW-CV) were analyzed by Sysmax XS-800i Hematology analyzer and peripheral blood film were done manually. Hemoglobin estimation was done by the Hemoglobin detector based on the cyanide free SLS (Sodium Lauryl Sulphate) hemoglobin detection method..

### C. Data Analysis

The socio-demographic data and clinical information of patients were validated. Statistical analysis was performed using software-Statistical Package for Social Sciences (SPSS), version 11.5. Mean Standard deviation was calculated for quantitative variables like age, BMI, conc. of hemoglobin etc. Categorical data were presented as frequency counts (%) and compared using  $\chi^2$ .

### D. Ethical Clearance & Consent From The Participants

Before conducting this study, a detail protocol was submitted to local review committee for being approved. The respondent was informed clearly that their results might be published but their personal identity would be kept confidential and it would be used only for study purpose. More over participants was allowed to withdraw them at any stage of the study.

## III. RESULTS

All the patients were aged over 15 years. Their mean ( SD) age was 40.16 ( 12.71) years with a maximum of 75 years. Proportion of male was 54.5% in this study. In this study most (59.5%) of the participants were married. Majority of the respondents were day labor (42.1%) and followed by service holder (29.8%). Most of the participants in this study were Muslim (79.3%). The mean ( SD) expenditure of participants was 7268.60 ( 3694.05) BDT. Among 121 participants 44(36.4%) were from rural area and 33 (27.3%) were from urban area. Among the respondents 51.2% had education of class five including non formal education as indicated in Table I.

TABLE I  
SOCIO-DEMOGRAPHIC PROFILE OF THE PARTICIPANTS

Variables	Number	Percentage
<b>Age group in year</b>		
<24	19	15.7
25 to 34	19	15.7
35 to 44	31	25.6
45 to 54	40	33.1
55 to 75	12	9.9
<b>Mean (+/- SD)</b>	<b>40.16 +/- 12.712</b>	<b>12.712</b>
<b>Sex</b>		
Male	66	54.5
Female	55	45.5
<b>Occupation</b>		
Unemployed	21	17.4
Day labor	51	42.1
Service	36	29.8
Business	13	10.7
<b>Religion</b>		
Islam	96	79.3
Buddhism	1	.8
Hinduism	24	19.8
<b>Family expenditure</b>		
Up to 10,000 BDT	102	84.3
More than 10,000 BDT	19	15.7
<b>Mean (+/- SD)</b>	<b>7268.60 (+/- 3694.05)</b>	
<b>Number of family member</b>		
1- 4	26	21.5
5 to 9	88	72.7
10 to 14	7	5.8
<b>Living Area</b>		
Rural	44	36.4
Urban	33	27.3
Semi-urban	26	21.5
Slum	18	14.9

Among 121 TB patients 75.2% were anemic. Out of 66 male patients 71.2% and in 55 female patients 80% were anemic. There was no significant association was found between age group, sex and marital status with anemia among the pulmonary TB patients ( $P > .05$ ) (Table II).

TABLE II  
PROPORTION OF ANEMIA IN PULMONARY TB PATIENTS

Variables	Anemic	Non anemic	Total	$\chi^2$	P value
	n (%)	n (%)	n (%)		
<b>Sex</b>					
Male	47(71.2)	19(28.8)	66 (54.5)	1.24	.27
Female	44(80)	11(20)	55(45.5)		
<b>Marital status</b>					
Unmarried	20(76.9)	6(23.1)	26(21.5)	.25	.88
Married	53 (73.6)	19(26.4)	72 (59.5)		
Others	18 (78.3)	5 (21.7)	23 (19.0)		
<b>Educational level</b>					
Illiterate	24(88.9)	3(11.1)	24(22.3)	17.2	.001
Upto class 5	49(79)	13(21)	62(51.2)		
Class 6-12	18 (64.3)	10(35.7)	28(23.1)		
Bachelor or more	0 (0)	4 (100)	4 (3.3)		

Fig. 1 showed that out of 91 pulmonary TB patients, 47.3% had the Normocytic normochromic anemia. 32% pulmonary TB patients had Microcytic hypochromic anemia.

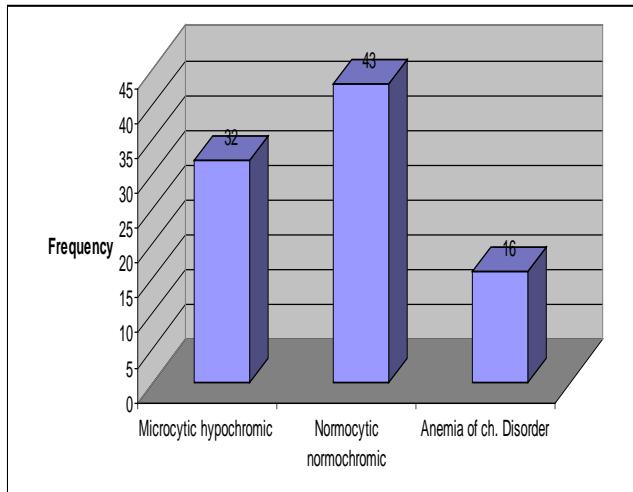


Fig. 1 Type of anemia in TB patients

Significant ( $P < 0.05$ ) association was found between sex and type of anemia. In male patient Normocytic normochromic anemia is more (63.8%) and in female microcytic hypochromic anemia is more (45.5%). (Table: III)

TABLE III  
RELATIONSHIP BETWEEN THE MORPHOLOGICAL TYPES OF ANEMIA WITH SEX

Sex	MHA	NNA	ACD	Total	$\chi^2$	P-value
	n(%)	n(%)	n(%)	n(%)		
Male	12(25.5)	30(63.8)	5(10.7)	47 (100)	10.88	.004
		)				
Female	20 (45.5)	13 (29.5)	11 (25.0)	44 (100)		

Here, MHA=Microcytic Hypochromic Anemia; NNA=Normocytic Normochromic Anemia; ACD=Anemia with Chronic Disorder

A strong association ( $P < .05$ ) between current health status on the basis of BMI of the TB patients and anemia was found in Table IV. Anemia is more (82.4%) in malnourished pulmonary TB patients than in normal (53.3%) pulmonary TB patients.

TABLE IV  
RELATIONSHIP BETWEEN THE CURRENT HEALTH STATUS ON THE BASIS OF BMI AND ANEMIA AMONG PULMONARY TB PATIENTS

Health Status	Anemic	Non anemic	Total	$\chi^2$	P value
	n (%)	n (%)	n (%)		
Malnourished	75(82.4)	16(17.6)	91(75.2)	10.235	.001
Normal	16(53.3)	14(46.7)	30(24.8)		

Strong association was found between morphological type of TB and anemia among pulmonary TB patients ( $P < .05$ ). Anemia is highest (88.4%) in other (relapse and treatment failure) cases and lowest (62.8%) in new smear negative cases (Table V).

TABLE V  
ASSOCIATION BETWEEN MORPHOLOGICAL TYPE OF TB AND ANEMIA IN PULMONARY TB PATIENTS

Type of TB	Anemic	Non anemic	Total	$\chi^2$	P value
	n(%)	n(%)	n(%)		
New smear negative	27(62.8)	16(37.2)	43(35.5)	7.57	.02
New smear positive	26(74.3)	9(25.7)	35(28.9)		
Others	38(88.4)	5(11.6)	43(35.5)		

In this study, no association ( $P > .05$ ) was found between weakness and anoxia before diagnosis of pulmonary TB patients. But a strong association ( $P < .05$ ) was observed in weight loss, cough before diagnosis and anemia (Table VI).

TABLE VI  
RELATIONSHIP BETWEEN OTHER SYMPTOMS AND ANEMIA AMONG PULMONARY TB PATIENTS

Other symptoms	Anemic	Non anemic	Total	$\chi^2$	P value
	n (%)	n (%)	n (%)		
<b>Weakness before diagnosis</b>					
Yes	65(73)	24(27)	89(73.6)	.852	.356
No	26(81.3)	6(18.8)	32(26.4)		
<b>Weight loss before diagnosis</b>					
Yes	82(82.2)	19(18.8)	101(83.5)	11.72	.001
No	9(45.9)	11(55.0)	20(16.5)		
<b>Anorexia before diagnosis</b>					
Yes	74(74)	26(26)	100(82.6)	.450	.502
No	17(81)	4(19)	21(17.4)		
<b>Cough before diagnosis</b>					
Yes	80(80.8)	19(19.2)	99(81.8)	9.16	.002
No	11(50)	11(50)	22(18.2)		
<b>Blood with cough</b>					
Yes	58(86.6)	9(13.4)	67(67.7)	4.43	.035
No	22(68.8)	10(31.3)	32(32.3)		
<b>Coughing time</b>					
$\leq 6$ months	19(61.3)	12(38.7)	31(31.3)	11.09	.002
No	61(89.7)	7(10.3)	68(68.7)		

#### IV. DISCUSSION & CONCLUSION

Tuberculosis remains a worldwide public health problem

and is the world's second most common cause of death from infectious disease [17]. A number of studies in India, Indonesia, South Korea, Nigeria have documented anemia in patients with TB, however, all the studies involved only small numbers of patients and the results were not uniform [17]. Anemia is a common complication of pulmonary tuberculosis, the reported prevalence ranging from 16 to 76% in different studies [8].

It was found in the study that most patients with active pulmonary TB have anemia, but the precise mechanism remains unclear in two different studies of West Africa and Indonesia [18]-[19].

There was no significant association ( $P>0.05$ ) found between age and residence area with anemia in this study. Most of the participants were 45-54 years age group. But nationwide tuberculosis prevalence survey in Bangladesh, 2007-2009 found the prevalence of TB was highest among persons aged 55-64 years in rural residents. They found that on diagnosis of TB 31.9% had anemia, among them 28.2% were male and 36.3 % were female. However, only 45 patients had the hemoglobin concentration was less than 10 g/dL. Anemia was more frequently associated with the female and old age [17]. In this study, 75.2% of pulmonary TB patients were anemic and the female were predominant (80%). In a similar study of E Sahiratmadja et al. (2007) in Indonesia found anemia in 239 active TB patients (63•2 %) compared with only thirty (30) controls (6•8 %) and females were more often affected [20]. Another study by R M Glasser and his co-researcher (1970) found that 63% TB patients were anemic [21].

Highest number (36.4%) of participants in this study was from rural area. In a similar study was done in Zimbabwe by E L Corbett et al. (2009), they found that TB was more common in urban than in rural areas [22].

In current study, monthly family expenditure of most of (84.3%) of the participants was less than 10000 BDT and anemia was found significantly higher in this group. Moreover the study found that 22.3% of the participants were illiterate. Anemia was found more in this group. A similar study conducted in India in 2004 also found that the prevalence of anemia was more in individuals belonging to low socioeconomic status group and individuals who were illiterate [23].

The present study shows that, among all the pulmonary TB patients, 75.2% were malnourished ( $BMI<18.5$  for Asian people). Anemia was more (82.4%) in malnourished TB patients. A similar study by P Malhotra et al. (2004) in India showed that the prevalence of anemia was more in individuals having low BMI [23]. Another study was done by Hausman et al., 2011 in Northern Georgia, showed the associations between BMI, dietary patterns and health conditions of the populations. They explored  $BMI =20$  and  $=25$  was prevalent in 30.9% and 25.3% of study participants, respectively. They also found that  $BMI=20$  was a risk factor for anemia. These two studies show the similarity with present study. However the current study shows that there is a strong association ( $P < .05$ ) between current health status on

the basis of BMI of the pulmonary TB patients and anemia [24]. Another study of R M Glasser and his co-researcher (1970), found the significance of hematological abnormalities in patients with tuberculosis and 63% tuberculosis patients were anemic, the reasons were nutritional deficiency, failure of iron utilization, malabsorption syndrome and marrow suppression [21].

A strong association between morphological types of TB and anemia among participants ( $P < .05$ ) was observed. Anemia is highest (88.4%) in relapse and treatment failure cases and lowest (62.8%) in new smear negative cases. Again, Madjdpor et al. (2006), observed mild to moderate anemia in chronic disease [25].

In the current study, 81.8% had cough before diagnosis and the duration of coughing was 2 to 84 months. There is a strong association ( $P < .05$ ) between cough before diagnosis of TB and anemia. Anemia is more in patients who had cough more than 6 months (89.7%). In a similar study in Indonesia by E Sahiratmadja et al. (2007) found that, anemia was more in patients with the history of long cough duration before starting treatment [20]. F T Wieringa et al (2002) found that anemia was more prevalent in TB patients with coughing for more than 1 month [24].

In present study, most of the pulmonary TB patients were anemic. Though proportion of normocytic normochromic anemia was more but there were a good number of patients having microcytic hypochromic anemia also. There was significant association between sex, educational level, nutritional status, and morphological types of tuberculosis, weight loss and cough before diagnosis, duration of coughing with anemia.

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