

# Types of Tuberculosis and Factors Associated with Treatment Outcome and Mortality in the Obuasi Municipality of Ashanti Region, Ghana

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**Abstract:** *Introduction:* Tuberculosis (TB) affects all persons in all countries of the world. Treatment outcomes remain a global indicator for measuring a country's progress towards elimination of tuberculosis. *Objective:* The study was conducted to determine the distribution of TB by type and factors associated with treatment outcomes and mortality among a cohort of patients who received treatment for this disease between January 2015-December 2017 in the Obuasi municipality of Ghana. *Results:* The distribution of TB type were as follows: smear positive pulmonary TB (SPPTB), 50.0%, clinically diagnosed (smear negative) pulmonary TB 46.2%, extra-pulmonary TB 3.8% and 114 (19.83%) TB+HIV comorbidity. About 157 (27.30%) of TB patients were not screened for HIV. Successful treatment outcome rate was 77.20%. Unsuccessful treatment outcome rate was 22.80%; 7.90% defaulted, whereas 13.77% died, 0.90% treatment failure and 0.23% transferred out. In multivariable analysis, TB-HIV co-morbidity (aOR=3.37, 95% CI=1.50-7.57, p=0.003) was associated with unsuccessful treatment outcome and mortality (aOR=3.38, 95% CI=1.60-7.12, p=0.001). HIV infection reduced the likelihood of patient having successful treatment outcome whilst increasing the risk of mortality. Noncompliance with enhanced surveillance of screening all TB patients for HIV was common.

**Keywords:** Factors, Tuberculosis, Types, TB-HIV Co-morbidity, Treatment Outcomes, Mortality, Ghana

## 1. Introduction

### Background

Tuberculosis (TB) is an infectious disease, known for centuries to affect, debilitate, impoverish large sections of the population especially in developing countries [1]. Though curable, TB is the ninth leading cause of death worldwide and the leading cause from a single infectious agent, ranking above HIV/AIDS [2]. In a recent global

report, the WHO highlighted the need for early diagnosis and successful treatment of people with TB to avert millions of deaths which occur each year as a result of this condition (an estimated 54 million over the period of 2000 to 2017) [4].

Treatment outcomes is an essential component in the prevention and control of infectious diseases such as TB [5].

This indicator is often used to evaluate programmes and interventions in terms of successes and failures [6]. This notwithstanding, concern have been raised about incomplete data about treatment outcomes, a cardinal indicator for measuring the achievement of Sustainable Development Goal 3 and the end TB global agenda. There has also been concerns about declining treatment outcomes. For instance, for the 5.9 million new and relapse cases who were treated in the 2016 cohort, the treatment success rate was 82% which was a decline from 86% in 2013 and 83% in 2015 [2].

In TB the management of TB algorism, Treatment outcomes are categorized into six (6); cured, treatment completed, treatment failure, died, defaulter, transferred out [7]. The Obuasi Municipality is noted for high level of TB cases with an estimated average yearly new case of 222 since 2009. Documenting the treatment outcomes will be relevant in designing interventions to reduce the burden of TB in the municipality and contribute towards the achievement of Sustainable Development Goal three [8].

## 2. Methods and Material

### 2.1. Description of the Study Area

The Obuasi Municipality created in 15th December 2003. It is located in the Southern part of Ashanti Region of Ghana within 64kms drive from Kumasi, the regional capital. The projected population of the Municipality in 2019 is 198950 [9]. The annual growth rate in the Municipality is about 2.4% which is largely due to the mining activities in the Municipality.

### 2.2. Study Designs and Population

This was a retrospective cohort study among clients who received treatment for TB between January 2015-December 2017 in the three DOTS centres; Obuasi government hospital, Bryant mission hospital and Anglogold hospital. All patients who were expected to complete their treatment by December, 2017 were included.

### 2.3. Data Collection Tool and Procedure

Data extraction sheet was used to collect secondary data from patients' folders in 2019. Some of data extracted from the primary TB data sources included socio-demographic characteristics (age, sex, weight), HIV status (HIV positive, HIV negative, HIV not done), treatment outcome etc (see supplementary file 1). The data was subsequently validated with the DOTS center TB registration books; facility register as well as the District TB register.

### 2.4. Data Analysis

After manual data validated, double data entry was done in Statistical Package for Social Science (SPSS) version 20 and compared. We explored to see the distribution of

the data for skewness. Descriptive statistical method was then used to summarize the data into frequencies and proportions. Bivariable analysis (using Pearson Chi Square test) and logistics regression was done to identify factors that were associated with treatment outcome (successful or unsuccessful) and mortality (alive or death). A successful treatment was defined as TB patients who has been declared as cured, that is negative smear microscopy at the end of treatment. In determining the predictors of mortality, only patients with data on whether they are alive or dead were included. A  $p < 0.05$  was deemed as statistically significant.

## 3. Results

### 3.1. Socio-Demographic Characteristics of Study Participants

A total of 604 attended the three DOTS facilities within the period but 574 met the inclusion criteria of having complete information on treatment outcome on their cards and TB registers. TB-HIV co-morbidity was 114 (19.83%) whilst 157 (27.31%) were not screened for HIV (Table 1).

*Table 1. Socio-demographic Characteristics (SDC) of Study Participants.*

SDC	Frequency [n=574]	Percentage [%]
Age [MD (IQR)]	42 (32-54)	
Age group (years)		
≤20	30	5.22
21-40	234	40.70
41-60	228	39.65
>60	83	14.43
Sex		
Female	152	26.43
Male	423	73.57
Weight [Mean (SD)]	51.58 ±10.18	
Weight (Kg)		
≤30	3	0.64
30-39	38	8.10
40-54	256	54.58
≥55	172	36.67
HIV status		
Negative	304	52.87
Positive	114	19.83
Not done	157	27.30

\*MD= Median \*IQR=Interquartile range \*SD= Standard deviation

### 3.2. Characteristics, Types and Treatment Outcomes

About 471 (87.87%) were newly diagnosed patients with transfer in being the least 3 (0.56%). Smear positive pulmonary TB were 278 (50.0%) and 257 (46.22%) were smear negative pulmonary TB. TB-HIV comorbidity was 114 (19.83%) whilst 261 (45.37%) were classified cured. Nearly three fourth 444 (77.20%) of the patients had successful tuberculosis treatment outcome (Table 2).

**Table 2.** Characteristics, Types and Treatment Outcome.

Characteristics, Types and Treatment Outcome	Frequency [n=574]	Percentage [%]
Type of patient (Category)		
New	471	87.87
Relapse	49	9.14
Transfer in	3	0.56
Failure	4	0.75
Return after default	5	0.93
Other	4	0.75
Type of TB		
Extra pulmonary TB	21	3.78
Smear negative PTB	257	46.22
Smear positive PTB	278	50.00
TB+ HIV	114	19.83
Treatment Outcome		
Cured	260	45.37
Treatment completed	183	31.83
Died	79	13.77
Defaulted	45	7.90
Treatment failure	5	0.90
Transferred out	2	0.23
Binary classification of outcome		
*Successful	443	77.20
Unsuccessful	131	28.80

\*Defined as sum of cured and completed treatment

### 3.3. Factors Associated with TB Treatment Outcome and Mortality

The result of the bivariable analysis of treatment outcome and factors are shown in Table 3. Factors that had statistically significant association with successful treatment outcomes were; age of participant ( $\chi^2=16.44$ ,  $p=0.001$ ), type of patient ( $\chi^2=12.94$ ,  $p=0.024$ ), type of TB ( $\chi^2=19.36$ ,  $p<0.0001$ ) and HIV status ( $\chi^2=21.44$ ,  $p<0.0001$ ). In multivariable logistic regression, patients with HIV-TB

comorbidity had 2.7 times the odds of unsuccessful TB treatment outcome than HIV negative patients (aOR=2.69, 95% CI=1.73-4.18,  $p<0.0001$ ). The predictors of mortality among patients with TB were HIV status ( $\chi^2=8.26$ ,  $p=0.016$ ) and type of TB ( $\chi^2=22.63$ ,  $p<0.0001$ ). HIV positive patients and patients with unknown HIV status were 3.38 times (aOR=3.38, 95% CI=1.60-7.12,  $p=0.001$ ) and 4.35 times (aOR=4.35, 95% CI=2.25-8.38,  $p<0.0001$ ) respectively more likely to die of tuberculosis as compared to HIV negative patients.

**Table 3.** Factors associated with TB treatment outcomes in Obuasi municipality, 2019.

Variables	Treatment Outcome		Chi-square value ( $\chi^2$ )	p-value	Mortality		Chi-square value ( $\chi^2$ )	p-value
	Successful n (%)	Unsuccessful n (%)			Alive N (%)	Died N (%)		
Age group (years)			16.44	0.001*			3.34	0.343
≤20	26 (86.67)	4 (13.33)			27 (96.43)	1 (3.57)		
21-40	150 (64.10)	84 (35.90)			162 (87.10)	24 (12.90)		
41-60	124 (54.39)	104 (45.61)			142 (84.52)	26 (15.48)		
>60	42 (50.60)	41 (49.50)			51 (83.61)	10 (16.39)		
Sex			3.28	0.070			2.80	0.094
Female	81 (53.29)	71 (46.71)			93 (81.58)	21 (18.42)		
Male	261 (61.70)	162 (38.30)			289 (87.84)	40 (12.16)		
Weight			0.30	0.960			5.76	0.124
≤30	2 (66.67)	1 (33.33)			2 (66.67)	1 (33.33)		
30-39	24 (63.16)	14 (36.84)			24 (82.76)	5 (17.24)		
40-54	173 (67.58)	83 (32.42)			187 (85.78)	31 (14.22)		
>55	116 (67.44)	56 (32.56)			126 (92.65)	10 (7.35)		
Type of patient			12.94	0.024*			6.83	0.234
New	298 (63.27)	173 (36.73)			329 (87.73)	46 (12.27)		
Relapse	23 (46.94)	26 (53.06)			26 (74.29)	9 (25.71)		
Transfer in	3 (100.00)	0 (0.00)			3 (100.00)	0 (0.00)		
Failure	2 (50.00)	2 (50.00)			3 (100.00)	0 (0.00)		
Return after default	1 (20.00)	4 (80.00)			3 (75.00)	1 (25.00)		
Other	1 (25.00)	3 (75.00)			3 (75.00)	1 (25.00)		
Type of TB			19.36	<0.0001*			8.26	0.016*
Extra pulmonary TB	14 (66.67)	7 (33.33)			16 (94.12)	1 (5.88)		
Smear negative PTB	132 (51.36)	125 (48.64)			163 (81.50)	37 (18.50)		
Smear positive PTB	194 (69.78)	84 (30.22)			201 (90.54)	21 (9.46)		

Variables	Treatment Outcome		Chi-square value ( $\chi^2$ )	p-value	Mortality		Chi-square value ( $\chi^2$ )	p-value
	Successful n (%)	Unsuccessful n (%)			Alive N (%)	Died N (%)		
HIV status			21.44	<0.0001*			22.63*	<0.0001
Negative	206 (67.76)	98 (32.24)			223 (93.31)	16 (6.69)		
Positive	50 (43.86)	64 (56.14)			66 (80.49)	16 (19.51)		
Not done	86 (54.78)	71 (45.22)			93 (76.23)	29 (23.77)		

\*Statistically significant variables at  $p < 0.05$

## 4. Discussion of Findings

Majority (87.87%) of patients were new TB cases with retreatment category of 10.82%. The high number of new cases shows an active transmission of tuberculosis in the municipality. However, the cases were more likely to have successful treatment outcome as compared to re-treatment cases [10] and less likely to have poor treatment outcome [11]. The high sensitization in the community using platforms such as celebrations of TB days, organization of durbar in communities, and public education could have led to an increase in knowledge and improved health seeking behaviour. The number of retreatment cases raises concerns about compliance and drug resistance. It is therefore necessary for close monitoring of patients on treatment to minimize the need for retreatment. There is also the need to conduct studies to ascertain if these treatment failures are not due to drug resistance or suboptimal blood concentration during treatment [12].

Also, majority (96.22%) of patients had pulmonary TB, of which 50.0% (278) were bacteriologically confirmed as sputum smear positive PTB. This finding is higher than the 2019 global tuberculosis report findings of 85% for pulmonary TB though that of confirmed cases of 55% [13] was higher than this current finding. Smear positive TB have a better treatment outcome than other types of the disease. The revised protocol for managing TB requires regular monitoring of patients by testing sputum results at 2<sup>nd</sup>, 5<sup>th</sup>, and 6<sup>th</sup> months in addition to clinical progress of the patients [14]. This further reinforces the need for close monitoring of patients to reduce rates of treatment failures because they will require second line of treatment with higher adverse effects and cost implication [15, 16].

Furthermore, 19.83% of all the types of TB case were diagnosed with HIV. This is high above the global TB patients living with HIV of 9% [4]. This study found that being HIV positive TB patient is associated with unsuccessful treatment outcome. This is because, there could be complications and drug reaction due to the concurrent intake of anti-tuberculosis and anti-retroviral medications which makes it difficult and uncomfortable for taking medications religiously. Again, this may be as a result of positive HIV patients having a compromised immune system, affecting their recovery rate or treatment success. Several studies [14, 17, 18] have all found that being HIV positive greatly influences treatment outcome negatively. In contrast to the findings of this study, Duru *et al.*, reported that HIV negative patients tend to have increased risk of having poor treatment outcome [19].

Regarding the treatment outcomes, 77.20% success rate was recorded within the three years. This is low as compared to national and regional averages of 87% in 2017 [20] and 86.2% [21] respectively. The higher death rate of 13.77% could have masked the actual success rate as observed by Ditah *et al.*, that adding deaths to unsuccessful treatment outcome for TB may be misleading since the death may be incidental and not causal [22]. Review of this classification may be necessary. Nonetheless, there is the need for the Ghana Health Service in this municipality to adopt innovative ways to improve treatment outcome in order to achieve the global agenda of ending TB by 2030.

TB-HIV comorbidity increased the odd of unsuccessful treatment outcome as well as mortality. The correlate between TB and HIV was one of the reasons for the global call for collaboration between these two conditions. As a result, an enhanced surveillance system of screening of patients with TB for HIV was introduced. Nonetheless, the findings of this study show that some facilities are not complying with this policy of screening all TB patients for HIV. About 157 (27.30%) TB patients in this study were not screened for HIV. This is a missed opportunity for the “know your status campaign” to achieve the 90-90-90 global agenda for HIV [23].

## 5. Conclusion

Majority of patients with tuberculosis had a successful treatment outcome. HIV infection reduced the likelihood of patient having successful treatment outcome whilst increasing the risk of mortality. Noncompliance with the protocol for enhance surveillance for HIV which require screening of all patients with TB with HIV was high. Regular screening of HIV patients for TB can lead can improve case detection and improve treatment outcomes.

## Limitations of Study

This study is limited to one Municipality in the region. The authors also dropped patients with incomplete data. We first tested to see if treating the missing figures as a variable and dropping same could alter our findings. However, we discovered dropping the missing variable had no statistically significant implication in this study.

## Declaration

### Ethical Approval

The study protocol was submitted and approved by Ghana

Health Service Ethics Review Committee (GHS ERC= GHS-ERC049/10/19).

### Data Availability

The data for this study are included in the manuscript and as supplementary files.

### Author's Contributions

DYA conceived, designed, implemented the study, and produced the draft manuscript. GFS and OK participated in data collection, analysis, and review of the manuscript. WY conducted the statistical analysis and contributed to the drafting of the results. PT-NT provided technical guidance and supervision throughout the study. All authors read and approved the final manuscript.

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### Conflict of Interest

The authors declare that they have no competing interests.

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