

Research

# Trend of Tuberculosis and Treatment Outcomes in Gambella Region with Special Emphasize on Gambella Regional Hospital, Western Ethiopia

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#### Abstract

**Background:** Tuberculosis (TB) is a serious public health problem in the developing countries. Early diagnosis, effective treatment and continues assessment of treatment outcome are important indicators of TB control.

**Objective:** To assess the trend of TB and treatment outcomes, in the past five years in Gambella region with special emphasize on Gambella hospital, South Western Ethiopia.

**Methods:** In this retrospective study, a five year (2006 to 2010) TB cases record review was done to assess the trend and treatment outcomes of TB patients in Gambella Region. Bivariable and multivariable logistic regression analyses were performed to assess the association between treatment outcomes and predictor variables.

**Results:** From the total of 5071 TB patients registered during the indicated period, 4813 (94.91%) were new cases and 258 (5.09%) were re-treated cases. Trend in annual incidence rate of all forms of TB decreased from 581 per 100,000 population in 2006 to 247 per 100,000 population in 2007, and then, increased in the year 2010 (263 per 100,000 population). From 2303 patients registered at regional hospital, 529 (23.00%), 1158 (50.35%) and 671 (26.65%) were extra pulmonary tuberculosis (EPTB), smear negative pulmonary tuberculosis (SNPTB) and smear positive pulmonary tuberculosis (SPPTB) cases, respectively. Regarding treatment outcomes, 1460 (63.40%) were successfully treated, 527 (22.88%) defaulted, 83 (3.60%) died, 2 (0.09%) failed and 231 (10.00%) patients were transferred out. Age of patients' above 15 years was significantly associated with low treatment success rate (TSR) (AOR=0.553, 95% CI, 0.423, 0.723, p<0.001).

Whereas, being female TB patients was significantly associated with high TSR (AOR=1.226, 95% CI, 1.031, 1.457, p=0.002).

**Conclusion:** Incidence rate of TB in the region showed a fluctuating pattern for the last five years with an estimated mean annual incidence rate of 322 per 100,000 population. Furthermore, the proportion of SNPTB cases was remained highest compared to cases of SPPTB and EPTB. The TSR of all types of TB in the region was unsatisfactory. Hence, strengthening health extension programs, continuous follow-up, supervision of treatment adherence and defaulters tracing should be strengthened to improve TSR and reduce TB burden in the region

**Keywords:** Tuberculosis; Mortality; DOTS; *Mycobacterium tuberculosis*; Treatment success rate

# Background

In 2009, the annual incidence of Tuberculosis (TB), expressed as the number of new TB cases, was globally about 9.4 million people (of which 55% of the cases were in Asia and 30% in Africa), and the annual number of deaths due to TB was 1.7 million, including 0.4 million patients infected with HIV [1]. Africa accounts for almost a third of the global total, and has the highest incidence and prevalence rates in which 13 of the 15 countries with the highest incidence rates in the world, and 9 of the 22 High Burden Countries (HBCs) [2].

Ethiopia is among the world's top 22 TB HBCs, and the country had an estimated annual TB incidence rate of 300/100,000, mortality rate of 54/100,000, and the prevalence of all forms TB was 480/100,000 [1]. About 40-70% of HIV patients in Ethiopia are co-infected with TB [3,4]. The Ethiopia Federal Ministry of Health (MOH) hospital statistical data reveals that TB is the leading cause of morbidity, one of the three major causes for hospital admission, and the second killer next to malaria [5].

The key elements in TB control are to detect the disease and treat the cases and to ensure complete their treatment and get cured [6]. Incomplete treatment may result in prolonged excretion

of bacteria which may resist the drug, causes disease and lead to increased morbidity/mortality and the spread of the disease [7]. Hence, assessments of the status of treatment outcomes and specific factors which may contribute to unsuccessful treatment outcomes are important in order to improve TB management program.

Ethiopia's National Tuberculosis and Leprosy Control Program (NTLCP) began to implement, Directly Observed Treatment Short Course (DOTS) the internationally recommended strategy for TB control in 1992 in two zones of Oromia region. Whereas DOTS strategy was introduced to TB control program in Gambella region in 2000.

Gambella Region is one of the high TB burden regions in Ethiopia

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[8]. In the year 2010, about 953 cases were detected and treated [9]. However, the trends of TB and treatment outcomes have not been assessed yet in the region. Therefore, this study was aimed to assess the trends and treatment outcomes of TB cases in Gambella region, with special emphasize on Gambella hospital, South Western Ethiopia.

# Methods

### Study area and population

Gambella regional State is located in south western Ethiopia, 777 km away from Addis Ababa. The region has a total area of 25,802 km<sup>2</sup> and administratively divided in to three Zones (Nuwer, Agnua, Mezeng) and one special District known as Itang. Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), the region has a total population of 306,916, consisting of 159,679 men and 147,237 women. In the region, there was only one hospital, which gives routine service for urban population and as a referral for rural residents. About 27 health centers, 34 clinics, 104 health posts and 16 drug venders were other health facilities in the region [10,11]

#### Study design and data collection procedure

A retrospective analysis of the trends and treatment outcomes of all TB patients registered from 2006-2010 at DOTS Clinic in Gambella regional hospital and regional data obtained from Gambella regional health bureau were performed. The registration document had basic information such as patients' age, sex, type of TB, AFB smear result, treatment regimen, treatment started date, and treatment stopped date and treatment outcomes. Data were collected using data sheet. Treatment outcomes and type of TB were defined according to the standard definitions of the NLCP adopted from WHO [12].

#### Extra pulmonary tuberculosis (EPTB)

Refers to a case of TB that involves organs other than the lung. e.g. pleura, lymph nodes, abdomen, genitourinary tract, skin, joints, bones and meninges. Diagnosis should be based on at least one specimen with confirmed *Mtb* or histological or strong clinical evidence consistent with active EPTB, followed by a decision of a clinician to treat with a full course of tuberculosis chemotherapy.

# Pulmonary tuberculosis (PTB)

Refers to a case of TB involving the lung parenchyma and can be classified as:-

**Pulmonary TB, smear positive (SPPTB):** SPPTB case is based on the presence of at least one acid fast bacillus (AFB+) in at least one sputum sample in countries with a well-functioning EQA system. In countries without functional EQA, a SPPTB case is defined as one with two or more initial sputum smear examinations positive for AFB, or one sputum smear examination positive for AFB plus radiographic abnormalities consistent with active PTB as determined by a clinician or one sputum smear positive for AFB plus sputum culture-positive for *Mtb*.

**Pulmonary TB, smear-negative (SNPTB):** a case of PTB is considered to be smear-negative if at least two sputum specimens at the start of treatment are negative for AFB in countries with a functional EQA system, where the workload is very high and human resources are limited; or decision by a clinician to treat with a full course of anti-TB therapy; and radiographic abnormalities consistent with active PTB and either laboratory or strong clinical evidence of HIV infection or if HIV-negative (or unknown HIV status living in an area of low HIV prevalence), no improvement in response to a course of broadPage 2 of 8

spectrum antibiotics (excluding anti-TB drugs and fluoroquinolones and aminoglycosides).

# Data analysis

Data were double entered in to EPI-DATA version 3.1 (EpiData Association, Odense, Denmark) and STATA version 8.2 (STATA Corp, College Station, TX) For categorical data, proportions with 95% confidence intervals, Odds ratio and Chi-square test were calculated. Univariable and Multivariable logistic regression model were performed to assess the association between treatment outcomes and predictor variables.

# Ethical considerations

The study protocol was approved by Addis Ababa University, Aklilu Lemma institute of Pathobiology, Ethical Review committee and Gambella regional health bureau.

# Results

# Trends of TB in the region

For the last 5 years (2006-2010) a total of 5,071 TB patients were registered. Of these, 4813 (94.91%) were new cases and the rest, 258 (5.09%) were re-treatment cases. Out of the total of new cases, 1799 (37.38%) were SPPTB, 1598 (33.20%) were SNPTB and the rest 1416 (29.42%) were EPTB cases. Out of the total of re-treated cases, 132 (51.20%), 34 (13.20%) and 92 (35.70%) were relapse, failure and defaulted cases, respectively. Table 1 shows trends of all forms of TB cases across the years during the study period.

# Trends in TB incidence rate

Trends in annual incidence rate of all forms of TB has decreased from 581 per 100,000 population in 2006 to 247 per 100,000 population in 2007, then increased to 304 per 100,000 population in 2008. Afterwards a slow decrease in incidence rate of TB has been observed in the year 2009 (213 per 100,000 population) and slowly increased in the year 2010 (263 per 100,000 population). The mean annual incidence rate was 322 per 100,000 population (Figure 1).

# Treatment outcomes of TB in the region

The overall TSR for SPPTB and re-treated cases for the last 5 years (2006-2010) were 72.2% and 47% respectively. Default rate, death rate and failure rate for SPPTB cases were 2.9%, 2.4% 0.4% respectively, while default rate, death rate and failure rate for the re-treated cases were 0.6%, 6.2%, 0.0% respectively (Table 2).

# Demographic characteristics of patients

A total of 2303 TB patients were registered at Gambella regional hospital from 2006- 2010. Of these, 1255 (54.5%) were males and 1048 (45.5%) were females. Out of the total 2303 cases, 1158 (50.4%) were SNPTB cases and the rest, 613 (26.7%), 529 (23%) were SPPTB and EPTB cases respectively. In terms of patients categories 2,137 (92.87%) were new, 64 (2.78%) were relapse cases, 37 (1.61%) were return after defaulting, 2 (0.09) were transferred in and 61 (2.65%) were in other patient category (Table 3).

# Trends of TB at Gambella hospital

The proportion of SNPTB remained highest compared to cases of SPPTB and EPTB during the study period (2006-2010) (p<001) and the cases of all forms of TB were higher among male TB patients (Figure 2 and 3).

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Years	New cases					All TB Cases			
	New SPPTB N (%)	New SNPTB N (%)	New EPTB N (%)	Total N (%)	Relapse N (%)	Failure N (%)	Default N (%)	Total N (%)	
2006	640 (41.21)	357 (22.99)	556 (35.80)	1,553 (90.66)	78 (48.75)	9 (5.63)	73 (45.63)	160 (9.34)	1,713
2007	250 (35.4)	288 (40.79)	168 (23.80)	706 (93.02)	28 (52.83)	18 (33.96)	7 (13.21)	53 (6.98)	759
2007	303 (31.7)	426 (44.65)	225 (23.58)	954 (97.59)	9 (45.00)	2 (10.00)	9 (45.00)	20 (2.05)	974
2008	247 (36.01)	236 (34.40)	203 (29.59)	686 (96.48)	17 (60.00)	5 (20.00)	3 (12.00)	25 (3.52)	711
2009	359 (39.28)	291 (31.84)	264 (28.88)	914 (100.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	914
Total	1799 (37.38)	1598 (33.20)	1416 (29.42)	4813 (94.91)	132 (51.2)	34 (13.20)	92 (35.70)	258 (5.09)	5071

SPPTB=smear positive pulmonary TB, SNPTB=Smear negative pulmonary TB, EPTB=Extrapulmonary TB, N=number **Table 1**: All forms of TB cases in Gambella region 2006-2010



Year	Category	Cases	No. evaluated	C (%)	тс	De (%)	F (%)	D (%)	TO (%)	TS (%s)
2006	SPPTB	459	363	177 (39)	98	29 (6)	7 (2.0)	32 (7.0)	20 (4.0)	275 (60.0)
	Re-treated	60	60	15 (25)	26	12 (20)	0 (0.0)	2 (3.0)	5 (8.0)	41 (68.0)
2007	SPPTB	640	274	141 (22)	75	15 (2)	0 (0.0)	22 (3.0)	21 (3.0)	216 (34.0)
2007	Re-treated	160	43	29 (18)	8	0 (0)	0 (0.0)	0 (0.0)	6 (4.0)	37 (23.0)
2009	SPPTB	250	221	98 (39)	111	5 (2)	0 (0.0)	3 (1.0)	4 (2.0)	209 (84.0)
2000	Re-treated	53	29	24 (45)	3	2 (4)	0 (0.0)	0 (0.0)	0 (0.0)	27 (51.0)
2000	SPPTB	238	238	168 (71)	44	3 (1)	0 (0.0)	1 (0.4)	22 (9.0)	212 (89.0)
2009	Re-treated	14	14	11 (79)	2	1 (7)	0 (0.0)	0 (0.0)	0 (0.0)	13 (93.0)
2010	SPPTB	297	297	154 (52)	125	4 (1)	0 (0.0)	9 (3.0)	5 (2.0)	279 (94.0)
2010	Re-treated	16	0	0 (0.0)	0	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0.0)
Total	SPPTB	1884	1393	738 (44.6)	453	56 (2.4)	7 (0.4)	67 (2.9)	72 (4.0)	943 (72.2)
	Re-treated	303	146	79 (33.4)	39	15 (6.2)	0 (0.0)	2 (0.6)	11 (2.4)	118 (47.0)

No.=number, TC=Treatment completed, C=Cured, D=default, F=failure. TO=transferred out, De=Death,TS=Treatment success

Table 2: Treatment outcome of SPPTB and re-treated cases of TB in Gambella Region from 2006-2010.

Trend of EPTB was found to be decreased as the patients' age increased. On the other hand, the trend of SPPTB was found to be increased in the age group between 15-34 years. The trends of all forms of TB were found to be decreased in the age groups above 45 years.

#### Treatment outcomes

Of 2303 TB patients who were registered at the hospital during the study period, 231 (10%) were cured, 1229 (53.4) completed the treatment, 527 (22.9%) were defaulted, 83 (3.6%) died, 2 (0.09%) were failed and 231 (10%) were transferred out to other health facility. The cure rate of TB patients increased over the study period from 11 (2.4%) in 2006 to 106 (17.7%) in 2010 (Table 4). The Treatment Success Rate (TSR) varies from 57.86% in 2006 to 73.64% in 2007.

#### Factors associated with treatment outcomes

As shown in Table 5, TSR was significantly associated with gender,

age and year of enrollment of TB patients (p<0.05). However, forms of TB, patient category and smear result were not significantly associated with TSR (p>0.05). Age and year of treatment of TB patients, were significantly associated (p<0.05) with death rate. Furthermore, year of enrollment was significantly associated with defaulted TB patients (p<0.001) (Table 6 and 7).

# Discussion

In this health institution based retrospective study, information on the treatment outcome, overall trend and incidence of all types of TB across the year during the study period were assessed in Gambella region with special emphasize on Gambella regional hospital. The trend in incidence rate of TB in this study was steeply decreasing for the year 2007 and then showed a fluctuating pattern from year to year, that might be as the result of inconsistency in prevention and control program, health professional high turnover and high population





Figure 2: Trends of TB across the years in Gambella regional hospital, 2006-2010.



Characteristics		Frequency	Percent	
Pay	Male	1,255	54.49	
Sex	Female	1,048	45.51	
	0-14	578	25.10	
	15-24	530	23.01	
	25-34	648	28.14	
Age group (yrs)	35-44	318	13.81	
	45-54	163	7.08	
	55-64	50	2.17	
	>64	16	0.69	
	SPPTB	613	26.65	
TB type	SNPTB	1158	50.35	
	EPTB	529	23.00	
	New	2,137	92.87	
	Relapse	64	2.78	
<b>TBpatients category</b>	Return after default	37	1.61	
	Transferred out	2	0.09	
	Others	61	2.65	

Yrs=years, SPPTB=smear positive pulmonary TB, SNPTB=Smear negative pulmonary TB, EPTB=extrapulmonary TB

 Table 3: General characteristics of study subjects (n=2303), Gambella regional hospital, 2006-2010.

movement in the region. The high prevalence of all forms of TB observed among male TB patients in current study was consistent with study conducted in Western Cape of South Africa, in which male TB suspects' outnumbered females by 1.45:1 and 2.08:1 among confirmed TB cases [13].

EPTB showed a trend of decreasing as the age of patients' increased across the years during the study period. Moreover, greater numbers of EPTB cases were observed in the age group of 0-14 years. This due to the reason that children usually consume raw milk, and in developing countries where bovine TB is uncontrolled and prevalent, most human cases occur in young person's [14]. On the other hand in young children TB disseminates and can be rapidly progressive early in life before immune competency is fully developed compared to adults and also delay in early diagnosis attributes to increased morbidity and mortality [15].

This study reveals that the overall TSR for all cases of TB in Gambella regional hospital and TSR of SPPTB (63.40%) and retreated cases (72.2%) of TB in the region were unsatisfactory when compared to the TSR (83%) observed among the 22 HBCs and 85% TSR suggested by WHO as a threshold [16,17] and study conducted

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Charactersitics					Treat	ment outcomes		Total
		Cured	Treatment ctd	Transferred out	Default	Death	Failure	
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	
Sex	Male	137 10.92)	627 (49.96)	136 (10.84)	301 (23.98)	52 (4.14)	2 (0.16)	1,255
	Female	94 (8.97)	602 (57.44)	95 (9.06)	226 (21.56)	31 (2.96)	0 (0.00)	1,048
Age Group (Years)	0-14	4 (0.690)	410 (70.93)	44 (7.61)	110 (19.03)	10 (1.73)	0 (0.00)	578
	15-24	78 (14.72)	260 (49.06)	54 (10.19)	121 (22.83)	17 (3.21)	1 (0.10)	530
	25-34	80 (12.35)	308 (47.53)	72 (11.11)	154 (23.77)	33 (5.09)	1 (0.31)	648
	35-44	40 (12.58)	152 (47.80)	36 (11.32)	76 (23.90)	13 (4.09)	0 (0.00)	318
	45-54	21 (12.88)	74 (45.40)	16 (9.82)	44 (26.99)	8 (4.91)	0 (0.00)	63
	55-64	7 (14.00)	19 (38.00)	8 (16.00)	16 (32.00)	0 (0.00)	0 (0.00)	50
	>64	1 (6.250)	6 (37.500)	1 (6.25)	6 (37.500)	2 (12.5)	0 (0.00)	16
	SPPTB	31 (37.68)	163 (26.59)	61 (9.95)	134 (21.86)	22 (3.59)	2 (0.30)	613
ТВ Туре	SNP TB	0 (0.000)	719 (62.09)	120 (10.36)	267 (23.06)	52 (4.49)	0 (0.0)	1,158
	EPTB	0 (0.000)	345 (65.22)	50 (9.45)	125,23 (5.02)	9 (1.700)	0 (0.0)	29`
	1998	11 (2.40)	254 (55.46)	24 (5.24)	146,14 (4.24)	23 (5.02)	0 (0.00)	58
	1999	13 (3.94)	230 (69.70)	26 (7.88)	47,9 (2.150)	14 (4.24)	0 (0.00)	30
Year Of Treatment	2000	37 (8.85)	247 (59.09)	35 (8.37)	90,13 (2.62)	9 (2.150)	0 (0.00)	18
	2001	64 (12.88)	256 (51.51)	44 (8.85)	120,23 (5.02)	13 (2.62)	0 (0.00)	97
	2002	06 (17.67)	242 (40.33)	102 (17.00)	124,14 (4.24)	24 (4.00)	2 (0.33)	00
	New	211 (9.87)	1138 (53.2)	222 (10.39)	486 (22.74)	78 (93.98)	2 (0.09)	2,137
	Relapse	18 (28.13)	30 (46.88)	2 (3.13)	12 (12.75)	2 (2.13)	0 (0.00)	64
	Re.default	1 (2.70)	21 (56.76)	1 (2.70)	11 (29.73)	3 (8.11)	(0.00)	37
	Tran. in	1 (50.00)	0 (0.00)	0 (0.00)	1 (50.00)	0 (0.00)	0 (0.00)	2
Patient Category	Other	0 (0.00)	39 (63.93)	5 (8.20)	17 (27.87)	0 (0.00)	0 (0.00)	61

Yrs=years, SNPTB=smear negative pulmonary tuberculosis, SPPTB smear positive pulmonary tuberculosis, EPTB=extrapulmonary tuberculosis, N=number **Table 4:** Treatment outcome by sex, age group, patient category, year of treatment and TB type, Gambella regional hospital, 2006-2010

Characteristics		Treatmen	t success	COR (95% CI)	AOR (95% CI)
onaracteristics					
Gondor		Yes N (%)	No N (%)		
Gender	Male	764 (60.88)	491 (39.1)	1	1
	Female	696 (66.41)	352 (33.59)	1.27 (1.07,1.51)	1.23 (1.03, 1.46)
Age Group	0-14	414 (71.63)	164 (28.37)	1	1
	15-24	338 (63.77)	192 (36.23)	0.69 (0.54, 0.89)	0.63 (0.45, 0.86)
	25-34	388 (59.88)	260 (40.12)	0.59 (0.47, 0.75)	0.53 (0.39, 0.72)
	35-44	192 (60.38)	126 (39.62)	0.60 (0.45, 0.81)	0.52 (0.37, 0.74)
	45-54	95 (58.28)	68 41.72)	0.55 (0.39, 0.79)	0.55 (0.36, 0.83)
	55-64	26 (52.00)	24 (48.00)	0.43 (0.24, 0.77)	0.54 (0.28, 1.05)
	>64	7 (43.75)	9 (56.25)	0.31 (0.11, 0.84)	0.38 (0.13, 1.08)
	SPPTB	394 (64.27)	219 (35.73)	1	1
ТВ Туре	SNPTB	719 (62.09)	439 (37.91)	0.91 (0.74, 1.12)	0.64 (0.12, 3.58)
	EPTB	345 (65.22)	184 (34.78)	1.04 (0.82, 0.33)	0.20 (0.01, 3.07)
	New	1,349 (63.1)	788 (36.87)	1	1
	Relapse	48 (75.00)	16 (25.00)	1.75 (0.99, 3.11)	1.79 (0.99, 3.24)
TB Patient Category	Ret.default	22 (59.46)	15 (40.54)	0.86 (0.44, 1.66)	0.89 (0.45, 1.77)
	Transfer in	1 (50.00)	1 (50.00)	0.58 (0.04, 9.35)	0.66 (0.04, 10.57)
	Others	39 (63.93)	22 (36.07)	1.03 (0.61, 1.76)	1.14 (0.67, 1.95)
0	Positive	391 (64.10)	219 (35.90)	1	1
Smear Result	Negative	772 (62.08)	441 (37.92)	0.92 (0.75, 1.12)	1.71 (0.47,6.23)
	2006	265 (57.86)	193 (42.14)	1	1
	2007	243 (73.64)	87 (26.36)	2.03 (1.49, 2.77)	2.29 (1.59, 3.27)
Year Of Treatment	2008	284 (67.94)	134 (32.06)	1.54 (1.17, 2.04)	1.58 (1.15, 2.18)
rreatment	2009	320 (64.39)	177 (35.61)	1.32 (1.01,1.71)	1.48 (1.09, 2.02)
	2002	348 (58.00)	252 (42.00)	1.01 (0.79, 1.29)	1.09 (0.82, 1.46)

AOR=Adjusted odds ratio, COR=Crude odds ratio, Ref=Reference

Table 5: Factors associated with treatment success rate among registered TB patients in Gambella regional hospital, 2006-2010.

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Characteri	istics	Death du	ring treatment	COR (95% CI)	AOR (95% CI)
			No (%)		
	Male				
	Female	52 (4.14)	1,203 (95.86 )	1	1
Sav	0-14	31 (2.96)	1,017 (97.04)	0.71 (0.45,1.11)	0.69 (0.43, 1.14)
Sex	15-24	10 (1.73)	568 (98.27)	1	1
	25-34	17 (3.21)	513 (96.79)	1.89 (0.85, 4.15)	2.52 (0.95, 6.68)
	35-44	33 (5.09)	615 (94.91)	3.05 (1.49, 6.24)	3.95 (1.60, 9.72)
	45-54	13 (4.09)	305 (95.91)	2.42 (1.05, 5.59)	2.83 (1.03, 7.77)
Age Group	55-64	8 (4.91)	155 (95.09)	2.93 (1.14,7.55)	3.74 (1.26,11.13)
	>64	0 (0.00)	50 (100.00)	-	-
	SPPTB	2 (12.50)	14 (87.50)	8.12 (1.63, 40.51)	7.84 (1.41 -43.62)
	SNPTB	22 (3.59)	591 (96.41)	1	1
	EPTB	52 (4.49)	1,106 (95.51)	1.26 (0.76, 2.09)	1.38 (0.83, 2.31)
ТВ Туре	new	9 (1.70)	520 (98.30)	0.47 (0.21, 1.02)	0.53 (0.24, 1.18)
	relapse	78 (3.65)	2,059 (96.35)	1	1
TB Patient		2 (3.13)	62 (96.88)	0.85 (0.21, 3.54)	0.78 (0.18, 3.43)
	Ret.default	3 (8.11)	34 (91.89)	-	-
	Transferred in	0 (0.00)	2 (100.00)	2.33 (0.70, 7.75)	1.86 (0.54, 6.34)
Cotomory	other	0 (0.00)	61 (100.00)	-	-
Category	Positive	22 (3.61)	588 (96.39)	1	1
	Negative	52 (4.47)	1,111 (95.53)	1.25 (0.75, 2.08)	1.40 (0.08, 23.79)
	1998	23 (5.02)	435 (94.98)	1	1
Smoor Booult	1999	14 (4.24)	316 (95.76)	0.84 (0.43, 1.65)	0.83 (0.41, 1.66)
Smear Result	2000	9 (2.15)	409 (97.85)	0.42 (0.19,0.91)	0.29 (0.12, 0.69)
Year of	2001	13 (2.62)	484 (97.38)	0.51 (0.25, 1.02)	0.39 (0.19, 0.86)
Treatment	2002	24 (4.00)	576 (96.00)	0.79 (0.44, 1.42)	0.63 (0.34, 1.17)

Yrs=years, COR=Crude odds ratio, CI=confidence interval, N=number, AOR=Adjusted odds ratio

 Table 6: Factors associated with death rate among registered TB patients in Gambella regional hospital, Ethiopia.

Characteristics			Defaulted fro	om anti-TB	
		Yes N (%)	No N (%)	C OR (95% CI)	AOR (95% CI)
Sex	Male	301 (23.98)	954 (76.02)	1	1
	Female	226 (21.56)	822 (78.44)	0.87 (0.72, 1.06)	0.85 (0.68, 1.07)
Age group	0-14	110 (19.03)	468 (80.97)	1	1
	15-24	121 (22.83)	409 (77.17)	1.26 (0.94, 1.68)	1.09 (0.74,1.59)
	25-34	154 (23.77)	494 (76.23)	1.33 (1.01, 1.75)	0.95 (0.60, 1.50)
	35-44	76 (23.90)	242 (76.10)	1.34 (0.96, 1.86)	0.99 (0.53, 1.85)
	45-54	44 (26.99)	119 (73.01)	1.57 (1.05, 2.36)	0.99 (0.44, 2.23)
	55-64	16 (32.00)	34 (68.00)	2.00 (1.07, 3.76)	0.83 (0.26, 2.62)
	>64	6 (37.50)	10 (62.50)	2.55 (0.91, 7.17)	-
TB type	SPPTB	134 (21.86)	479 (78.14)	1	1
	SNPTB	267 (23.06)	891 (76.94)	1.07 (0.85,1.36)	0.66 (0.12, 3.58)
	EPTB	125 (23.63)	404 (76.37)	1.11 (0.84, 1.46)	1.43 (0.09, 20.39)
TB patient category	New				
	486 (22.74)	1,651 (77.26)	1	1	
	Relapse Default	12 (18.75)	52 (81.25)	0.78 (0.42, 1.48)	0.78 (0.40, 1.53)
	Transfer in	1 (50.00)	1 (50.00)	3.39 (0.21, 54.4)	3.14 (0.19, 50.38)
	Other	17 (27.87)	44 (72.13)	1.31 (0.74, 2.32)	1.18 (0.62, 2.26)
Smear result	Positive	133 (21.80)	477 (78.20)	1	1
	Negative	269 (23.13)	894 (76.87)	1.08 (0.85,1.37)	1.15 (0.29, 4.52)
Year of treatment	1998	146 (31.88)	312 (68.12)	1	1
	1999	47 (14.24)	283 (85.76)	0.36 (0.25, 0.51)	0.35 (0.23, 0.53)
	2000	90 (21.53)	328 (78.47)	0.57 (0.43, 0.79)	0.63 (0.45, 0.89)
	2001	120 (24.14)	377 (75.86)	0.68 (0.51, 0.90)	0.69 (0.49, 0.97)
	2002	124 (20.67)	476 (79.33)	0.56 (0.42, 0.74)	0.55 (0.39, 0.75)

AOR=Adjusted odds ratio, CI=confidence interval, N=number, TB=tuberculosis, COR=Crude odds ratio '

Table 7: Factors associated with default rate among registered TB patients in Gambella regional hospital, Ethiopia.

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in Tigray [18]. The low TSR might be due to high default rate (22.9%) and transferred out rate (10%) observed in the regional hospital and poor data handling system in the region. On the other hand, this result is relatively higher than the TSR seen at Gondar university teaching hospital [19]. The relatively high treatment success rate might be due to the high transferred out rate observed at Gondar University teaching hospital compared to the transferred out rate in Gambella regional hospital (42% vs 10%).

In agreement with the study conducted in Pakistan [20], the current study demonstrated the higher TSR among female TB patients compared to male TB patients. Whereas high default rate and death rate were observed among male TB patients compared to female TB patients. However, the proportion of female patients registered for anti TB treatment were relatively low compared to male patients, that may probably reflect gender difference in TB epidemiology.

In this study, the TSR among SPPTB patients were 64.27% at the hospital and 72.2% at the regional state which is low compared to the results of study conducted in Tigray [18] and Guangzhou, China [21]. The difference might be due to the mobility of the community from place to place before completion of treatment and TB prevention and control program in the current study was not as such strong. In agreement with the study conducted in India, this study showed high TSR which was seen among new TB patient category compared to patients who received re-treatment as "return after default" and patients who were returned after defaulted from the treatment were showed more default rate compared to new patients [22]. This group of defaulters seems refractory to the conventional approach of treatment supervision; social and cultural factors that might play a role need to be explored.

This study showed that except the first one year of treatment, the trend of TSR decreased across the years in contrary to study conducted in Southern Ethiopia in which there has been a continuous increase in TSR over time during the study period [23]. The observable difference in the trend of TSR might be due to improper implementation of DOTS strategy and lack of trained man power & staff turnover in the region. A trend in transfer out rate increased over time during the study period which might be as a result of establishment of different health facilities in the region.

The study showed that patients in the age group over 15 years had significantly low TSR compared to TB patients in the age group of < 14 years. This might be due to close follow up of the children by the families, while they were on anti TB treatment. The higher death rate was observed in the age group >64 years which is in agreement with the finding of a study conducted in Eastern Taiwan [24]. As advanced age is a risk factor for death, close monitoring of treatment is necessary in older TB patients.

The overall default rate in the current study (22.88%) was higher than the average 6.2% observed among the 22 HBCs [25] and 10% among the rural households in northwest Ethiopia [26] and the default rate of TB patients increased across the years during the study period (Fig.1). The observable difference in high default rate in the study area might be due to apparent clinical improvement during intensive phase and migration to other sites because of pastoral nature and other different reasons. Furthermore, the default rate across the age groups of TB patients was steadily increased from 19.03% in the age group of 0 - 14 years to 37.5% in the age group of >64 years which warrants further investigation.

The death rate (3.6%) in this study was higher than death rate

reported from China but lower than reported previously by several similar studies Baltimore City, USA (24%) [27], Vaud County, Switzerland (14%) [17], Norway (9%) [6] and Hamburg, Germany (6.2%) [28]. However, it is similar to death rate reported from Addis Ababa (4%) and the national figure (3%) [29]. The observable difference might be due to patients who died from TB in those previous studies were in advanced age group (median age was 71 years) and lack of follow up and defaulter tracing mechanism. Furthermore, the death rates of SPPTB and SNPTB in this study were higher than the study conducted in Addis Ababa [30]. This might be due to high prevalence of HIV in the area [31] though it needs additional investigation. Since data were taken from those already visited and registered at health facilities, it may be subjected to selection bias and Lack of relevant information was observed to assess the association between those variables with treatment outcomes.

#### Conclusion

Trends in annual incidence rate had showed a fluctuating pattern for the last five years with an estimated mean annual incidence rate of 322 per 100,000 population which is greater than the national figure. The TSR of all forms of TB patients treated at Gambella regional hospital was unsatisfactory (63.40%) compared to 85% treatment success suggested by WHO as a threshold. The higher TSR were observed in the age group of < 14 years compared to patients who were above 15 years of age. A high proportion of default rate (22.88%) seen in the area is a serious problem for the TB control program and it needs to be addressed urgently. Continuous follow up of patients by family and health workers, supportive supervision, home visits especially by health extension workers, strengthening health extension program in the region, community mobilization for early detection and treatment of cases and defaulter tracing are important strategies to reduce TB burden & treatment interruption and improve TSR in the region.

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#### **Competing Interests**

The authors declare that we have no competing interests.

#### Authors' Contributions

DD designed the study, collected data, analysis and drafted the manuscript. ML participated in study design and write up. JB participated in study design, data analysis and write-up. All authors read, critically revised and approved the final manuscript. ML is the guarantor of the paper.

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