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Pulmonary tuberculosis (PTB) among suspected cases in delta state, South-Southern Nigeria

Abstract

Background: Pulmonary tuberculosis (PTB) remains a global health concern with majority of the cases recorded in low and middle income countries. Poverty, overcrowding, malnutrition, HIV/AIDS and socio-cultural factors have been considered to be responsible for its prevalence.

Objectives: Limited data exists on the incidence of PTB for the study region. Most of the existing data are products of isolated surveys or are targeted towards a particular population (in most cases HIV/AIDS participants). This study therefore seeks to evaluate the incidence of PTB among a cross-sectional and evenly distributed population in Delta State, South-Southern Nigeria, and to assay for correlation between PTB and age, sex, retroviral status and geographical location.

Materials and methods: Gene Xpert register of the selected facilities for the year 2017 were retrieved, reviewed and data on participants analyzed.

Result: Incidence of 25.4% (643/2535) was recorded for PTB. Age grade 21-40 years accounted for 52.4% of positive PTB cases while those above 81years gave an incidence of 0.5%. The male group and HIV positive participants accounted for 61.4% and 15.7% respectively of PTB cases, while HIV/PTB co-infection rate was 4.0%. Delta South had the highest zone-based incidence of 48.4% while Delta North gave the lowest zone-based incidence of 24.4%.

Conclusion: Our findings indicate that PTB remains a public health concern even though the rate is declining. Data from this study should aid in planning and design of further studies within the region and should serve as a guide for policy formation and strategic implementation of PTB control.

Keywords: pulmonary tuberculosis, incidence, suspected cases, age, sex, retroviral status, Nigeria

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Introduction

Tuberculosis (TB) a chronic pulmonary disease caused by a group of non-motile, rod-shaded, aerobic and acid fast bacteria called the Mycobacterium Tuberculosis Complex (MTC),[1] is known to currently infect about one-third of the world's population with a new infection recorded every second.[2] Members of the MTC includes *Mycobacteriun tuberculosis*, *Mycobacterium bovis*, *Mycobacterium africanum*, *Mycobacterium microfti* and *Mycobacterium canetti*[3]

Tuberculosis remains a global health burden as one third of the world's population has latent TB with about 10% of this population developing active TB within their life time.[4] In 2012, 1.3million people died from TB, placing it among the leading causes of death from infectious diseases.[4] Nigeria ranks first in Africa and fourth among the 22 high TB burden countries in the world with no fewer than 460,000 cases recorded annually.[3]

Establishment of TB requires the presence of the bacilli, a susceptible host and an environment that facilitates transmission. Thus, risk factors associated with TB can be grouped as exogenous and endogenous. Exogenous factors such as bacillary load in sputum and proximity of an individual to the infection source determines if exposure will result into infection.[5] Progress from infection to active TB is dependent on endogenous factors such as HIV status, nutritional status, age, sex, and behavioral as well as socio-economic factors.[5]

Although radiological findings via chest x-ray is presumptive of PTB, laboratory confirmation via microscopy (Zieh-Neelson for Light and auramine-rhodamine for fluorescence), culture (using Lowenstein-Jensen and related media), Immunological test (tuberculin skin test) and nucleic acid amplification test such as Gene xpert MTB/RIF produced by Cepheid, Sunnyvale is required for definitive diagnosis.

The Gene Xpert is a cartridge based nucleic acid amplification test which is automated and can detect and identify MTC DNA. It purifies and concentrates MTB from sputum, buccal washings and aspirates. The genomic material from the purified and concentrated MTC is isolated via sonication, amplified using PCR and identified using fluorescent probes called molecular beacons.[6] Although it is not cost effective and usually not suitable for monitoring therapy, its increased sensitivity and specificity when compared to other diagnostic method and timely nature,[7] prompted the WHO to recommend it as first-line diagnostic method ahead of conventional microscopy and culture in the year 2010.

There are few reports on the incidence of PTB for Delta State but most are product of isolated surveys carried out in specific health-care settings or institution or limited to a particular population (mostly HIV positive population). However, this study seeks to evaluate the incidence of PTB among a cross-sectional and evenly distributed population of individuals suspected to have PTB and to assay for correlation between PTB and age, sex, retroviral status and geographical location in Delta State, South-Southern Nigeria.

Materials and methods

Study design and area

This is a retrospective and cross-sectional study carried out in Delta State South-Southern Nigeria. Carved out from the former Bendel State, it is an oil and agricultural producing state with an estimated population of 4,112,448. It is multi-ethnic, Asaba is its capital city, it has a land mass of 18,050km^2 and Warri city is its economic nerve as well as its most populated. The study area lies between longitude 5º00 and 6º45 East and latitude 5º00 and 6º30 North. It is bonded by Edo State (North), Anambra (East) and Bayelsa (Southeast). Delta State has a wide coastal belt inter-lace with rivulets and streams, which forms part of the Niger Delta.

Sampling frame

The biggest DOT (Directly Observed Therapy) center for each of the three senatorial zones of the state was purposively selected to ensure adequate sampling and appropriate representation. These centers were Central Hospital Warri (Delta South), Central Hospital Sapele (Delta Central), and Federal Medical Centre Asaba (Delta North). The Gene Xpert registers for these health facilities were reviewed and data recovered.

Inclusion and exclusion criteria

Individuals of all age group and sex suspected to have PTB from January through December 2017 were eligible for the study. Only those with incomplete demographic or PTB result were excluded from the study.

Data collection and management

Participant's age, sex, HIV status as well as senatorial zones were retrieved and recorded against PTB results. Data recorded were analyzed using SPSS 23 and were expressed as simple frequency and percentage. Association between PTB and other studied variables was analyzed using Pearson's Chi-Square or Fishers's exact test at a confidence limit of 95% and p-value lesser than 0.05 were regarded to be significant.

Ethical clearance

Ethical approval was obtained from Delta State Ministry of Health Asaba and Participant's privacy was not violated because data collected did not include participant's identity.

Results

A total of 2535 participants comprising of 1291 males (50.9%) and 1244 females (49.1%) took part in the study. Age-grade 21-40years had the highest number of participants 1087 (42.9%) while participants age 81 and above where 35 (1.4%). 1156 participants (45%) of the studied population were HIV negative while 631 (24.9%) were HIV positive. Delta South had the highest number of participants 981 (38.7%) while Delta Central had the least number of participants (719(28.4%). Table 1 summarizes the characteristics of the studied population.

A general incidence of 25.4% was recorded Table 2.

Participants within the age grade of 21-40years accounted for 52.4% of the total PTB positive cases recorded while the lowest incidence of 0.5% was recorded for those within the age group of 81years and above Table 3. Statistical analysis for association between age and PTB gave a p-value of 0.000 indicating a strong association between both Table 3.

Table 1 Characteristics of the studied population

Variables	Frequency	Percentage
Age (years)		
0-20	341	13.5
21-40	1087	42.9
41-60	815	32.1
61-80	257	10.1
81 and above	35	1.4
Sex		
Male	1291	50.9
Female	1244	49.1
HIV Status		
Positive	631	24.9
Negative	1156	45.6
Unknown	748	29.5
Zone		
Delta South	981	38.7
Delta Central	719	28.4
Delta North	835	32.9

Table 2 Incidence of pulmonary tuberculosis

Suspected PTB cases	Frequency	Percentage
Positive	643	25.4
Negative	1892	74.6
Total	2535	100

Table 3 Incidence of PTB in relation to age

Age (years)	PTB Positive	PTB Negative	p-value
			0.00
0-20 Count	80	261	
% within age	23.50%	76.50%	
% within PPTB	12.40%	13.80%	
% of total	3.20%	10.30%	
21-40 Count	337	750	
% within age	31.00%	69.00%	
% within PPTB	52.40%	39.60%	
% of total	13.30%	29.60%	
41-60 Count	179	636	
% within age	22.00%	78.00%	
% within PPTB	27.80%	33.60%	
% of total	7.10%	25.10%	

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Table continued....

Age (years)	PTB Positive	PTB Negative	p-value
61-80 Count	44	213	
% within age	17.10%	82.90%	
% within PPTB	6.80%	11.30%	
% of total	1.70%	8.40%	
81& above Count	3	32	
% within age	8.60%	91.40%	
% within PPTB	0.50%	1.70%	
% of total	0.10%	1.30%	

PPTB=643, NPTB=1892, n=2535, n(0-20)=341, n(21-40)=1087, n(41-60)=815, n(61-80)=257, n(81& above)=3s5

61.4% of the positive PTB cases were accounted for by the males in contrast to the 38.6% recorded for the females Table 4. Analysis for significant association between PTB and sex gave a p-value of 0.000 indicating a strong relationship between both Table 4.

Table 4 Pulmonary tuberculosis in relation to sex

Sex	PTB Positive	PTB Negative	p-value
			0
Male Count	395	896	
% within sex	30.60%	69.40%	
% within PPTB	61.40%	47.40%	
% of total	15.60%	35.30%	
Female Count	248	996	
% within sex	19.90%	80.10%	
% within PPTB	38.60%	52.60%	
% of total	9.80%	39.30%	

PPTB=643, NPTB=1892, n-2535, nMale=1291, nFemale=1244

Incidence of pulmonary tuberculosis in relation to HIV status revealed that HIV negative participants accounted for 57.5% of positive PTB cases while HIV positive individuals gave an incidence of 15.7% Table 5. Analysis for association between HIV status and PTB acquisition gave a p-value of 0.000 Table 5.

Table 5 Pulmonary tuberculosis incidence in relation to HIV status

HIV Status	PTB Positive	PTB Negative	p-value
			0
Positive Count	101	530	
% within Status	16.00%	84.00%	
% within PPTB	15.70%	28.00%	
% of total	4.00%	20.90%	
Negative Count	370	786	
% within Status	32.00%	68.00%	
% within PPTB	57.50%	41.50%	
% of total	14.60%	31.00%	
Unknown Count	172	576	
% within Status	23.00%	77.00%	
% within PPTB	26.70%	30.40%	
% of total	6.80%	22.70%	

PPTB=643, NPTB=1892, n=2535, nHIV+=631, nHIV- =1156, nHIVun=748

Pulmonary tuberculosis incidence in relation to zone gave a striking decreasing trend from South to Central and finally to North with these respective incidences (48.4%, 27.25 and 24.45) Table 6. A p-value of 0.000 was obtained when association between PTB and geographical location (zone) was analyzed.

Table 6 Incidence of PTB in relation to geographical location (zone)

Zone	PTB Positive	PTB Negative	p-value
			0
South Count	311	670	
% within zone	31.70%	68.30%	
% within PPTB	48.40%	35.40%	
% of total	12.30%	26.40%	
Central Count	175	544	
% within zone	24.30%	75.70%	
% within PPTB	27.20%	28.80%	
% of total	6.90%	21.50%	
North Count	157	678	
% within zone	18.80%	81.20%	
% within PPTB	24.40%	35.80%	
% of total	6.20%	26.75	

PPTB=643, NPTB=1892, n=2535, nSouth=981, nCentral=719, nNorth=835

Discussion

The incidence of 25.4% recorded in this study indicates a declining trend when compared to other studies in Ebonyi (48%), in Kenya (42%), 37.9% in Enugu and 49.3% for some part of Delta State.[8–11] However, Sani et al[12], Kooffreh et al[3] and Aliyu et al[13] reported similar incidence of 25.5%, 24.8% and 23.0% respectively for Niger State, Northern Nigeria and Calabar South-Southern Nigeria. The findings of this study concur with WHO reports that tags Nigeria as a hyper-endemic region for PTB. The incidence can be attributed to poverty, mal-nutrition, the HIV/AIDS epidemic, overcrowding, poor health care system and the emergence of multi-drug resistant strains of tuberculosis which are prevalent in low income setting like the study region.

Age group 21-40 years recorded the highest incidence of PTB (n=337) (52.4%) followed by age group 41-60 years (n=179) (27.8%). This finding is in consonant with Gupta et al's report for South India,[2] Ukwaja et al[8] report for Ebonyi, Southeast Nigeria[8] and Yonge et al[9] record for Kenya.[9] These age groups represent the work force of most nations. Thus, increased exposure to risk factors such as travelling, occupational hazards and socio-cultural practices that encourages PTB transmission and acquisition synonymous with these age groups may be responsible for the increased prevalence. These age groups also constitute the sexually active circle. Thus, HIV infection which is more prevalent within this circle may also be a contributing factor.

The incidence of PTB in relation to sex gave a ratio of 1: 1.6 in favor of the males. Several studies have reported this outcome[2,3,8,14] However, Ahmad et al gave a contrasting report for Dargai in Pakistan where an incidence of 57.6% was obtained for females.[15] Smoking, alcoholism, increased exposure to infection sources, inequality in socio-economic status, difference in access to health-care and hormone-related differences[16] may be responsible for the difference in

sex-based incidence recorded in this study.

HIV infection has been linked to PTB acquisition. Two mechanisms have been postulated to be responsible. The first being reduction in immunity associated with HIV infection facilitating reactivation of latent TB to active TB while the second is the marked reduction in lymphocytic and macrophagic immunity typical of HIV infection, enhancing the acquisition of new or fresh infection. Incidence of PTB among HIV positive participants in this study was 15.7%. This reveals a drastic decline when compared with the 51.4% reported by Jemikalajah and Okogun for some part of Delta State, 34.5% reported by Gyar et al[17] for Lafia, central Nigeria and 42% recorded by Kassu et al[18] for Ethiopia.[11,17,18] However, Olaniran et al[19] reported a 13.9% incidence for Ile Ife, South west Nigeria[19] which is in consonant with the findings of this study. Statistical analysis for association between PTB and HIV status gave a p-value of 0.000 but frequency distribution revealed that there is no association between been HIV positive and PTB acquisition since bulk of the PPTB case were accounted for by HIV negative participants or those with unknown status.

The incidence recorded on a zonal-basis revealed a decreasing trend from South (48.4%), Central (27.2%) and (24.4%) for North. Several studies have postulated that PTB is usually more prevalent in coastal areas.[9] Coastal areas have higher annual rainfall resulting to a reduction in exposure time between residence's skin and sunlight which is critical for vitamin D synthesis (a very vital requirement for intact immunity). Alvaro-Meca et al reported a significant association between amount of rainfall and PTB.[20] Lower temperature, overcrowding in fishing camp and environmental pollution via gas flaring, burning of fossil fuel, illegal refining of crude and oil spillage which are more prevalent in the southern part of Delta State may be responsible for the high incidence recorded for the zone. Alvaro-Meca et al[20] also reported significant association between PTB and lower temperature and increase in air pollutants such as SO_2 and NO_2. Lower temperature, particles from combustion of fossil fuel and air pollutants such as SO_2 and NO_2 have been found to reduced immunity by either impairment of lung function or suppression of the expression of pro-inflammatory mediators or stimulating inflammation of the air ways which results to decrease in macrophagic function in turn enhancing susceptibility to respiratory tract pathogens and TB.[20] Most communities in Delta South are riverine and lack adequate transport routes and standard health-care facilities. Thus, poor access to health care services within this zone may also contribute to the increased incidence recorded.

Conclusion

PTB remains a major health concern. Data from this study suggest more need to be done to augment the control of TB by relevant authorities and all stake holders to ensure the 'Stop TB Partnership' ultimate goal of eliminating TB as a public health issue by 2050 is actualize. The association of PTB with HIV infection is gradually reducing thanks to increase in enlightenment and strict ART therapy compliance. Thus, more effort should be channel into investigating physiological determinants such as diabetes, hypertension, hypercholesteramia, obesity as well as evaluating the environmental effects of our study region on PTB acquisition and distribution. This study gave a 15.7% incidence for PTB among HIV positives and a PTB/HIV co-infection rate of 4.0%. Studies on PTB among HIV positive individuals within the study region in a bid to understand the reducing co-infection rate and possible co-variables responsible for the pattern of data generated in this study is highly recommended.

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Conflict of interest

Authors declare there is no conflict of interest in publishing the article.

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