Prevalence of *Mycobacterium tuberculosis* in North Central Nigeria

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Abstract: Prevalence of *Mycobacterium tuberculosis* is on the increase in developing countries especially in Nigeria despite the availability of short course therapy that are inexpensive and effective. This study was carried out to determine the prevalence of *M. tuberculosis* in North central Nigeria. A total of 2800 sputum samples from suspected pulmonary TB patients attending secondary health care facilities–across North central, Nigeria were collected and processed for the presence of *M. tuberculosis* using Gene Xpert. The result revealed a prevalence of *M. tuberculosis* of 13.25% among the studied patients. Patients aged 30-39 years had the highest prevalence of 39.08% with male respondents having 13.88% while females had 12.56%. Also, 20.6% of PTB patients were co-infected HIV. The prevalence of TB was 13.24% and 13.26% among alcoholic consumers and non-alcoholic consumers respectively and 14.2% and 12.8% among smokers and non-smokers respectively. The importance of education with regard to the occurrence of PTB in this study shows that respondent with secondary and primary education had the highest prevalence of 13.6%, followed closely by those with tertiary education (13.4%), the least were participants with no formal education (12.4%). Base on the quality of sputum as a reservoir for MTB, bloody stained sputum showed the highest prevalence of 19.90 % of PTB as compare to mucoid showing 12.50 % as the lowest. The study detected high prevalence of *M tuberculosis* causing PTB among new cases across the North Central states of Nigeria, and this could serve as a wakeup call to put more effort and channel resources that will lead to reduction of the prevalence of PTB.

Key word: Prevalence, Pulmonary Tuberculosis, Sputum, Gene Xpert

INTRODUCTION

Tuberculosis (TB) is an infectious disease usually caused by *Mycobacterium tuberculosis* (MTB) which affects the lungs but can also affect other parts of the body (WHO, 2011). The classic symptoms of active TB are a chronic cough with blood-containing sputum, fever, night sweats, and weight loss (WHO, 2019). The historical term "consumption" came about due to the weight loss. Infection of other organs can cause a wide range of symptoms (CDC, 2011).

Pulmonary Tuberculosis is spread through the air when people who have active TB in their lungs cough, spit, speak, or sneeze. People with latent TB do not spread the disease (CDC, 2011). Active infection occurs more often in people with HIV/AIDS and in those who smoke and about 251 000 people died of HIV-associated TB (WHO, 2018). Diagnosis of active TB is based on chest X-rays, as well as microscopic examination, use of GeneXpert and culture of sputum or body fluids. Diagnosis of latent TB relies on the tuberculin skin test (TST) or blood tests (Wambura *et al.*, 2018; CDC, 2011).

Tuberculosis caused an estimated 1.5 million deaths among HIV-negative people and there were an additional 300, 000 deaths from TB (range, 266 000–335 000) among HIV-positive people. Globally, the best estimate is that 10.0 million people (range, 9.0–11.1 million) developed TB disease including 5.8 million men, 3.2 million women and 1.0 million children. There were cases in all countries and age groups, but overall, 90 % were adults (aged ≥15 years), 9 % were people living with HIV (WHO, 2019).

Nigeria is classified among the 14 high burden countries for TB/HIV and MDR-TB. In its incidence rating of all forms of TB, it was 219/100,000 population (WHO, 2018). A total of 432 Nigerians dies daily from TB with estimated 115,000 dying each year with its case detection rate of 24% and an estimated 500,000 new cases with only 104,904 cases notified to the NTBLCP (WHO, 2018).

Despite the availability of short - course therapy which is both inexpensive and effective, the spread of PTB is still a challenge in Nigeria and providing data through surveillance will no doubt help in

monitoring and evaluating strategy for control of TB at every level of the health care system in Nigeria (WHO, 2011).

Therefore, this study was carried out to determine the prevalence of *Mycobacterium tuberculosis* causing PTB across all the states in the North Central of Nigeria.

MATERIALS AND METHODS

Study Area/ Population

This study was carried out in the North Central zone of Nigeria with the seven states situated geographically in the middle belt region of Nigeria, spanning from the west, around the confluence of River Niger and River Benue. It comprises of Niger, Kogi, Benue, Plateau, Nassarawa, Kwara and FCT- Abuja. Two health institutions in each state were randomly selected using balloting method. A total of 2800 suspected pulmonary TB patients were enrolled in this study between September 2017 and October 2018 across North central zone with two General Hospital per each state. High TB patient flow, existence of better diagnostic facilities, DOTS Centres and skilled human resource were the major reasons for selecting the specified health facilities.

Ethical Approval and Consent

Ethical approval was granted by the ministry of health in all the respective states while informed and written consent were obtained from the participants and questionnaire were administered.

Sample Collection and Processing

Two consecutive 3-5 ml spot and early morning sputum samples were collected from the participants in a dry, clean, transparent, leak proof, and wide-mouthed container for presumptive test. Samples were collected, labelled from the individual patient pooled together for analysis using Gene Xpert for detection of MTB (Joshua *et al*., 2013).

A structured Questionnaire was administered to the respondents including patient origin, age, sex, symptoms, HIV status, Alcohol intake, smoking, marital status, educational status and participants identity were kept confidential throughout this study.

Method for GENEXPERT

The samples were processed within 48 hours of sample collection and where samples couldn't be processed on the same day for Gene Xpert, it was stored in the refrigerator at 2-8^{o}C. All sputum samples for Gene Xpert were run at various health centres following standard procedure (WHO, 2013).

At least 1 ml of sputum was required and was inspected for quality, and if appropriate, sample reagent was added to the sputum sample in a ratio of 2:1 and the lid was closed. Sample was then shaken for 10–20 times to unclog the sputum and incubated for approximately 10 min. Sample was then shaken again and incubated for a further 5 min. The liquefied sample was then transferred into the Gene Xpert cartridge in the Gene Xpert MTB/RIF assay system computerization according to the standard operating procedures to carry out the analysis. Results were automatically generated indicating if MTB was detected or not detected. Where MTB was detected, the Gene Xpert automatically generated result indicating if the MTB was rifampicin resistant or not resistant (WHO, 2013).

Data Analysis and Interpretation of Result

The statistical analysis was performed using SPSS software version 21. Descriptive statistics was used to depict the demographic and clinical variables. Chi-square tests was used to evaluate the level of significance among the variables using a *P* value of less than 0.05 at 95% confidence interval ~~to~~ considered ~~it~~ as statistically significant.

RESULTS

A total of 2800 sputum samples collected were analysed, out of which, 1470 were males and 1330 were females. Patients in the age group 30–39 years had the highest frequency of 39.08% and those aged ≥60 years had the lowest (2.97%) (Table 1). The prevalence of MTB among the studied participants was 13.25% (371/2800), out of which 204 (13.8%) were positive for males and 167 (12.5%) were females (P=0.04). The study also revealed that, out of 1152 cases with a positive HIV status, 238 (20.6

%) were MTB positive as well and this positivity rate was significantly higher than in non-HIV participants (P=0.001) (Table 1). Table 2 revealed that the prevalence of MTB was significantly higher among the married participants (14.6 %) than the unmarried participants (12.3%) (P=0.001). The prevalence of MTB was 13.24% and 13.26% (P=0.001) among alcoholic consumers and non-alcoholic consumers respectively and 14.2% and 12.8% (P=0.02) among smokers and non-smokers respectively. The importance of education with regard to the occurrence of PTB in this study shows that respondent with secondary and primary education had the highest prevalence of 13.6%, followed closely by those with tertiary education (13.4%), the least were participants with no formal education (12.4%) (P=0.001). Base on the quality of sputum as a reservoir for MTB, bloody stained sputum showed the highest prevalence of 19.90 % of PTB as compare to mucoid showing 12.50 % (P=0.001) as the lowest.

Benue and Niger state showed highest prevalence rate of 64(16.0%) of MTB across the states in the North central Nigeria respectively in Table 3.

Table 1: Prevalence of *Mycobacterium tuberculosis* among Studied Subjects in Relation to Sex and Age in North Central, Nigeria

Variables	Number examined	%	Number Positive	%	X^2	P value
Sex						**0.04**
Females	1330	47.5	167	12.56		
Males	1470	52.5	204	13.88		
Total	**2800**		**371**	**13.25**		
Age (years)						**0.001**
≤19	114	4.07	20	5.39		
20-29	797	28.46	106	28.57		
30-39	941	33.61	145	39.09		
40-49	530	18.93	71	19.14		
50-59	231	8.25	18	4.85		
≥60	187	6.68	11	2.94		
Total	**2800**		**371**	**13.25**		

($p<0.05$)

Table 2: Prevalence of *Mycobacterium tuberculosis* in relation to some Demographic Factors in North Central Nigeria

Variables	Number Examined	Number Positive (%)	P – Value
Sex			**0.04**
Female	1330	167 (12.56)	
Male	1470	204 (13.88)	
Age			**0.001**
≤19	114	20 (5.39)	
20-29	797	106 (28.57)	
30-39	941	145 (39.08)	
40-49	530	71 (19.14)	
50-59	231	18 (4.85)	
≥60	187	11 (2.97)	
HIV Status			**0.001**
Yes	1152	238 (20.60)	
No	989	78 (7.00)	
Unknown	639	55 (8.60)	
Marital Status			**0.001**
Single	1064	156 (14.60)	
Married	1736	215 (12.30)	
Alcohol			**0.001**
Yes	1541	204 (13.24)	
No	1259	167 (13.26)	
Smoking			**0.02**
Yes	787	112 (14.20)	
No	2013	259 (12.90)	
Educational Status			**0.001**
None	724	909 (12.40)	
Primary	655	88 (13.60)	
Secondary	928	126 (13.60)	
Tertiary	493	66 (13.40)	
Appearance of Sputum			**0.001**
Bloody Stained	181	36 (19.90)	
Mucoid	2016	254 (12.50)	
Purulent	127	17 (13.30)	
Salivary	476	64 (13.25)	
Total	**2800**	**371 (13.25)**	

($p<0.05$)

Table 3: Prevalence of *Mycobacterium tuberculosis* Across the States in North Central Nigeria

State	Number Examined	Number Positive	Number Negative	Number In determinant	Prevalence (%)
Abuja	400	44	344	12	11
Benue	400	64	335	1	16
Kogi	400	46	337	17	11.5
Kwara	400	57	340	3	14.25
Nasarawa	400	46	354	0	11.25
Niger	400	64	299	37	16
Plateau	400	50	340	10	12.5
Total	**2800**	**371**	**2349**	**80**	**13.25**

DISCUSSION

The result of this study showed highest prevalence of MTB among those aged 30-39 years (39.08 %). This was similar to a study carried out in Delta state South-South of Nigeria in which the calculated average highest prevalence of 29.8 % was in age group 25-34 years (Eze *et al*., 2018). A prevalence of 30.14% was also recorded in Jigawa State, North Western Nigeria for age group 25-34 years (Baba and Hincal, 2015). In West Africa, research done in Kenya by Yonge *et al.* (2017) also corroborated the findings of this present study.

The prevalence of MTB as relate to age groups across various work cited above represent the work force of most nations. Thus, increased exposure to risk factors such as travelling, occupational hazards and socio-cultural practices could encourage PTB transmission may be responsible for the increased prevalence. MTB prevalence decreased steadily with age having the youths being at greater risk of becoming active patients while very old respondent may never report the case of onset of PTB or probably die of it while ascribing it to sickness of old age which might be the reason for the lowest incidence in the study.

The prevalence rate in this study shows 13.88 % for male and 12.56 % in female and it is statistically significant. The study is in agreement with results of some studies carried out in Nigeria which gave female to male ratios of 1/1.3. One of the possible reasons for the high prevalence among males may also be due to stigma attached to the disease which seems to have more effect on the females than males, women suffering from PTB may have been boycotted and ill-treated. The effect includes social isolation, reduced chances of marriage, rejection, and harassment by in-laws and spouse, hence male respondents will likely visit health care facility than females. In another research work done in Abuja by Lawson *et al.* (2010) on the yield of smear microscopy and radiological findings of male and female patients with tuberculosis also confirms that males ~~will~~ attend the health services than females. The result of this study aggresses with another research work done in Niger state showing prevalence rate of males to females as 26.0 % and 24.6 % respectively (Sani *et al*., 2015). Other similar work done by Egbe *et al*. (2016) and Audu *et al.,* (2018) also report similar high prevalence rates in males compare to females. The possible reasons could also be attributed to the behavioural factors such as smoking, alcohol consumption, malnutrition and poor living conditions which are predisposing factor to PTB with more males being smokers than females. Males may travel more frequently, have more social contacts, spend more time in settings that may be conducive to transmission, such as bars and engage in professions associated with a higher risk for tuberculosis, such as mining. However, high incidence of MTB in male recorded in this study was contradicted by the findings of Ahmed *et al.* (2015) in Dargai in Pakistan who recorded a prevalence of 57.6 % in females compared to 42.37 % in male.

The reported TB/HIV co-infection rate of 20.6% in this study is similar to Ogbo *et al*. (2018). Other studies also report a prevalence of 29.0% in Ogun state, South west (Kolade *et al*., 2016), 25% in Lagos, south west of Nigeria (Matthew *et al*., 2017). Gyar *et al.* (2015) from Lafia, North central Nigeria reported 34.5% TB/HIV prevalence. However, a very low prevalence of 7.7 % was reported in Jos, South East (Charles *et al*., 2016) and 11.2 % in Kano, North West (Muhammad and Muhammad, 2018). Another study recorded 5.1 % in pregnant women attending ante-natal in Ogun state (Atilola *et al*., 2018). Adu *et al.* (2015) recorded 10.6% in Agbor Delta state, South-South, Nigeria. These variations in prevalence rate could likely be attributed to different sample size used or methodology employed in the design of the study. It could also stem from availability and follow up of the use of ART in the treatment of HIV or lack of adherence to ART for HIV drug intervention hence the high prevalence. The disparity could also be an indication of the decline in stigmatisation of HIV in the states where low percentages were recorded which

could enhanced the attending factors of patient to seeking medical care early.

The social correlation of marital status to prevalence of MTB is in accordance with other findings across Nigeria and other countries. A study done in Kano, North west of Nigeria showed a high prevalence of 40.5% in favour of those married and 25.0% to singles (Muhammad and Muhammad, 2018). A similar work done in Ogun state, south west also recorded 92.3% and 7.7% for married and singles respectively, although, the rate were three times higher compare to this study (Atilola *et al*., 2018). Another finding in Ethiopia recorded 64.8 % for married and 19.0 % for singles to support the outcome of this present study (Kelemuwa *et al*., 2017). The reasons for this high prevalence in married respondent could probably be attributed to the enclose living condition of couple whose spouse may have been infected at one point and able to pass the Bacilli to one another especially with men engaged/exposed to smoking, drinking and are expected to be in greater contact with people who suffer from active Tuberculosis than women. However, Kolade *et al.* (2016) contradicted this view in a research recording 4.2 % for singles as against 2.6 % in married participant in the same South west.

The prevalence of alcohol consumption in this study is significant to prevalence of PTB, however, there was a slight fraction in frequency recorded for respondent who do not consume alcohol (13.24 %) as against alcohol consumers (13.26 %). This could probably be attributed to the fact that this present study did not conduct an alcohol titre level in the blood of the participant which is not part of the scope of this study but only relied on information gathered from the participant through structured questionnaire.

The prevalence of 14.2% PTB for those that smoke in this study as compared to non-smokers (12.8%) agrees with previous researches that have been conducted. Another study done at Federal Medical Centre Owerri in Imo state, South east Nigeria showed a high prevalence 2.6% for smokers of cigarette, which also support the findings of this study (Iroezindu *et al*., 2016). Additional research conducted in Barcelona Spain, on the assessment of the influence of direct tobacco smoking as a risk factor to contracting PTB showed a high prevalence of 59.8% for cigarette smoker validating the findings of this study (Altet *et al*., 2017). Although, the prevalence of PTB in cigarette smoker in this present work is lower than those gotten from other findings, nonetheless, the observation could be as a result of the methodology or sample size used.

The importance of education and occurrence of PTB in this study shows that respondent with secondary and primary education has the highest frequency of 13.6%. The result of this study is in total agreement with similar study conducted which records highest frequency in secondary participants (Hassan *et al*., 2017). Another study conducted in Oyo state, South-West, Nigeria also correlated with the result of this study (Oladimeji, *et al*., 2018). The work carried out by Bisallah *et al.* (2018) also agrees with the result of this study, though a higher frequency was recorded but the result follows the same pattern.

Physical appearance and quality of the sputum samples collected shows that 19.9% of the samples collected were stained with blood and account for the highest frequency while the lowest percentages of samples were salivary (13.25%). This finding contradicts the result gotten from Niger State in Nigeria, whose report stated that 46.6% of the samples collected were for salivary while the lowest percentages of samples were bloody (8.3%) (Sani *et al.,* 2015). The high frequency of occurrence in the bloody samples might suggest positivity of PTB in the sample.

CONCLUSION

The prevalence of *Mycobacterium tuberculosis* detected in this study was high in spite of the effort and strategic polices employed to reduce TB in Nigeria.

This is a wakeup call that more effort and resources still need to be channeled to reduce its incidence to the barest minimum. Upbeat measures are also needed urgently to address the challenges of swift diagnosis and early commencement of TB treatment to ease spread of PTB in North central of Nigeria.

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