Original article

Prevalence of Childhood Tuberculosis at National Tuberculosis, Leprosy and Buruli Ulcer Training Centre & Referral Hospital, Zaria, Nigeria

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ABSTRACT

Background: Tuberculosis (Tb) is a chronic infectious disease that is preventable and curable, yet a major cause of childhood morbidity and mortality. Tb prevalence are under-estimated in many high burden countries. Childhood Tb remain a pointer to a recent Tb infection in the environment; thus, lack adequate control unlike Tb infection in the adult population. The study aimed to determine the prevalence of childhood Tb at National Tb, Leprosy and Burulli Ulcer Training Center & Referral Hospital (NTBLTC) Zaria.

Methods: The prevalence of Tb was studied among children age 0-14 retrospectively using GeneXpert MTb/ Rif diagnostic tool. A cross-sectional study design by reviewing data from January 2021 to December 2024 was used. The results were analyzed using SPSS version 2.0 and MedCal, with a P- value of less than 0.05 considered as significant.

Results: A prevalence of 4% Tb with 0.2% Drug Resistance Tuberculosis (DR-Tb) was recorded among a total studied population of 5,170. The outcome of the prevalence varied with sex, age, Human Immune Deficiency Virus (HIV) status, residency and diagnostic positivity pattern, where residency & Age had a strong association with children developing Tb with a p-value of less than 0.05. The Female gender was more with positivity rate of 51.7%, and 1.3% Tb/HIV co-infection.

Conclusion: This study recorded a low prevalence of 4% among the study population when compared with World Health Organization (WHO) global Childhood Tb report of, 2022, 2023 & 2024 with 11%, 12% & 11% prevalence rate respectively.

Keywords: *Tb, Childhood, HIV, AIDS, DR-Tb, DS-Tb*

1.0 INTRODUCTION

Tuberculosis is a communicable disease that is a major cause of ill health and one of the leading causes of death worldwide, until the coronavirus (COVID-19) pandemic. (Wingfield T et al., 2021). Tb was the leading cause of death from a single infectious agent, ranking above HIV/AIDS. Tb is caused by the bacillus Mycobacterium tuberculosis, which is spread when people who are sick with Tb expel bacteria into the air (e.g. by coughing). The disease typically affects the lungs (pulmonary Tb) but can affect other sites. (WHO, 2024).

Tuberculosis is transmitted through the inhalation of an infectious droplet of tubercule Baccilli suspended in air from an infected person. Most of the transmission of Tb are by adults/adolescents with PTb to other adults or to children. Children can also infect others if they have been infected with Tb, however, this is much less common, thus the risk of Tb infection depends on infectiousness of the source case, the duration and intensity of contact, virulence of the organism, and immune status of the child (Seddon & Shingadia, 2014). Children with PTb are less contagious because Tb in children is described as paucibacillary in nature and less likely to have cavitary lesions in lungs; as pulmonary cavitary lesions in adults may have up to 10 million to 1 billion bacilli compared to 100- 10,000 organisms in nodular lesions (Batra & Ang, 2019) .Children also have a less forceful cough that may suspend the mycobacteria in the air, have less endobronchial secretions, produce less sputum and swallow sputum even if produced, (Starke & Cameron, 2020).

Although significant similarities exist between spectrum of Tb occurring in adults and children, there are important differences in the characteristics and peculiarities of Tb in children. These characteristics and peculiarities may be partly responsible for the gap created in the control efforts of Tb especially in developing countries. Many of these are obscure especially to policy makers and some clinicians (Maitra et al., 2019).

Tuberculosis is distinct from other microorganisms not only due to its slow growth and difficulties to study in the laboratory, but also due to its inherent physiology such as its complex cell envelope and its metabolic pathways (Maitra et al., 2019).

The diagnosis of childhood Tb can be challenging because it mimic many common childhood diseases, and therefore, high index of suspicion is required to improve detection of cases (Maitra et al., 2019). Poor access and delay in initiating appropriate Tb treatment in children have implications on child morbidity and mortality, (WHO, 2016). The actual magnitude of childhood Tb epidemic is difficult to assess, mainly due to diagnostic difficulties and non-inclusion of children in most surveys, (WHO, 2016).

The incidence of Tb in Nigeria was put at 338/100,000 and 418,000 for 2017 and 2024, respectively, making Nigeria 6th in 2024 among the countries with high burden of TB in the world. Apart from drug sensitive Tb (DS-Tb); drug resistant Tb (DR-Tb) and HIV & AIDS are also prevalent in Nigeria. Infection with HIV is the single most important risk for developing Tb. The prevalence of Childhood Tb is a good indication of ongoing transmission of Tb in the community, as such its burden can provide a considerable measure of Tb control in a community.

The main aim is to assess the prevalence of Childhood Tuberculosis at National Tuberculosis, Leprosy and Buruli Ulcer Training & Referral Hospital Zaria. The objectives are to determine the relation of developing childhood Tb with the following indicators; Age, Sex, HIV status, Residence and Positivity patterns

Children age (0-14) adds nearly 11% of all Tb cases worldwide (WHO, 2021). In the year 2020, about four million children were infected with Tb, among which 115,000 were DR-Tb, the death rate accounting from all form of Tb is about 16% who are HIV-negative and 9.8% HIV-positive and more were left severely disabled (WHO, 2021). Most of the deaths due to TB in children usually occurs among the under-five children, (Dodd et al., 2017). The reasons for the high mortality among the under-five may be due to under or delayed diagnosis, difficulties involved in making the diagnosis, child-unfriendly drug formulations, malnutrition coupled with usually severe forms of Tb in this category of children among other host factors peculiar to the young children. The majority of the global Tb deaths occur in the WHO African and South East Asian regions; these two regions account for 85% of the combined total of Tb deaths in HIV-negative and positive (Genene, 2016).

Childhood Tb is a pointer to a recent Tb infection in the environment; thus, lack adequate control unlike Tb infection in the adult population. This is because most of the Tb infection in children progress to a disease within a year or two, (Perez-Velez CM & Marais BJ, 2012). Tb disease in adults is mainly due to reactivation of a dormant infection. An adult with active pulmonary tuberculosis (PTb) may infect on the average, between 10 and 15 persons every year (FMOH, 2015), Communities and countries recording high rates of Tb in children suggest that active Tb transmission happens in these areas. This may not be unconnected with the relatively lower immunity of the younger children compared to the older ones and the adults. Although the drivers of the Tb infection such as poverty with its attendant problems, DR-Tb, overcrowded living condition among others, cut across all the age groups; disease progression drivers; such as other infections that weaken immune system, malnutrition etc are commoner in the pediatric population.

Likewise, severe forms of Tb like Tb meningitis and miliary Tb are also commoner in the domain of the children population (Marais BJ et al, 2004).

However, children with DR-Tb are reported to be relatively older, have severe disease and tend to have higher rates of smear positivity, who are more likely to transmit Tb than children with Drug susceptible Tb (DS-Tb) (Seddon et al., 2012) .Young children who swallow sputum are also at risk of developing gastrointestinal Tb from an infected sputum, thus the higher prevalence of abdominal Tb in children (Lancella .L et al, 2023).

2.0 METHODOLOGY

2.0.1 STUDY LOCATION/AREA

This study was conducted at the National Tuberculosis, Leprosy and Buruli Ulcer Training center & Referral Hospital (NTBLTC), Saye Zaria located at the central zone of Kaduna State, Nigeria. The center serves as the Referral center of Tb diagnosis & treatment for the Northern region of Nigeria. The center has the capacity to diagnosed, hospitalized & train health care workers on Tb, DR-Tb, Leprosy, HIV & Burruli ulcer using both molecular, culture and Microscopy assay.

2.0.2 DIAGNOSTIC TOOL

GeneXpert MTb/Rif molecular diagnostic tool was used to test sputum and stool sample. Thi is a cartridge-based nucleic acid amplification test (NAAT) for rapid tuberculosis diagnosis and rapid antibiotic sensitivity test. It is an automated diagnostic test that can identify Mycobacterium tuberculosis DNA and resistance to rifampicin (Rif)

2.0.3 DESIGN OF THE STUDY AND DATA COLLECTION

The study was a retrospective cross-sectional study spanning through 2021 to 2024. Checklist was developed to collect data form the Laboratory register for the following indicators; Age, Sex, HIV status, Residence and Positivity patterns.

2.0.4 STUDY POPULATION

i. Inclusion criteria

Data for all children between the ages of 0-14 years were collected.

ii. Exclusion criteria

Data for all ages above or greater than 14 years were excluded.

2.0.5 SAMPLE SIZE DETERMINATION

Data for four (4) years from January 2021 to December 2024 were retrospectively collected.

2.0.6 SAMPLING TECHNIQUE

Quota sampling technique was used to collect data for children between the ages of 0-14 years

2.0.7 ETHICAL CONSIDERATION

Ethical clearance was collected from the institution Health Researchm & ethics committee.

2.0.8 ANALYSIS

The Data analysis was done using SPSS version 2.0 and MedCal, with a P-value of less than 0.05 considered as significant.

3.0 RESULTS AND DISCUSSION

Figure 1, show the prevalence of childhood Tb between January 2021 to December 2024, where a total of 5,170 children age (0-14) were tested at NTBLTC Saye Zaria,

where (232) are diagnosed positive which gives a prevalence of 4% among which (11) was DR-Tb given rise to a prevalence of 0.2%.

This prevalence is below the WHO global Childhood Tb report, 2022, 2023 & 2024 of 11%, 12% & 11% prevalence respectively. Also lower than the report of MSH, 2018 (14%) and a retrospective study from southern Ethiopia by Getahun et al., 2012 reported (13%). This indicates that in NTBLTC childhood Tb was under diagnosed. This reason could be due to inadequate community awareness on childhood Tb, because the sign and symptoms of Tb in children mimic other diseases. Poor quality or suboptimal sample also impacts the diagnostic output.

As shown on Table 1, significant relationship exist amongst age groups in developing Tb diseases. As such the magnitude of Tb in this study is higher between the ages of (11-14) 41.8%. This is not in agreement with the study done in Sudan which report 46.7% Tb cases between the age ranges 0– 4 years (Osman, 2014). This could be due to the fact that children at this age group children are more active and expose to the environment than 0-4 and 6-10 who are most time together with the parents. However on a contrary study Lamb GS & Starke JR, 2017 reports progression of TB increases among children aged 5-9 years and throughout adolescence, which could be associated with immunity changes due to puberty. This change contributed to an increased risk of progression to TB among adolescent and young adults (Lamb GS & Starke JR, 2017). It was reported in another study again about 50% of cases occur among infants and children less than 5 years of age by Lamb GS & Starke JR, 2016. Moreover the ages between 5 and 14, often called the "favored age," children usually have the lowest rates of tuberculosis disease in any population (Lamb G.S & Starke J.R 2016). Therefore the age of the child at acquisition of tuberculosis infection seems to have a great effect on the occurrence of both primary and reactivation tuberculosis (Lamb G.S & Starke J.R, 2016) Approximately 50% of untreated children less than 1 year of age develop radiographically significant lymphadenopathy or segmental lesions, compared with 24% of children 1 to 10 years of age and 16% of children 11 to 15 years of age (Miller F.J et al., 1963).

This study also revels significant relationship among children developing Tb in relation to residential status on table 1. The study agrees with the WHO 2021, who report about 4 million children aged under 5 years are household contacts affected by people living with Tb, Padmanesan .N et al., (2013) reported household contacts who live with infectious Tb patients are one of the groups at high risk of developing Tb. As such rural household with a positivity of 62.7% is not unconnected with the fact that Tb is the disease of the poor or low income earners that is now also spreading to the urban area which is shown in this study with a positivity of 37.3%. WHO 2020 global Tb report shows that the major drivers of TB are household air pollution, under nutrition, poverty, diabetes, tobacco and smoking, which contribute to nearly half of the global TB burden. Such determinants need to be addressed urgently, including through social protection.(Lönnroth .K et al, 2009). Singh et al., (2018) also reports that the Potential household environmental factors can enhance Tb's prevalence risk, such as overcrowding and poor living structures Therefore the Tb poverty cycle interruption using social protection measures that alleviate poverty, reduce food insecurity and mitigate catastrophic costs of Tb-affected households was reported by Andrade .K et al., (2013) and Aragão K et al., (2021)

Gender was insignificant in this study in relation to children developing tuberculosis as shown on table 1. Although more female population developed Tb with a positivity rate of (51.7%) than the male population. This study is similar to a prospective study done in India who reported 61.7% of Female diagnosed cases (Joshi, 2018) and a retrospective study done in Addis Ababa 55% (Genene, 2016). This indicates that during childhood, females might be more prone to Tb than male as against adult population. This main reason was not clear to why girls are more affected than boys in the period of childhood.

Co-infection between HIV and TB was recorded with 1.3% though insignificant in this study to children developing TB as shown on table 1, because most of the studied population had an unknown HIV status to ascertain the statistics. In TB epidemic countries TB/HIV co-infections is common, and it's very important to note that HIV has a debilitating effect on the immune system by depleting the CD4 cell counts making the body prone to invasion by opportunistic infections such as TB. HIV-positive individuals are 20 times at more risk of latent Mycobacterium tuberculosis infection reactivation and subsequent progression to active TB

compared to HIV-negative people. Teweldemedhin M et al., 2018 & Kolade RE et al., 2016) and this risk increases by 2.5-fold in HIV- positive children (Okechukwu AA et al., 2011).

Table 2, shows the diagnostic positivity pattern using GeneXpert MTb/Rif, this reveals the re 232 diagnosed MTb positive. Therefore 11 were confirmed DR-Tb and they are mostly females from the rural household.

The Female diagnosed positive are more than the Male with 52% and Most of them are from the rural areas with 72.9%.

MTb-T, Rif-I indicate the presence of Tuberculosis but in a minute quantity, while the rifampicin resistance is undecided, as such this group of population are also placed on DS-Tb.

	Total Number	Number Positive (MTb Detected %)	X2	OR (95% CI)	P-Value
Gender					
Male	2600	112(48.3%)	0.3603		0.548
Female	2570	120(51.7%)		1.08(0.8331-1.4103)	0.548
Residency					
Rural	2522	145(62.7%)	6.594		0.010*
Urban	2648	87(37.3%)		0.56(0.3332 to 0.9626)	0.035*
Age					
0-4	1098	57(24.6%)	9.9751		0.001*
6-10	1779	78(33.6%)			
11-14	2293	97(41.8%)			
HIV Status					
Positive	8	3(1.3%)	14.78		1.208
Negative	289	10(4.3%)			
Unknown	4870	219(94.4%)			

Table 1. Socio-demographic and Risk Factors associated with Childhood Tuberculosis

Key: HIV: Human immune Virus; X2: Chi-square; OR: Odds ratio; CI: Confidence Interval

	MTb-D (%) Rif-N	MTb-D (%) Rif-D	MTb-T (%) Rif-I
Total number Positive	202	11*	19
Sex			
Male	102(43.7%)	4(1.7%)	6(2.6%)
Female	100(43%)	7(3%)	13(6%)
HIV Status			
Positive	3(1.3%)	0(0%)	0(0%)
Negative	10(4.3%)	0(0%)	0(0%)
Unknown	189(85%)	11(4.7%)	19(8%)
Age			
0-5	49(21%)	1(0.4)	7(3%)
6-10	82(12%)	5(2%)	10(4.3%)
11-14	71(31%)	5(2%)	2(0.9%)
Residency			
Rural	129(55%)	9(4%)	5(2.5%)
Urban	73(31%)	2(1.5%)	14(6%)

Table 2. Diagnostic Positivity Pattern of Childhood Tuberculosis

Key: MTb-D: Mycobacterium tuberculosis Detected; MTb-N: Mycobacterium tuberculosis Not Detected; MTb-T: Mycobacterium tuberculosis Trace; Rif-D: Rifampicin Detected; Rif-N: Rifampicin Not Detected; Rif-I: Rifampicin Indeterminate

4.0 CONCLUSION

In NTBLTC Saye, the prevalence of children age (0-14) with Tuberculosis was 4% among which 0.2% was DR-Tb. As such the prevalence is lower comparing to WHO global Childhood Tb report of, 2022, 2023 & 2024 with 11%, 12% & 11% prevalence rate respectively. Moreover the diagnosis of childhood Tb can be challenging because it can mimic many common childhood diseases, and therefore, high index of suspicion is required to improve case detection & reporting.

5.0 RECOMMENDATIONS

This Study strongly recommend quality and optimal sample collection in order to ensure accurate diagnosis. Ensure effective infection control guidelines published by the WHO contains policies are followed for the prevention of Tb transmission in a variety of settings, that will help reduce Tb transmission in household, health care facilities and congregate settings.

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