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Pattern and Outcome of Childhood Tuberculosis Seen at the University of Port Harcourt Teaching Hospital, Nigeria

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Abstract

Background: Despite the fact that Tuberculosis (TB) is preventable, treatable and curable, it has remained a significant cause of childhood morbidity and mortality. Identifying patterns of TB and its treatment outcome which is the aim of this study is relevant for TB control programmes. **Methodology:** This was a retrospective cross-sectional study carried out over a three-month period from April-June 2019 at the directly observed treatment Short course (DOTS) clinic of the University of Port Harcourt Teaching Hospital (UPTH), Nigeria. Relevant information on all children 0 - 18 years with tuberculosis over a four-year period from January 2015 to December 2018 was retrieved and analysed. Information retrieved included the age, sex, HIV status, method of diagnosis of tuberculosis, type of Tuberculosis and the treatment outcome of the patients. **Results:** There were 202 childhood (0 - 18 years) cases seen over the study period. Out of these, 109 (53.96%) were males and 93 (46.04%) females. Majority of them (40.59%) were 1 - 4 years of age. There were 194 (96.04%) new cases, 6 (2.9%) transfer and 2 (0.99%) retreatment cases. One hundred and six (80.69%) had pulmonary TB, 23 (11.39%) TB adenitis, 10 (4.95%) had TB spine, 3 (1.49%) TB abdomen and 3 (1.49%) TB meningitis. TB/HIV co-infection rate was 48.45%. One hundred and eight completed treatment, 10 (4.95%) were cured, 22 (10.89%) died, 46 (22.77%) defaulted and 16 (7.92%) were transferred out. Successful treatment outcome rate was 58.41%. **Conclusion:** Pulmonary TB was the commonest type of TB found and treatment success rate was just above average.

Keywords

Childhood, Tuberculosis, Pattern, Outcome

1. Introduction

Tuberculosis (TB) is a chronic infectious disease caused by Mycobacterium tuberculosis and is the second leading cause of death from an infectious disease worldwide [1] [2]. Despite the fact that it is preventable, treatable and curable, it has remained a significant cause of childhood morbidity and mortality. TB kills more than one million people every year [2] [3] and in 2017, it caused an estimated 1.3 million deaths among HIV-negative people with an additional 300,000 deaths among HIV-positive people [4]. Most deaths from TB could be prevented with early diagnosis and appropriate treatment.

Tuberculosis is a multi-system disease with the lungs as the primary focus. When TB affects other organs other than the lungs, it is called Extra Pulmonary TB (EPTB). Pulmonary TB is commonly reported in studies with a prevalence ranging from 46.5% - 92.0% [5] [6] [7] [8].

Extra-pulmonary TB (EPTB) may occur in any organ of the body such as lymph nodes, central nervous system (CNS), abdomen (intra-abdominal organs, peritoneum), pericardium, bone, joint genitourinary tract and breast. EPTB is sometimes life threatening such as in TB meningitis and TB pericarditis while others cause significant disability and ill-health. EPTB accounts for about 15% - 20% of all TB cases with an increasing global annual incidence [9].

Miliary tuberculosis or disseminated tuberculosis is a type of infection which occurs in different organs at the same time such as Pulmonary, lymph nodes, kidneys, liver and spleen [10].

Whether TB is Pulmonary or EP, pharmacological treatment modalities are near similar for both drug sensitive and drug resistant TB in adherent patients and their outcome can be evaluated. A proven strategy to ensure patients' adherence to anti-tuberculous medication is the use of DOTS therapy [11]. DOTS involves mainly an early diagnosis of quality provided sputum-smear microscopy and standardised short-course anti-TB treatment given under direct and supportive observation [12]. Other components are a regular, uninterrupted supply of high-quality anti-TB drugs, standardised recording and reporting; and sustained political and financial commitment. It is aimed at ensuring that patient with TB complete treatment to cure and prevent the development of drug-resistant TB in the community [12].

DOTS is associated with significantly improved treatment outcome with an overall reduction in morbidity and development of multidrug-resistant TB [13] [14].

Despite enormous improvement in TB treatment outcomes that have led to the prevention of 53 million deaths between 2000 and 2016, there are still major problems with the treatment of TB [15]. Poor TB treatment outcomes are disproportionately high in low-income countries and among low-socio-economic groups within countries. Identifying patterns of TB treatment outcome across geographic areas is particularly relevant for TB control programs and health care providers for planning, implementing, monitoring, and evaluating control and

prevention efforts to those areas at highest risk. The Global Burden of Disease (GBD) study [2] [15] and the World Health Organization (WHO) [3] have produced national-level estimates of morbidity and mortality from TB on an annual basis. However, TB treatment outcome for administrative units of countries such as States, Local Governments may differ significantly from the national average. Sub-national level analyses are important for planning purposes and to determine where services can further be strengthened. This study is therefore aimed at evaluating the pattern and outcome of childhood Tuberculosis at the University of Port Harcourt Teaching Hospital.

2. Methodology

2.1. Study Area, Population and Data Tool

The directly observed treatment Short course (DOTS) clinic of the University of Port Harcourt Teaching Hospital (UPTH), Port Harcourt, Nigeria was the study centre. Diagnosis, treatment and follow up of TB cases are carried out in this centre according to the National guidelines on TB and leprosy management. All children diagnosed with tuberculosis by both clinical and bacteriological methods constituted the study population. The data tool was the National TB registers and case notes of the patients in the UPTH Dots centre.

Inclusion criteria

All children aged 0 - 18 years whose information were in the National TB register in the DOTS clinic in the UPTH from January 2015 to December 2018.

Exclusion criteria

1) Patients aged more than 18 years.

2) Patients with RIF resistant TB.

Study procedure

This was a retrospective cross-sectional study carried out over a three month period from April-June 2019. Relevant information on all children 0 - 18 years with tuberculosis over a four year period from January 2015 to December 2018 was retrieved. Information retrieved included the age, sex, HIV status, method of diagnosis of tuberculosis, type of Tuberculosis and the treatment outcome of the patients. Bacteriological diagnosis was done using a positive sputum smear for AFB (by ziel Nelson) or by a confirmed positive Xpert MTB/RIF test which also detects Rifampicin resistance. Clinical diagnosis was made in children with suggestive clinical features and confirmed using suggestive chest radiograph findings and a positive Tuberculin sensitive test (TST). Tuberculosis treatment outcome was assessed according to WHO [16] and National Tuberculosis and Leprosy Control Program (NTLCP) [17] guidelines. Tuberculosis treatment outcomes were classified as follows:

1) Cured-sputum smear positive patient who was sputum negative in the last month of treatment and on at least 1 previous occasion.

2) Treatment completed—Patient who has completed treatment but who does not meet the criteria to be classified as a cure or a failure.

3) Treatment failure—Any TB patient who is sputum smear positive at 5 months or later during treatment.

4) Died—Patient who died from any cause during the course of treatment (regardless of the cause of death).

5) Defaulted/Lost to follow up—Patient whose treatment was interrupted for two consecutive months or more after registration.

6) Transferred out—A TB patient who has been transferred to another local government area to continue his/her treatment and for whom treatment outcome is not known.

2.2. Data Analysis

The data obtained was entered into an Excel spreadsheet and analyzed by calculation of means, percentages and ratios using SPSS version 20. A test of significance between proportions and means was assessed using Chi-Square and T-test and a p value < 0.05 was considered significance at 95% confidence interval.

3. Results

There were 202 childhood (0 - 18 years) TB cases seen in the DOTS clinic in UPTH over the study period. One hundred and nine (53.96%) were males and 93 (46.04%) were females with male to female ratio of 1.2:1. Their mean age was 5.35 years ±5.32 years. Forty-two (20.79%) were less than 1 year of age; 82 (40.59%) were 1 - 4 years; 31 (15.35%) were 5 - 9 years; 26 (12.87%) were 10 - 14 years and 21(10.40%) were 15 - 18 years of age. One hundred and ninety-four (96.04%) were new TB cases, 6 (2.9%) were transferred from other DOTS centres and 2 (0.99%) returned for treatment after defaulting. One hundred and sixty-three (80.69%) patients had pulmonary TB, 23 (11.39%) had TB adenitis, 10 (4.95%) had TB spine, 3 (1.49%) had TB abdomen and another 3 (1.49%) had TB meningitis (Figure 1).

In 187 (92.57%) cases, diagnosis was made clinically and radiologically and 15 (7.45%) patients had positive sputum microscopy. Gene Xpert was done for only

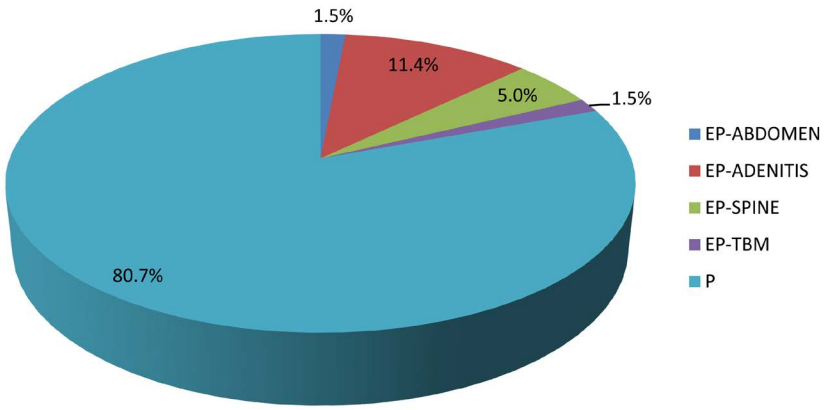

Figure 1. Pattern of Tuberculosis cases seen among the children. Note: P = Pulmonary TB, TBM = TB meningitis.

26 (12.87%) patients, out of these 20 (76.92%) was positive. Five (2.48%) patients were positive for both Gene Xpert and sputum smear. HIV test was done for only the 194 (96.04%) new TB cases, out of these 94 (48.45%) patients were positive for HIV. Three (3.19%) patients were both sputum smear and HIV positive.

One hundred and eighty-nine (93.56%) patients received 6 months of anti TB drugs, while 13 (7.45%) were treated for 12 months. Out of the 94 (48.45%) HIV positive patients, 92 (97.87%) were on anti-retroviral therapy.

One hundred and eight (53.46%) patients completed their anti TB treatment, 46 (22.77%) defaulted, 22 (10.89%) died, 16 (7.92%) patients were transferred out and 10 (4.95%) patients were completely cured. No treatment failure was recorded. Successful treatment outcome rate in this study was 58.41%, a combination of those cured (4.95%) and those who have completed treatment (53.46%). Unsuccessful treatment outcome rate was 33.66%, combination of those who defaulted (22.77%) and those who died (10.89%).

Table 1 shows the association between age group and gender with type of TB. The age group 1 - 4 years had the highest proportion of those with pulmonary TB (41.10%, 67/163)), TB adenitis (43.48%, (10/23)) and TB spine (40.00%, (4/10)).These findings were not statistically significant (p = 0.52). A higher proportion of those with pulmonary TB (52.76%), TB adenitis (60.87%), TB spine (70.00%) and TB meningitis (66.67%) were males, while the females had a higher proportion of those with TB abdomen (100.00%) and TB spine. These observations were not statistically significant (p = 0.26).

Table 2 shows the association between age group and some variables. All those less than 1 year of age were placed on the 6 months treatment regimen and the age group 5 - 9 years had the highest proportion of those placed on the 12 months treatment regimen. However, this was not statistically significant (p = 0.20). Diagnosis of TB in those less than 1 year of age (100%) was only done clinically, while the highest (33.33% (7/21)) proportion of smear positive TB was

Table 1. Association between age group and gender with type of TB.

Characteristic	Type of TB (%)					Total	X^2 (p value)
Age group	**Pulmonary**	**Adenitis**	**TB Spine**	**Abdomen**	**TBM**		
<1 year	36 (22.09)	5 (21.74)	0 (0.00)	0 (0.00)	1 (33.33	42 (20.79)	15.10
1 - 4 years	67 (41.10)	10 (43.48)	4 (40.00)	0 (0.00)	1 (33.33)	82 (40.59)	(0.52)
5 - 9 years	21 (12.88)	4 (17.39)	3 (30.00)	2 (66.67)	1 (33.33)	31 (15.35)	
10 - 14 years	21 (12.88)	2 (8.70)	2 (20.00)	1 (33.33)	0 (0.00)	26 (12.87)	
15 - 18 years	18 (11.04)	2 (8.70)	1 (10.00)	0 (0.00)	0 (0.00)	21 (10.40)	
Total	163 (100.0)	23 (100.0)	10 (100.)	3 (100.00)	3 (100.0)	202 (100)	
Gender							
Male	86 (52.76)	14 (60.87)	7 (70.00)	0 (0.00)	2 (66.67)	109 (53.96)	5.28
Female	77 (47.24)	9 (39.13)	3 (30.00)	3 (100.00	1 (33.33)	93 (46.04)	(0.26)
Total	163 (100.00)	23 (100.0)	10 (100)	3 (100.00)	3 (100.00)	202 (100)	

Table 2. Association between age group and some variables.

Characteristics	Age Group (%)					Total	Chi-Square (X^2) (p-value)
Category	**≤1 year**	**1 - 4 years**	**5 - 9 years**	**10 - 14 years**	**15 - 18 years**		
R-12	0 (0.0)	7 (8.54)	4 (12.90)	1 (3.85)	1 (4.76)	13 (6.44%)	6.03 (0.20)
R-6	42 (100)	75 (91.46)	27 (87.1)	25 (96.15)	20 (95.24)	189 (93.56)	
Total	42(100)	82 (100)	31 (100)	26 (100)	21 (100)	202 (100)	
Diagnosis							
Clinical	42 (100)	80 (97.56)	29 (93.55)	22 (84.62)	14 (66.67)	187 (92.57)	29.28 (0.001)*
Smear positive	0 (0.00)	2 (2.44)	2 (6.45)	4 (15.38)	7 (33.33)	15 (7.43)	
Total	42 (100)	82(100)	31(100)	26 (100)	21 (100)	202 (100)	
Gene Xpert							
Positive	2 (100)	5 (83.33)	1 (25.00)	5 (100)	7 (77.78)	20 (76.92)	8.32 (0.08)
Negative	0 (0.00)	1 (16.67)	3 (75.00)	0 (0.00)	2 (22.22)	6 (23.08)	
Total	2 (100)	6 (100)	4 (100)	5 (100)	9 (100)	26 (100)	
HIV test result							
Positive	21 (52.50)	44 (55.70)	16 (53.33)	8 (33.33)	5 (23.81)	94 (48.45)	9.51 (0.04)*
Negative	19 (47.50)	35 (44.30)	14 (46.67)	16 (66.67)	16 (79.19)	100 (51.55)	
Total	40 (100)	79 (100)	30 (100)	24 (100)	21 (100)	194 (100)	

*Statistically significant ($p < 0.05$).

found among the age group 15 - 18 years and this is statistically significant ($p = 0.001$). A higher proportion of those less than 1 year (52.50%), 1 - 4 years (55.70%) and 5 - 9 years (53.33%) were HIV positive. This is statistically significant ($p = 0.04$).

Table 3 shows the association between gender and some variables. A higher proportion of those on the 6 months treatment regimen were females (94.62%, (88.93)), while a higher proportion of those on the 12 months regimen were males (7.34%, (8/109). This is not statistically significant ($p = 0.78$). There is no statistically significant differences between gender and the method of diagnosis ($p = 0.60$). A higher (50.00%, (53/106)) proportion of the males have TB/HIV co-infection compared to the females (46.59%, (47/88)). This is also not statistically significant ($p = 0.67$).

Table 4 shows the association between treatment outcome and some variables. Those who were cured following treatment belonged to the age groups 10 - 14 years (50.00%, (5/10)) and 15 - 18 years (50.00% (5/10)). The highest proportion of those who died (40.91%, (9/22)), those who defaulted (50%, (19/46)) and those who transferred to another DOTS centre (50%, (8/16)) belonged to the 1 - 4 years age group. This is statistically significant ($p = 0.002$). Gender had no statistically significant association with treatment outcome ($p = 0.09$), however, a higher proportion of those cured (70.0%, (7/10)) and those who died (59.09%, (13/22)) were females. While a higher proportion of those who

Table 3. Association between gender and some variables.

Characteristics	Gender (%)		Total (%)	Chi-Square (p-value)
Category	Male	Female		
R-12	8 (7.34)	5 (5.38)	13 (6.44)	0.08 (0.78)
R-6	101 (92.66)	88 (94.62)	189 (93.56)	
Total	109 (100)	93 (100)	202 (100)	
Diagnosis				
Clinical	102 (93.58)	85 (91.40)	187 (92.57)	0.10 (0.60)
Smear positive	7 (6.42)	8 (8.60)	15 (7.43)	
Total	109 (100)	93 (100)	202 (100)	
Gene Xpert				
Positive	8 (72.73)	12 (80.00)	20 (76.92)	0.00 (1.00)
Negative	3 (27.27)	3 (20.00)	6 (23.08)	
Total	11 (100)	15 (100)	26 (100)	
HIV test result				
Positive	53 (50.00)	41 (46.59)	94 (48.45)	0.11 (0.67)
Negative	53 (50.00)	47 (53.41)	100 (51.55)	
Total	106 (100)	88 (100)	194 (100)	

Table 4. Association of treatment outcome with some variables.

Characteristics	Cured	TC	Died	Defaulted	Transferred	Total	X^2 (p-value)
Age group							
<1 year	0 (0.00)	22 (20.37)	6 (27.27)	12 (26.09)	2 (12.50)	42 (20.79)	20
1 - 4 years	0 (0.00)	46 (42.59)	9 (40.91)	19 (41.30)	8 (50.00)	82 (40.59)	(0.002)*
5 - 9 years	0 (0.00)	20 (18.52)	5 (22.73)	5 (10.87)	1 (6.25)	31 (15.35)	
10 - 14 years	5 (50.00)	12 (11.11)	1 (4.55)	5 (10.87)	3 (18.75)	26 (12.87)	
15 - 18 years	5 (50.00)	8 (7.41)	1 (4.55)	5 (10.87)	2 (12.50)	21 (10.40)	
Total	10 (100.00)	108 (100.0)	22 (100.00)	46 (100.00)	16 (100.00)	202 (100.00)	
Gender							
Male	3 (30.00)	57 (52.78)	9 (40.91)	27 (58.70)	13 (81.25)	109 (53.96)	9.26
Female	7 (70.00)	51 (47.22)	13 (59.09)	19 (41.30)	3 (18.75)	93 (46.04)	(0.09)
Total	10 (100.00)	108 (100.0)	22 (100.0)	46 (100.00)	16 (100.00)	202 (100.00)	
Tx Category							
R-12	1 (10.00)	4 (3.70)	2 (9.09)	5 (10.87)	1 (6.25)	13 (6.44)	3.62
R-6	9 (90.00)	104 (96.30	20 (90.91)	41 (89.13)	15 (93.750)	189 (93.56)	(0.60)
Total	10 (100)	108 (100)	22 (100)	46 (100)	16 (100)	202 (100)	
Disease site							
Pulmonary	9 (90.00)	88 (81.48)	18 (81.82)	38 (23.31)	10 (62.50)	163 (80.63)	12.82
Adenitis	1 (10.00)	9 (8.33)	3 (13.64)	5 (10.87)	5 (31.27)	23 (11.39)	(0.89)

Continued

Spine	0 (0.00)	6 (5.56)	1 (4.55)	2 (4.35)	1 (6.25)	10 (4.95)	
TBM	0 (0.00)	3 (2.78)	0 (0.00)	0 (0.00)	0 (0.00)	3 (1.49)	
Abdomen	0 (0.00)	2 (1.85)	0 (0.00)	1 (2.17)	0 (0.00)	3 (1.49)	
Total	10 (100)	108 (100)	22 (100)	46 (100)	16 (100)	202 (100)	
Diagnosis							
Clinical	4 (40.00)	103 (95.37)	21 (95.45)	43 (93.48)	16 (100)	187 (92.57)	43.45
Smear positive	6 (60.00)	5 (4.63)	1 (4.55)	3 (6.25)	0 (0.00)	15 (7.43)	(0.001)*
Total	10 (100)	108(100.0)	22 (100.00)	46 (100.00)	21 (100.00)	202 (100.00)	
HIV test result							
Positive	2 (20.00)	49 (45.79)	15 (71.43)	20 (50.00)	8 (50.00)	94 (48.45)	10.38
Negative	8 (80.00)	58 (54.21)	6 (28.57)	20 (50.00)	8 (50.00)	100 (51.55)	(0.07)
Total	10 (100)	107 (100)	21 (100)	40 (100)	16 (100)	194 (100)	

β = Fisher's Exact.

defaulted (58.70%, (27/46)) were males. Majority of those who were cured of the disease (90.0% (9/10)) and those who died (90.91%, (20/22)) were on the 6 months regimen. These findings were not statistically significant (p = 0.60). Majority of those who were cured (90.00%, 9/10)), who died (81.82%, (18/22)) and who defaulted (23.31%, (38/46)) had pulmonary TB. These findings were however not statistically significant (p = 0.89). Majority (71.43%, (15/21)) of those who died had TB/HIV co-infection. Majority (80.00%, (8/10)) of those who were cured following treatment were HIV negative, though these findings were not statistically significant (p = 0.07). Majority (60.00%, 6/10)) of those who were cured following treatment were smear positive. Majority (95.45%, (21/22)) of those who died and who defaulted (93.45%, (43/46)) had clinically diagnosed TB. These findings were statistically significant (p = 0.001).

Age (p = 0.53), gender (p = 0.95), treatment category (p = 0.19), type of TB (P = 0.80), method of diagnosis (p = 0.76) and HIV status (p = 0.13) had no association with successful or unsuccessful treatment outcome.

4. Discussion

Our study revealed a slight male preponderance in the prevalence of TB cases seen over the study period, supporting the declaration of the World Health Organisation that males are more predisposed to contracting TB compared to females [18]. This finding also corroborates the reports of three previous studies which found a male preponderance amongst patients with TB [8] [19] [20] [21]. However, it contrasts with the report of one study which found more females with TB than males, though this particular study only involved adolescents 12 - 18 years [22]. The possible explanation for the observed male preponderance has been linked to biological differences between males and females in certain age groups that affect the risk of being infected as well as the risk of progression to

TB disease [23] [24].

Childhood TB is said to occur most commonly among infants and young children under five years of age due to their relatively reduced immunity which enhances their early progression from TB infection to TB disease [8]. Our study showed that almost two third of the TB cases occurred in children less than five years of age, supporting the findings in two previous studies in Nigeria which reported a high prevalence of TB of 30.4% [8] and 53.43% [25] among under fives, though our prevalence is much higher than theirs. TB in this age group has been quantitatively linked to infectious adult TB prevalence in their immediate environment and is a marker for on-going TB transmission within the community [26].

Adolescents are said to be a high risk population for developing new TB disease due to an increase in new infections during the adolescent period or following conversion from latent TB to active TB disease [27] [28]. It is not surprising, therefore, that the adolescent age group made up almost a quarter of the TB cases seen in our study. Adolescents may acquire TB either at home or from school [29] [30], most importantly, a previous study showed that having an index adolescent TB case in the classroom significantly increased the risk of classmates contacting active TB [30]. What this means is that our adolescent TB patients acted like a reservoir for the transmission of the disease in their schools, supporting the inclusion of schools in TB screening programmes.

Pulmonary TB accounted for more than four fifth of the TB cases, making it the most common type of TB found in our study. Extra pulmonary TB accounted for less than a quarter (19.31%) of the TB cases. Our findings are similar with those of Affusim *et al.* [6] who reported that 78.6% of the TB cases found were pulmonary TB and extrapulmonary TB accounted for 21.4%. It is also similar to the 92% pulmonary TB reported by Budgell *et al.* [7]. Though Ogbudebe *et al.* [8] also found more pulmonary TB compared to extrapulmonary TB, the proportion of their pulmonary TB was quite low (58.0%) compared to ours and their extra pulmonary TB was much higher (42%) than ours. In contrast to our report, a study done in Kinshasa reported a very high proportion (59.0%) of extrapulmonary TB compared to pulmonary [31]. The explanation given for this deviation from the norm was difficulties in diagnosing pulmonary TB in their facilities due to lack of adequate radiological support [31]. The low prevalence rate of extrapulmonary TB found in our study could be as a result of the difficulties of diagnosing extrapulmonary TB because it involves biopsies and culture of various body fluids. Hence WHO's recommendation for Xpert MTB/RIF assay to be used in the diagnosis of extrapulmonary TB [32]. Since 92.5% of our TB cases were diagnosed clinically. It is possible some extrapulmonary TB cases may have been misdiagnosed. The commonest extrapulmonary Tb found was TB adenitis, which is also similar to the report of a previous study [7].

We further observed that the age group 1 - 4 years had the highest proportion of those with pulmonary TB, TB adenitis and TB spine. The vulnerable immunity of this age group put them at risk of developing all types of TB, including the

life threatening types like TB meningitis and disseminated TB [33], though in our study no patient had disseminated TB. Extra pulmonary TB was most commonly found among the 5 - 9 year age group.

The diagnosis of TB amongst the under-fives in our study was done clinically. This may be related to the difficulties in diagnosing TB in this age group due to the challenges in obtaining sputum for microscopy and the pauci-bacillary nature of their TB. Because of these challenges, the WHO recommended the use of Expert MTB/RIF for the diagnosis of both pulmonary TB and extrapulmonary TB in children due to its sensitivity [31]. Unfortunately, this test was done for only 12.87% of the patients. The adolescent age group had the highest proportion of those with smear positive results. This is expected as the adolescents have the adult type TB with cavitation on chest radiograph and positive sputum microscopy which involves significant transmission risk for their close contacts [34]. Perhaps, this is what informed the merging of adolescent TB with adult TB in most surveys. We also observed that the under-fives had the highest proportion of those with TB/HIV co-infection. This may be related to the high vertical transmission of HIV in Nigeria [35].

The 58.41% treatment success rate (combination of those who completed treatment (53.46% and those who were cured 4.95%) recorded in this study is low compared to the 83% and 79.2% treatment success rate reported by Ogbudebe *et al.* [8] and Adejumo *et al.* [36] respectively in Nigeria, 89.8% reported by Budgell *et al.* [7] in South Africa and 69.6% reported by Aketi *et al.* [31] in Kinshasa. The possible explanation for our low treatment success rate is the high rate of default and transfer (30.67%) recorded in our study, compared to the 1.1% - 15% default rate recorded in these other studies.

One of the variables with significant association with treatment outcome in our study was age group. Whilst those who were cured in our study were the adolescents, the adolescent age group also had the second highest proportion of those who defaulted from treatment. This is to be expected because adolescence has been identified as one of the classic risk factors for poor adherence to anti-TB therapy [34], and so the adolescent TB patients deserved to be closely monitored and followed up. The fact that they also had the highest proportion of those with open TB in our study is very worrisome because they are capable of transmitting the disease to their close social contacts. Efforts to control TB in Nigeria should also be directed at the adolescent age group. The 5 - 9 year age group had the highest proportion of those who died (16.13%), closely followed by those less than 1 year of age (14.29%). Efforts channeled towards reducing TB mortality should also be focused on the older children who are of primary school age in Nigeria and not only on the under fives.

Our study further showed that method of diagnosis had positive association with treatment outcome ($p = 0.00$). A higher proportion of those who were cured (60%) were smear positive, while a higher proportion of those who died (95.45%) and those who defaulted (93.48%) were clinically diagnosed. Perhaps delay in confirming diagnosis and commencement of appropriate therapy may

have contributed to these deaths.

We equally observed that a higher proportion (71.43%) of those that died were HIV positive. This supports the declaration of The Joint United Nations Programme on HIV and AIDS (UNAIDS) that HIV positive people are much more likely to die from TB than HIV negative people [37]. We also noted that half of those who defaulted were HIV positive. This discontinuation of therapy will lead to increase in TB/HIV mortality in the country.

Previous studies [7] [8] [36] reported that type of TB, HIV status, sputum microscopy result [7], clinical methods of diagnosis [8] and age [35] were associated with successful and unsuccessful treatment outcome. However, our study showed no such association and this is difficult to explain.

In conclusion, pulmonary TB was the commonest type of TB found in our study. The commonest extrapulmonary TB found was TB adenitis. The treatment success rate was just above average and age, gender, HIV status and Method of diagnosis had no association with successful or unsuccessful treatment outcome.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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