TETANUS IN SCHOOL AGE CHILDREN SEEN AT THE UNIVERSITY OF PORT HARCOURT TEACHING HOSPITAL: A NEED FOR BOOSTER DOSES OF TETANUS TOXOID VACCINE IN NIGERIA.

ABSTRACT

Background: Tetanus still causes significant morbidity and mortality amongst children in Nigeria despite decades of immunisation with tetanus vaccine.

Objectives: To determine the prevalence, case fatality rate and predictors of fatality amongst school age children treated for tetanus at the University of Port Harcourt Teaching Hospital.

Materials and Methods: This was a retrospective study of all children aged 4 to 17 years treated for tetanus at the University of Port Harcourt Teaching Hospital between January 1, 2009 and December 31, 2019. Data was obtained from the case notes and ward registers. Socio-demographic characteristics, presenting complaints, incubation period, onset interval, number of Diphtheria, Pertussis and Tetanus (DPT) vaccine received at infancy, treatment outcome, duration and cost of hospital stay were obtained, entered into a spread sheet and analysed with SPSS version 20. Results are presented in tables and percentages. The level of significance was set at P value <0.05.

Results: During the period under review, there were 53 children aged 4 to 17 years treated for tetanus, accounting for 0.3% of the total admission. The mean age was 10.79±3.35 years. There were 33 (62.26%) males and 20 (37.74%) females. Majority 26 (49.06%) of the children were of low socioeconomic class. The commonest 28(52.8%) route of infection was broomstick injury. Majority 32(60.3%) of the children were not immunised in infancy. The mean incubation period was 7.34±4.21 days and the mean onset interval was 8.87±10.44 hours. The two most common symptoms were generalized spasms 49 (21.03%) and trismus 47 (20.17%). Short incubation period (≤4 days) and short onset interval (≤4 hours) were significantly associated with higher death rates (p=0.0002;p=0.012). Patients with short incubation period of ≤4 days and short onset interval of≤ 4 hours are more likely to die (p=0.0002; p=0.012).

Conclusion: There was a high tetanus case fatality rate amongst school age children at University of Port Harcourt. Short incubation period and onset interval were associated with

higher mortality. Booster doses of TT containing vaccines should be administered to primary and secondary school children in Port Harcourt to curb the menace.

Keywords: Tetanus, School age, Children, Tetanus toxoid, Vaccine

1. INTRODUCTION

Despite being vaccine preventable, tetanus continues to cause significant morbidity and mortality among children in Nigeria as well as in many developing countries, where immunization rates are still low.[1] The disease is contracted through exposure to the spores of the bacterium *Clostridium tetani*, a gram positive organism which only survives in anaerobic environments.[1] Tetanus spores are commonly found in the environment, especially in soil, dust and animal feaces and easily contaminate wounds. The very potent neurotoxin produced by the spores in contaminated wounds is responsible for the signs and symptoms of the disease.[1]Whilst post neonatal tetanus may follow deep puncture wounds, crush wounds, otitis media, dental infection,[2] maternal and neonatal tetanus follow abortions, unclean deliveries and unhygienic umbilical cord care practices.[1]

Tetanus is characterized by a sudden onset of painful contractions of the muscles of the face, jaw, neck and back, hypertonia and generalized muscle spasms. [3] The case fatality rate for tetanus varies from 10% to 70% globally and 27.4% to 51.0% at the University of Port Harcourt Teaching Hospital, depending on the age of the patient; with most of the deaths occurring during the neonatal period.[4,5,6,7,8]

Tetanus is easily preventable through immunization with tetanus toxoid containing vaccines.[9] The World Health Organization (WHO) recommended 3 primary and 3 booster doses of such vaccines for complete protection for life.[9] The primary doses are to be given at 6, 10 and 14 weeks of age with a minimum interval of 4 weeks in between doses.[9] The 3 booster doses are preferable to be given during the second year of life (12-23 months), 4 -7 years and 9-15 years of age, with at least 4 years interval between the booster doses.[9]

The three primary doses of tetanus toxoid containing vaccines only protect during the first three to four years of life, while the three booster doses provide long term immunity.[4] The recipients antitoxin levels are expected to rise considerably greater than the protective level of 0.1IU/ml after the first 4 doses of TT.[2] In countries where these recommendations have been followed judiciously and where immunisation coverage rates have been consistently high, tetanus incidence have remained low.[1]

Nigeria adopted the WHO's immunisation guideline[9] but only included the 3 primary doses of TT in her immunization schedule and since 1979 children have been receiving the 3 doses of the Tetanus Toxoid vaccines as DPT1,2 and 3 in infancy,[10] without the benefits of the booster doses. Furthermore, Nigeria's immunisation coverage rate has remained consistently low despite several decades of immunisation practice .[11] The recent demographic and health survey revealed that only 31% of Nigeria's infants are fully vaccinated according to the National Programme on Immunisation (NPI) schedule and the coverage rate for DPT 3 was only 50%.[11] Though this represents a slight improvement from the 2013 DPT 3 coverage rate of 38%,[12] it is still not acceptable that 50% of Nigeria's children are not protected against tetanus. Even among those who received the three primary doses of TT in infancy, the antitoxin levels have been known to fall below the minimal protective level during the school age period,[2,5,13,14] predisposing school age children to developing post neonatal tetanus, thus necessitating the recommendation for the administration of pre-school entry and in-school booster doses of TT to school age children.[9] Consequently, despite more than 3 decades of immunisation, school age children in Nigeria still continue to suffer from tetanus, including those ones that received the three doses of tetanus toxoid in infancy.[14]

Reports from several studies in Nigeria showed that school age children accounted for 87% to 95.5% of the cases of post neonatal tetanus cases seen in the health facilities across Nigeria .[8,15,16] Despite knowing this, no research on post neonatal tetanus have targeted school age children to evaluate the impact of the disease on this particular age group. This study therefore aimed to evaluate the prevalence, case fatality rate and predictors of fatality among school age children 4-17 years treated for tetanus at the University of Port Harcourt Teaching Hospital.

2. MATERIALS and METHODS

2.1: Study Site:

University of Port Harcourt Teaching Hospital is a tertiary hospital situated in Port Harcourt the capital of Rivers State in Southern Nigeria. The hospital is a referral centre for most life threatening diseases like tetanus. Department of Paediatrics is one of the major clinical departments in the hospital. The department runs general outpatient and specialist clinics every working day, from where patients are admitted into the children's emergency room and the children's medical wards. All children diagnosed with tetanus are admitted directly into the Tetanus Room within the children's medical ward.

2.2.Methods

This was a descriptive, retrospective cross-sectional study carried out at the Department of Paediatrics of the University of Port Harcourt Teaching Hospital. The ward registers and case notes of all children aged 4 years to 17 years admitted with the clinical diagnosis of tetanus into the tetanus room from January 1, 2009 to December 31, 2019 were retrieved. Information obtained included socio-demographics; presenting complaints; portal of entry; incubation period; onset interval; doses of DPT received during infancy; treatment received; treatment outcome; duration and cost of hospital stay. The social class of the patients was calculated using the educational qualification and occupation of their parents (Oyedeji classification).[17]

2.3.Statistical Analysis

The data obtained was entered into a spreadsheet, coded and analysed with SPSS version 20. Categorical data were presented in the form of frequencies and percentages and summary statistics in means and standard deviations with results presented in tables. Chi-square test was performed to test for association between two or more categorical variables and to determine the level of statistical significance between variables. Bivariate analysis was used (with a two-by-two contingency table) to determine the risk association (using odds ratio, ORs). All ORs were reported with their 95% confidence interval (CI) and corresponding p-values. An observation was said to be statistically significant if the p-value was ≤ to 0.05 at a 95% CI.

3. RESULTS

During the period under review, there were 16,980 admissions of which 53 were cases of tetanus amongst children aged 4 to 17 years, accounting for 0.3% of admissions. The mean age was 10.79±3.35 years. About half 28 (52.83%) of them were in the 10 to 15 years age group. Thirty three (62.26%) were males and 20 (37.74%) were females with male to female ratio of 1.7:1. Majority 29(54.72%) were in primary school. Most of the children 26 (49.06%) were of low socioeconomic class (Table 1). Majority of the fathers 32(60.38%) and mothers 25 (47.17%) had secondary education. The most common occupation amongst the fathers 12 (22.64%) and mothers 19 (35.85%) was trading.

Figure 1 showed the trend in tetanus prevalence, with the highest prevalence in 2017 and 2018.

Table 2 showed that the commonest route of the infection was broomstick injury 28 (52.8%), followed by injuries from other penetrating objects 11(20.8%) and road traffic accidents11 (20.8%). Majority 32 (60.3%) of the children were not immunised in infancy.

The mean incubation period was 7.34±4.21 days and the mean onset interval was 8.87± 10.44 hours. The most common complaint at presentation were: Spasms (21.03%); inability to open mouth (20.17%) and neck stiffness (16.31%).

Thirty six (67.92%) children recovered and were discharged home; 13 (24.53%) died; 1 (1.89%) developed deep bed sores and was referred to the Burns and Plastics Unit of the hospital; 1 (1.89%) absconded with the parents, and the parents of 2 (3.77%) children signed against medical advice. The mean duration of hospital stay was 22.94±13.53 days and the average cost of hospital stay and treatment was 142, 571.69±70,784 naira (593 USD).

Figure 2 showed that the death rate from tetanus dropped from 30.8% in 2010 to 7.7% from 2016 to 2019.

Table 3 showed that gender (p=0.654) and socioeconomic status (p=0.937) were not significantly associated with death. Patients who had incubation periods of 4 days and below (≤4 days) had a significantly higher fatality rate compared to those with incubation periods of 5 days and above (≥5 days) (76.92 vs. 23.08; p=0.0002). Patients who had incubation period of 4 days and below were 15.71 times more likely to die compared to those with incubation periods of 5 days and above (OR=15.71; p=0.0002; 95CI: 3.41-72.31). Patients who had onset interval of 4 hours and

below (1-4 hrs) had a significantly higher fatality rate compared to those with onset interval of 5 hours and above (≥5 hrs) (43.48% vs. 23.08%; p=0.012) . Patients who had onset interval of 4 hours and below were 6.92 times more likely to die compared to those with onset interval of 5 hours and above (OR=6.92; p=0.012; 95%CI: 1.62-29.51) (Table 3).

Patients with duration of hospital stay of 10 days and below (≤10 days) had a significantly higher case fatality rates, compared to those with duration of hospital stay of 11 days and above (≥11 days) (76.92% vs. 23.08%; p=0.001). Patients with duration of hospital stay of 10 days and below were 28.33 times more likely to die compared to those with duration of hospital stay of 11 days and above (≥11 days) (OR=28.33; p=0.001; 95%CI: 5.42-148.23) (Table 3).

4. DISCUSSION

Despite decades of immunisation, tetanus is still prevalent in Nigeria with a significantly high morbidity and mortality among children.[8,15,16, 18] This study revealed a prevalence of 0.3%, which is similar to reports from various studies in Nigeria.[14,18,19,20,21,22,23]

There was a male preponderance which is in accordance with the findings of previous studies in Nigeria and India.[8,15,18,19,24]Perhaps the fact that males are more adventurous and so are more likely to sustain injuries on their lower limbs may explain the male preponderance observed. Most of the children belong to families in the lower socioeconomic class, which is in complete agreement with the report of a previous study in Nigeria[15]and which lends credence to the likelihood that they may have engaged in risky habits like walking and playing barefooted as is common among children from lowly backgrounds.

Findings from this study and other studies in Nigeria showed that broomstick injuries are the commonest route of infection with Clostridium tetanus in older children.[8,14,15] This is probably because broomsticks are commonly used to sweep floors in Nigeria and so are commonly found in homes and schools. These brooms get easily contaminated with the spores of Clostridium tetanus when used to sweep floors. Flogging children with brooms, as is commonly done in homes and schools in Nigeria[25] constitutes a significant risk factor for tetanus infection as the strands easily penetrate the skin, introducing the tetanus spores into the broken skin. However, a study done in India reported chronic suppurative otitis media as the most common portal of entry of tetanus,[19] indicating differences in cultural practices between India and Nigeria.

Lack of immunisation with primary and booster doses of TT or incomplete immunisation have been identified as major risk factors for the persistence of post neonatal tetanus in Nigeria. [5,15,26,27,28] In this study, as much as 79.2% of the children were either not immunised or were incompletely immunised with TT containing vaccines in infancy, which is consistent with the reports from other studies in Nigeria.[8,14,15] Also consistent with the report of previous studies in Nigeria[12,13,15] is our observation that no child received the booster doses of TT recommended by WHO.[9] The fact that a few children received the three primary doses of TT containing vaccines in infancy and still came down with tetanus is a serious indicator of the inadequacy of the primary doses of TT in protecting school age children against tetanus and supports the clamoring for the inclusion of booster doses of TT containing vaccines in Nigeria's NPI schedule.

The mean incubation period of 7.34±4.21 days and mean onset interval of 8.87±10.44 hours are within the range of what have been reported in other studies.[14,27]Generalised spasms, inability to open the mouth (trismus) and neck stiffness were the common symptoms amongst the patients, which is similar to previous reports.[21,27]

Ill health is one of the very common reasons for absenteeism in Primary schools in Nigeria [29]and our findings corroborated this statement. The average duration of hospital stay was 22.94±13.56 days, which is 22 days spent away from school. If regular school attendance is a pre-requisite for acquiring skills and knowledge for good academic success,[29] it then follows that this long duration of hospital stay will impact negatively on the academic achievements of these children. Other studies in Nigeria showed similar duration of hospital stay.[8,14,16]

The average cost of hospital stay among the patients in this study is 142,571.69±70,784 naira, an equivalent of 593 dollars. This is quite a lot of money in a country where half (90 million) of the population live in extreme poverty, earning less than 1.90 United States dollars per day.[30] With less than 5% of the population of Nigeria registered with the National Health Insurance Scheme (NHIS),[31] most families in Nigeria pay their medical bills out of their pockets, further impoverishing them.[32] This situation is even worse for families in the low socioeconomic class, like majority of the families in this study who may not have been able to foot their medical bills without assistance.

Tetanus death rate is said to be high in countries like Nigeria with very poor immunisation coverage rates.[4,5,6] The high case fatality rate (24.53%) is within the range of 4.1%-50%

reported in other studies in Nigeria and India[15,16,19,24, 32] This may be related to the fact that majority of the study sites are tertiary health facilities where critically ill patients requiring intensive care are referred. Our result further showed a consistent reduction in the tetanus case fatality rates from 30.8% in 2010 to 7.7% in 2019, indicating a much improved tetanus case management.

Short incubation periods and onset intervals are associated with higher fatality rates in this study, which is consistent with what is generally known about tetanus and also with what has been reported in other studies.[18,33,34] Patients with short incubation periods of ≤4 days and short onset intervals of ≤4 hours were 15.71 and 6.92 times more likely to die from the disease respectively. Contrary to our observation, Ajite et al found no positive correlation between incubation period and onset interval with the clinical outcome and opined that both factors may not be useful tools to determine prognosis in post neonatal tetanus.[12]

The study further revealed a higher mortality rate among patients with short duration of hospital stay (≤10 days). This observation may be related to the natural history of the disease in which symptoms are severe in the first and second week of the onset of the disease, coinciding with the half-life of the circulating toxins.[14,34] It therefore follows that majority of the deaths are likely to occur within the first and second week of the onset of the disease.

CONCLUSION

Tetanus still causes high morbidity and mortality among school age children in Port Harcourt, even among those who received the three primary doses of TT during infancy. There is need to strengthen the routine immunisation programme in Port Harcourt to ensure that every child receives the three primary doses of TT in infancy. Booster doses of TT should be administered to primary and secondary school children to prevent the disease. Extensive campaign against flogging children with broomstick should be conducted in Port Harcourt to prevent tetanus.

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Table 1: Sociodemographic characteristics of the patients.

CHARACTERISTICS	FREQUENCY (53)	PERCENTAGE (%)
Age (Years)		
4-9	20	37.74
10-15	28	52.83
≥16	5	9.43
Sex		
Male	33	62.26
Female	20	37.74
Educational Level		
Secondary	22	41.51
Primary	29	54.72
Nursery	1	1.89
None	1	1.89
Family Socioeconomic Class		
High social class	3	5.66
Middle social class	24	45.28
Low social class	26	49.06

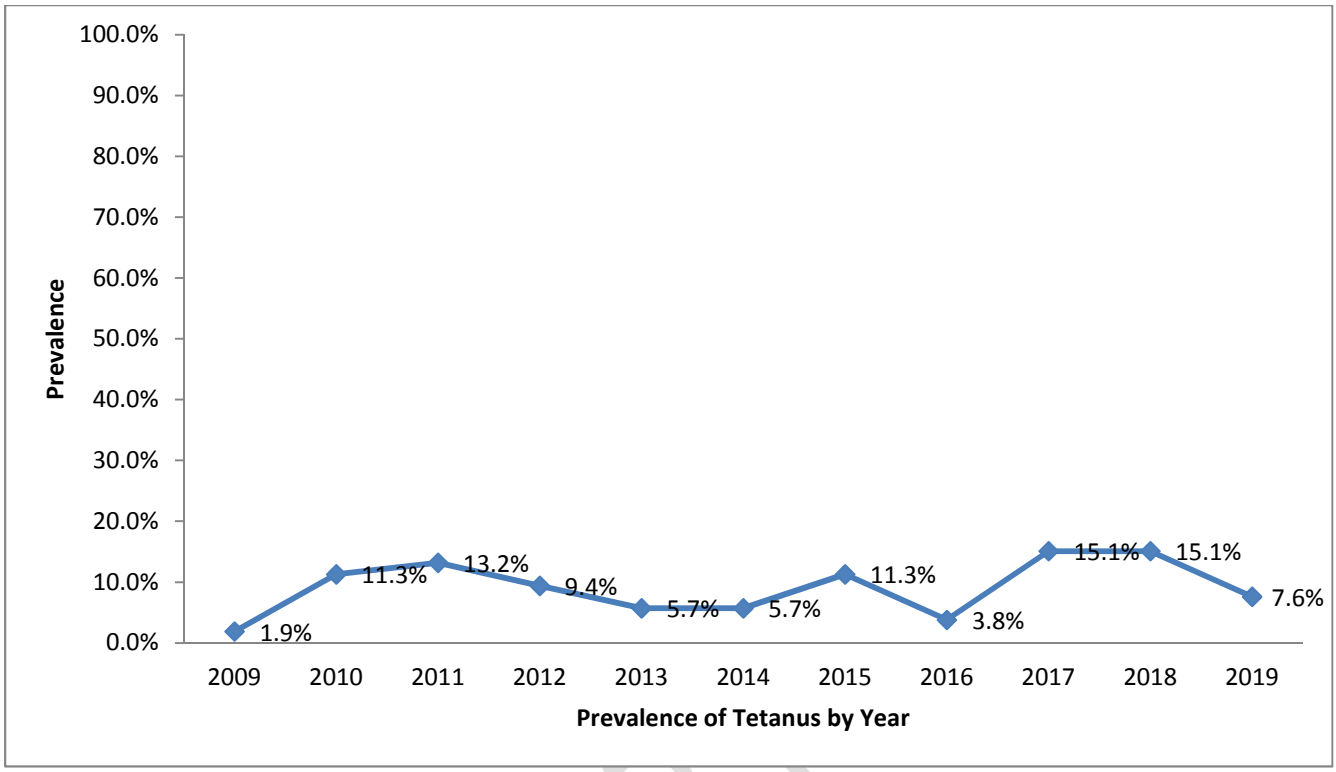

Figure 1: Trend in Tetanus prevalence from 2009 to 2019.

Table 2: Route of infection and Immunisation status of the patients

ROUTE	FREQUENCY (53)	PERCENTAGE
Broomstick injury	28	52.8
Injuries from road traffic accidents	11	20.8
Other deep penetrating injury on the lower limbs	11	20.8
Chronic ear infection	2	3.8
Tooth extraction	1	1.8
TT Immunisation status of the children		
Completed immunization in infancy	11	20.8
Incomplete immunization in infancy	10	18.9
Not immunised	32	60.3
Received booster doses of TT	0	0.0

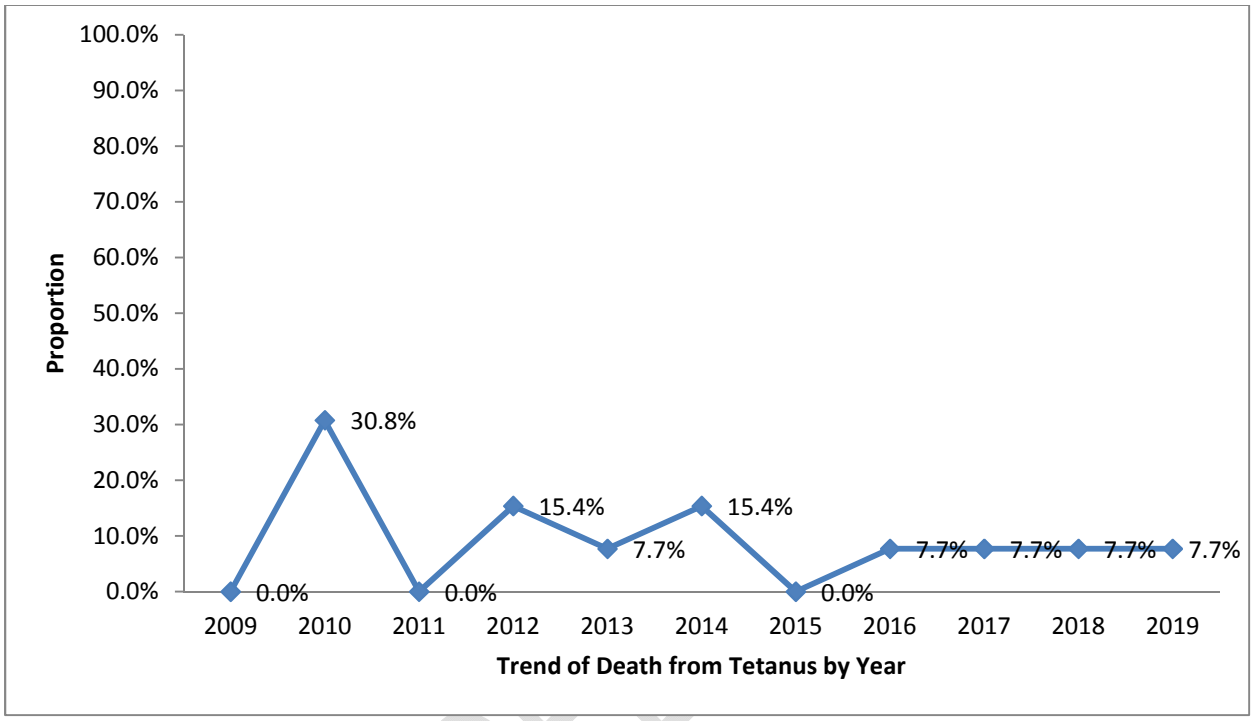

Figure 2: **Trend of Death from Tetanus by Year**

Table 3: Association of Gender, Socioeconomic status, Onset interval, Incubation period and TT immunisation status of the patients with Number of Deaths

CHARACTERISTICS	DEATH (%)		TOTAL	χ^2 *(p-value)*	OR (95% CI)
Sex	**YES**	**NO**			
Male	7 (53.85)	26 (65.00)	33 (62.26)	0.15	0.63
Female	6 (46.15)	14 (35.00)	20 (37.74)	(0.654)	(0.18-2.24)
Socioeconomic class					
Low Class	7 (53.85)	19 (47.50)	26 (49.06)	0.006	1.29
Middle/High class	6 (46.2)	21 (52.50)	27 (50.94)	(0.937)	(0.37-4.52)
Incubation period					

≤4 days	10 (76.92)	**7** (17.50)	17 (32.08)	13.29	15.71
≥	3 (23.08)	33 (82.50)	36 (67.92)	(0.0002)*	(3.41-72.31)
Onset interval					
1-4 hours	10 (43.48)	13 (56.52)	23 (43.40)	6.18	6.92
≥5 hours	3 (23.08)	27 (67.50)	30 (56.60)	(0.012)*	(1.62-29.51)
Duration of hospital stay					
≤10 days	10 (76.92)	6 (15.00)	16 (30.19)	18.24	28.33
≥11 days	3 (23.08)	34 (85.00)	37 (69.81)	(0.001)*	(5.42-148.23
TT immunisation status in infancy					
Completed	2 (15.38)	9 (22.50)	11 (20.75)		
Incomplete	3 (23.08)	7 (17.50)	10 (18.87)	0.405	
Not immunised	8 (61.54)	24 (60.0)	32 (60.38)	(0.817)	

***=statistically significant.**