EPIDEMIOLOGY OF PULMONARY TUBERCULOSIS IN THE UNIVERSITY OF PORT-HARCOURT TEACHING HOSPITAL: AGE RELATED DISPARITIES

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Abstract: This study investigated the age-related disparities in the prevalence of pulmonary Tuberculosis in the Port-Harcourt metropolis of Rivers-State, Nigeria. A total of 1038 sputum samples were collected from in and out patients of the University of Port- Harcourt Teaching Hospital for a period of one year. Three (3) deep cough samples were collected per patient over a period of three days. The samples were examined macroscopically and microscopically. The Ziehl-Neelsen technique for the detection of *Mycobacterium tuberculosis* in sputum was carried out. The sputum samples were also cultured using MacConkey, Chocolate and Blood agar. Biochemical tests were used for identification. Of the 1038 samples collected, 348(33.5%) tested positive and 690(66.5%) were negative for acid bacilli. From this study, the age ranges of subjects were 1 to 80 years. The study showed that there was a significant difference between age groups for carriage rates of AFB between children and more elderly adults (46.3% vs. 8.8%, P <0.05), between adolescents and more elderly adults (31.1% vs. 8.8%, P <0.05) and between younger adults and more elderly adults (38.3% vs. 8.8%, P <0.05). The study showed that there was no significant difference between age groups for carriage rates of AFB between children with positive and negative AFB smears (46.3% vs. 53.7%, P >0.05) and between younger adults with positive and negative AFB smears (38.3% vs. 61.7%, P >0.05). The study also showed that there was a significant difference between age groups for carriage rates of AFB between adolescents with positive and negative AFB smears (31.1% vs. 68.9%, P <0.05), and between more elderly adults with positive and negative AFB smears (8.8% vs. 91.2%, P <0.05). In conclusion, the 33.5% reported in this study assumed significance and is also an indicative of an emerging epidemic in Port Harcourt, Nigeria. Continued research on age and tuberculosis need to be geared in the direction of ascertaining the magnitude of age disparities in tuberculosis, from contracting the disease to successful recovery and rehabilitation and examining the causes underlying any age disparities, to understand the extent to which these are biological, social/cultural or operational, through comparative studies in disease settings.

N. Frank-Peterside, A.P. Onwuka and Okonko IO. **EPIDEMIOLOGY OF PULMONARY TUBERCULOSIS IN THE UNIVERSITY OF PORT-HARCOURT TEACHING HOSPITAL: AGE RELATED DISPARITIES.** *Rep Opinion* 2012;4(5):58-64]. (ISSN: 1553-9873). http://www.sciencepub.net/report. 10

Keywords: Epidemiology, Pulmonary Tuberculosis, Age, Disparities, Ziehl-Neelsen technique

1. Introduction

Africa is facing the worst tuberculosis epidemic since the advent of the antibiotic era. Driven by a generalized human immunodeficiency virus (HIV) epidemic and compounded by weak health care systems, inadequate laboratories, and conditions that promote transmission of infection, this devastating situation has steadily worsened, exacerbated by the emergence of drug-resistant strains of tuberculosis (Chaisson and Martinson, 2008; Okonko et al., 2012). Tuberculosis can either be acute and short lived or chronic and long term. Tuberculosis spreads very quickly and was a leading cause of death in Europe (CDC, 2000). At the turn of the twentieth century, more than 80% of the people in the United States were infected before age 20 years, and tuberculosis was the single most common cause of death. After decades of steady decline, tuberculosis cases increased in 1986 in the United States (WHO, 2000).

Tuberculosis (TB) is caused by *Mycobacterium tuberculosis*. The pathogen is a slow growing bacterium that is believed to have evolved from soil bacterium more than 10,000 years ago (Dwivedi et al., 2005). It is a respiratory disease affecting nearly 32% of the world's population (Dye and Williams, 2003). Among communicable diseases, TB is the second leading cause of death worldwide, killing nearly 2 million people each year (Dwivedi et al., 2005) with most

cases occurring in developing countries. Of all the new tuberculosis cases reported each year, 95% occur in developing countries. Most of these countries, which are plagued by poverty and poor sanitation, have begun to see an increase in the number of TB infected cases (Haskins et al., 2009).

The recent increase in the prevalence of tuberculosis (TB) globally, particularly in Africa has been attributed to the increase in the number of human immune deficiency virus (HIV) infected patients (Rogeaux *et al.,* 1993). Presently, the prevalence of pulmonary tuberculosis has been on the increase. This might among other factors be related to the co-infection of HIV and TB. The occurrence of TB is linked to dense population, poor nutrition and poor sanitation (Byarugaba, 2004). Risk factors associated with the spread of Tuberculosis include, history of TB in the family, occupation, unfavourable living conditions, number of people in the family, HIV status, work related migration phenomenon, as well as age and gender related disparities. This study is designed to investigate the activities of Tuberculosis in our locality as it relates to age.

2. MATERIALS AND METHODS

2.1. Study population

A total of 1038 sputum samples were collected from in- and out- patients of the University of Port-Harcourt Teaching Hospital (UPTH) for a period of 1year, January, 2007 to January, 2008. The patients had productive cough, consistently for a period of 3weeks and had gone to the D.O.T. clinic. They were examined and referred to the UPTH. They consisted of 628males and 410 females of ages 1-80 years and were all reporting for the first time so there were no exclusion factors.

2.2. Sample collections

Three samples were collected per patient after a deep cough over a period of 3 days according to Guidelines of the National Tuberculosis Control Programme. Two samples at least must be positive for Acid Fast Bacilli (AFBS) in order to confirm a diagnosis of sputum, positive for pulmonary diagnosis. Examination of the specimens was done at the UPTH, Microbiology Department Laboratory. Ethical consent was sought for and was received.

2.3. Bacteriological analysis

The sputum samples were examined macroscopically and described and identified according to their appearance. The sputum was also examined microscopically after Gramm staining. The Ziehl-Neelsen smear method of detecting Acid Fast Bacilli was also used. Cultivation and sensitivity testing for *M. tuberculosis* was performed on MacConkey agar, Chocolate agar as well as Blood agar as described by Cheesbrough (2006).The organism isolated was identified using an array of tests as described by Cheesbrough (2006). The modified Kirby-Bauer sensitivity testing techniques as described by Cheesbrough (2006) was adopted for antimicrobial sensitivity testing.

2.4. Data Analysis

Data generated in these studies were analyzed using the Chi-square and Student t-test. The differences were considered significant where p-value was less than 0.05.

3. RESULTS ANALYSIS

The following results were obtained from the study carried out in the University of Port Harcourt Teaching Hospital, Microbiology Department from January 2007 to January 2008. A total of 1,038 subjects were sampled for Acid Fast Bacilli (x3) using standard methods. The subjects were classified into three groups; the children, adolescents and adults based on their age and gender respectively. Their age was between 1 year and 80 years but some subjects those ages were not disclosed but fall within the adult age group were grouped as adults. This is shown in Table 1. It showed that children ages 1-15 years (46.3%) had the highest prevalence of AFB (x3) positive smears, of which male children (52.0%) had higher prevalence compared to their female counterparts (48.0%).

The number and percentage of adolescents within the age group of 16-18 years that were AFB (x3) smear positive were 38(31.1%), out of which 9(23.7%) subjects were males and 29 (76.3%) females. The number and percentage of adults that tested positive to AFB (x3) were 285 (33.1%), out of which 127 (44.6%) were male subjects and 158 (55.4%) were female subjects. Among adults within the age group of 20-40 years, the number and percentage of positive smears was 206(38.3%), out of which the male subjects were 85(46.2%) and the female subjects 121(58.7%). Also, among adults within the age group of 41-60, the number and percentage of positive smears was 39(20.9%), out of which the male subjects had 18 (46.2%) and the female subjects 21 (53.8%). Furthermore, the number and percentage of positive smears among adults within the age group of 61-80 years was 5(8.8%), out of which the male subjects had 4(80.0%) and the female subjects 1(20.0%). The

percentage of the adults whose ages were not disclosed but had positive smear was 35(43.2%), out of which the male subjects were 20(57.1%) and the female subjects, 15(42.9%) as shown in Table 1. The study showed that there was a significant difference between age groups for carriage rates of AFB between children and more elderly adults (46.3% vs. 8.8%, P <0.05), between adolescents and more elderly adults (31.1% vs. 8.8%, P <0.05) and between younger adults and more elderly adults (38.3% vs. 8.8%, P <0.05).

Table 1: Distribution of Subjects for Pulmonary Tuberculosis Screening in Relation to Ages

Age Groups (Years)	No. Tested (%)	No. Positive (%)	Males (%)	Females (%)
1-15(children)	54(5.2)	25(46.3)	13(52.0)	12(48.0)
16-18(adolescents)	122(11.8)	38(31.1)	9(23.7)	29(76.3)
20 – 40(adult)	538(51.8)	206(38.3)	85(41.3)	121(58.7)
41-60(adult)	186(17.9)	39(20.9)	18(46.2)	21(53.8)
61-80(adult)	57(5.5)	5(8.8)	4(80.0)	1(20.0)
Adults (without giving age)	81(7.8)	35(43.2)	20(57.1)	15(42.9)
Total	**1,038(100.0)**	**348(33.5)**	**149(42.8)**	**199(57.2)**

Table 2 shows the total number and percentage of subjects that were negative for acid bacilli (x3) in relation to age groups. The number and percentage of negative smears among the children within the age group of 1 – 15 years were 29 (53.7%), out of which the male subjects were 21 (72.4%) and the female subjects were 8 (27.6%). The number and percentage adolescents age group 16-18 years were 84(68.9%) out of which the males subjects were 64(76.2%) and the female subjects were 20(23.8%). Also, the number and percentage negative smears among adults within the age group 21-40 years was 332 (61.7%), out of which the male subjects had 245 (73.8%) and the female subjects 87(26.2%). Furthermore, the number and percentage of negative smears among adults within the age group of 41-60 years were 147(79.1%), out of which the male subject had 118(80.3%) and 29(19.7%) were females. The number and percentage of negative smears among adults within the age group of 61-80 years was 52 (91.2%), out of which 31 (59.6%) were male subjects while 21(40.4%) were female subjects. The number and percentage of negative smears among some adults whose age were not disclosed was 46(56.8%), out which the male subjects had no negative smears (0.0%) but the 46(100.0%) females had negative smears (Table 2).

Table 2: Percentage of Negative Smears among Subjects in relation to age groups

Age Groups (Years)	No. Tested (%)	No. Negative (%)	Males (%)	Females (%)
1-15(children)	54(5.2)	29(53.7)	21(72.4)	8(27.6)
16-18(adolescents)	122(11.8)	84(68.9)	64(76.2)	20(23.8)
20 – 40(adult)	538(51.8)	332(61.7)	245(73.8)	87(26.2)
41-60(adult)	186(17.9)	147(79.1)	118(80.3)	29(19.7)
61-80(adult)	57(5.5)	52(91.2)	31(59.6)	21(40.4)
Adults (without giving age)	81(7.8)	46(56.8)	0(0.0)	46(100.0)
Total	**1,038(100.0)**	**690(66.5)**	**479(69.4)**	**211(30.6)**

Table 3 shows comparative number and percentage of positive and negative AFB smears among Subjects. The study showed that there was no significant difference between age groups for carriage rates of AFB between children with positive and negative AFB smears (46.3% vs. 53.7%, P >0.05) and between younger adults with positive and negative AFB smears (38.3% vs. 61.7%, P >0.05). The study also showed that there was a significant difference between age groups for carriage rates of AFB between adolescents with positive and negative AFB smears (31.1% vs. 68.9%, P <0.05), and between more elderly adults with positive and negative AFB smears (8.8% vs. 91.2%, P <0.05). Other details are shown in Table 3.

Table 3: Comparative number and percentage of positive and negative AFB smears among Subjects

Age Groups (Years)	No. Tested (%)	No. Positive (%)	No. Negative (%)
1-15(children)	54(5.2)	25(46.3)*	29(53.7)*
16-18(adolescents)	122(11.8)	38(31.1)**	84(68.9)**
20 – 40(adult)	538(51.8)	206(38.3)*	332(61.7)*
41-60(adult)	186(17.9)	39(20.9)**	147(79.1)**
61-80(adult)	57(5.5)	5(8.8)**	52(91.2)**
Adults (without giving age)	81(7.8)	35(43.2)*	46(56.8)*
Total	**1,038(100.0)**	**348(33.5)**	**690(66.5)**

Keys: * = Not Significant (P>0.05), ** = Significant (P<0.05),

Table 4 shows the summary of the statistics obtained from the pattern of pulmonary tuberculosis among male subjects that had positive smears. The mean among the children between the age group of 1-5 years was 4.33±2.03 while among the adolescents and adults it was 4.50±2.50 and 35.67±24.99 respectively. Also the variance among the children between the age group of 1-15 years was 12.33 while among the adolescents and the adults it was 12.50 and 18.74. Furthermore, the standard deviation among the children within the age group mentioned above was 3.51 and 3.54 among the adolescents, while among the adults it was 43.29. Table 4 shows the summary of the statistics obtained from the pattern of pulmonary tuberculosis among female subjects that had positive smears. The mean among the children between 1-15 years was 4.00 ± 1.53 while among the adolescents and the adult it was 14.50±3.5 and 47.67±37.12 respectively. Also the variance among the children of 1-15 years was 7.00 while among the adolescents and adults it was 24.5 and 41.33 respectively. The standard deviation among the children was 265 while among the adolescents and the adults it was 4.93 and 64.29 respectively.

Table 4: The Statistics of Pattern of Pulmonary Tuberculosis among Sampled Subjects (Positive Smears)

Statistics	Children (1-15) Years	Adolescents (16-21) Years	Adult (22-80) Years
Male subjects			
Mean	4.33±2.03	4.50±2.50	35.67±24.99
Variance	12.33	12.50	18.74
Standard deviation	3.51	43.29	43.29
Female subjects			
Mean	400±1.53	14.50±3.5	47.67±37.12
Variance	700	24.5	41.33
Standard deviation	2.65	4.95	64.29

4. DISCUSSION

Infections caused by *Mycobacterium tuberculosis* are among the commonest in our hospitals, especially found in patients with suppressed immune system activity as a result of HIV. TB is a leading cause of morbidity and mortality among people living with HIV (PLWHIV). The WHO estimated that TB accounted for 30% of AIDS death in 1999 (WHO, 1999). In Nigeria, tuberculosis is common; a prevalence rate of 9.2% has been reported in one study and a case fatality rate of 12% in another (Salami and Oluboye, 2003). A total of 1,038 subjects were sampled for Acid Fast Bacilli (x3) using standard methods; of which 348 representing 33.5% were positive for Acid fast Bacilli (3x). In line with the findings of Akpaka et al. (2006), productive cough, fever, weight loss and diarrhea were prevalent symptoms in patients with TB, and these symptoms appear to be indicators that should raise the suspicion of this clinical condition. The 33.5% reported in this study is higher than the 23.0% who were reported to be positive for AFB by both microscopy and culture in a study by Idigbe et al. (1998) among prison inmates and the 7.0% recorded in the general population in Lagos. It is also higher than the 15.0% reported in a study by Okonko et al. (2012) among subjects on directly observed treatment regimen (DOTS) at Abeokuta, Nigeria.

From this study, the age ranges of subjects were 1 to 80 years. In a study by Bello (2010), majority (75.3%) of the patients were within age bracket of 16 - 45 years. The study showed that there was a significant difference between age groups for carriage rates of AFB between children and more elderly adults (46.3% vs. 8.8%, P <0.05), between adolescents and more elderly adults (31.1% vs. 8.8%, P <0.05) and between younger adults and more elderly adults (38.3% vs. 8.8%, P <0.05). The study showed that there was no

significant difference between age groups for carriage rates of AFB between children with positive and negative AFB smears (46.3% vs. 53.7%, P >0.05) and between younger adults with positive and negative AFB smears (38.3% vs. 61.7%, P >0.05). The study also showed that there was a significant difference between age groups for carriage rates of AFB between adolescents with positive and negative AFB smears (31.1% vs. 68.9%, P <0.05), and between more elderly adults with positive and negative AFB smears (8.8% vs. 91.2%, P <0.05). This is similar to the findings of Okonko et al. (2012) who reported that TB infection was higher in subjects less than 40 years of age. This is in agreement with what was reported by Akpaka et al. (2006) that the prevalence of HIV coinfection among patients with tuberculosis was highest in patients aged 30-39 years and that and the prevalence of TB without HIV coinfection was also highest in this age group in their study in Jamaica. Previous studies have also reported the highest prevalence of TB in this age group (Eriki et al., 1991; Holmes et al., 1998; Bruchfeld et al., 2002). Obiora et al. (2004) also reported higher infection rate for TB among <20 years and 21–30 years old subjects in Benin and Irrua, Nigeria. Nnorom et al. (1996) reported higher infection rate for TB among 16-30 age group in urban and rural communities in Nigeria.

The mean (± SD) age of the patients in this study is similar to the observations of other workers (Idoko et al., 1994; Wokoma et al., 1997; Habib et al., 1998; Ahidjo et al., 2005) and Hsieh *et al.* (1996) in Taiwan who reported a similar age distribution among HIV–associated PTB patients. This corroborates the fact that HIV and TB is more common in people in their productive and sexually active age groups (Dolin et al., 1994; Ahidjo et al., 2005). Similar studies carried out in poverty stricken areas of Latin America reported that the age-group distribution found for pulmonary tuberculosis was consistent with other studies, affirming that in developing countries, the greatest concentration of pulmonary tuberculosis patients lies in the age group of 15-50 years (Romero et al., 2007). According to the study carried out by Romero et al. (2007), age was significant associated with chronic cough at P>0.001 whereby 24.3% of the patients were aged $\geq$ 45 years. In the total population, only 16.5% were aged $\geq$ 45 year (Remero et al., 2007).

Among male subjects, within the age group of 61-80 years, the prevalence rate of pulmonary tuberculosis was higher 4(80.0%) than other age groups. This is deviates from the work done by Romero et al. (2007) where the male subjects aged 35-44 year had a high prevalence. The World Health Organization for National Tuberculosis Programme on the management of childhood tuberculosis provides guidance on the effective management of childhood tuberculosis as part of routine (NTP) activities (WHO, 2006). Research plays an important role in the implementation of recommended policies for effective management of childhood tuberculosis as part of routine NTP activities.

5. CONCLUSION

This study has shown that the level of pulmonary tuberculosis infection differ between male and female of diverse age groups. Despite this disparity, mortality from tuberculosis is similar among males and females in Africa (WHO, 1999). Among younger age groups, female patients were more infected with pulmonary tuberculosis than males and the same was found in older age groups. Tuberculosis is responsible for more female deaths around the earth than any other infectious disease, including malaria and AIDS (Murray, 1990). In addition, studies have suggested that progression from tuberculosis infection to disease may be faster in women of reproductive age than men of the same age (Murray, 1991).

In conclusion, the 33.5% reported in this study assumed significance and is also an indicative of an emerging epidemic in Port Harcourt, Nigeria. The modest age group differences in the presentation of pulmonary tuberculosis in the one year outcome of this study suggests an impetus for larger and longer studies in this area, or studies with a different design example, case control studies. Continued research on age and tuberculosis need to be geared in the direction of ascertaining the magnitude of age disparities in tuberculosis, from contracting the disease to successful recovery and rehabilitation, starting with 1) ensuring that all current data on progress of global control of tuberculosis is age disaggregated, 2) re-examining age disaggregated data from surveys and data maintained by tuberculosis programmes, and 3) examining the causes underlying any age disparities, to understand the extent to which these are biological, social/cultural or operational, through comparative studies in disease settings.

ACKNOWLEDGEMENTS

We thank all participants who volunteered and those who participated in this study. The authors express their sincere appreciation to the management and staff of Department of Medical Microbiology & Parasitology, University of Port Harcourt Teaching Hospital, Choba, Rivers State,

Nigeria, for the assistance received from the Staff of Medical Laboratory Unit during this research.

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4/22/2012