***Original Research Article***

**Prevalence of Tuberculosis and Associated Socio-economic Determinants Among Patients Attending Immanuel General Hospital Eket, Akwa Ibom State**

**ABSTRACT**

Tuberculosis is one of the top causes of mortality especially in countries with low socio-economic status. This study was carried out to investigate the prevalence of tuberculosis and associated socio-economic determinants among patients attending Immanuel General Hospital in Eket, Akwa Ibom State. A cross-sectional study was conducted among 150 patients with presumptive tuberculosis diagnosis within a period of 12 months at Immanuel General Hospital Eket (IGHE). Deep-cough sputum samples were collected from patients who were able to expectorate and processed according to standard bacteriological method. Microscopic detection of acid-fast bacilli was carried by Zeihl Neelsen method, while *Mycobacterium tuberculosis* were cultured in Lowenstein-Jensen (LJ) medium and colonies identity were further confirmed using SD BIOLINE rapid diagnostic test. Data for the study was collected with the aid of a structured questionnaire and analyzed using SPSS software version 27. p-value less than 0.05 were considered to be statistically significant. Out of 150 sputum samples, 36% were AFB positive while 27.3% were culture-positive for *Mycobacterium tuberculosis.* Tuberculosis infection rate was higher in males (29.4%) than females (21.9%) and significantly associated with age of patients (*P* = .02). The study findings also revealed high TB prevalence and risk of infection among the employed patients (*P* < .001; OR=29.7 at 95% C.I.), and among other socioeconomic risk factors like family size (*P* = .001), number of people sleeping in a room (*P* < .001), employment status (*P* < .001), income level (*P* = .003), meals per day (*P* = .001), and previous TB exposure (*P* < .001) of patients. The prevalence of TB is high in IGHE and is significantly associated with some socioeconomic risk factors. Efforts should be made to reduce TB prevalence by improving the socioeconomic status of people in Eket Local Government Area of Akwa Ibom State.

**Key words:** Tuberculosis, acid-fast bacilli, socioeconomic determinants, age, poverty

1. **INTRODUCTION**

Tuberculosis (TB) remains a major public health problem in many underdeveloped and developing countries of the world [1]. The increase in TB problem correlate with an increase in countries, particularly in sub-Saharan Africa where intricate socio-economic factors such as malnutrition, poverty, homelessness, overcrowding, poor and delayed diagnosis, and poor drug susceptibility testing procedures are experienced [2]. This favours high TB prevalence with concomitant increase in mortality and morbidity rates. According to the 2022 statistics, 10.6 million people had TB infection worldwide - these includes 5.8 million men, 3.5 million women and 1.3 million children [1]. In the same year, the total number of TB-related deaths, including those in people living with HIV was 1.3 million. The net decrease in TB-related deaths from 2015 - 2022 was 19%, falling far short of the WHO End TB Strategy Milestone of a 75% reduction by 2025 [1].

According to World Health Organization reports, Nigeria ranked 6th among the nations with the highest number of TB cases and contributes an estimated 4.4% to the globally TB cases in 2021 [3]. The prevalence of TB is worsened in Nigeria when there is high prevalence of HIV infections. People with HIV are more vulnerable to active TB. In estimation, 63,000 Nigerians who are HIV/AIDS positive develops TB easily and 39,000 Nigerians died from TB annually [4]. The prevalence of TB increases significantly due to poor economic outcome that has existed among the people [5].

Tuberculosis detection cases are still at increase in many Nigerian states in recent years, despite concerted efforts to stem the tide [6]. The control of the disease in Nigeria is coordinated by the national tuberculosis and leprosy control program in line with the ‘stop TB partnership’ initiatives whose ultimate target is to eliminate TB as a public health problem to less than one case per million population by the year 2050. However, TB cases continue to be on the increase, causing disruptions to trade and commerce and straining the already limited resources in every parts of the country [7]. In 2014, 82 fresh cases of tuberculosis infection were reported in Immanuel General Hospital, Eket between January and December [8].

As reported in studies, some socio-economic determinants contribute the high TB cases recorded in many resource-constraint settings. Among these determinants, education, gross domestic savings, household income, and gross domestic product per capita top the list for TB prevalence in Nigeria [6]. The socio-economic status (SES) of individuals has been shown to influence a person’s susceptibility to TB. The burden of TB follows a strong socio-economic gradient between and within countries, with the poorest socio-economic status being most at risk [9]. People with low SES are exposed to several risk factors such as malnutrition, indoor air pollution, alcohol which increase their risk for TB. It has been reported that socio-economic determinants like drug abuse, poverty, inaccessibility of health care system, lack of health workers, treatment distance and homelessness may induce treatment failure and subsequently, increase incidence of TB prevalence [10]. There is dearth of epidemiological data regarding the role of socio-economic factors in TB prevalence in Eket Local Government Area of Akwa Ibom State. Considering the reports of high rate of TB prevalence in the state and other neighbouring regions of the country [9,11,12,13], it is important to investigate the socioeconomic determinants of TB in the area, as a means to finding a solution to curb the menace. Therefore, this study was carried out to determine the prevalence of tuberculosis and associated socio-economic determinants among patients attending Immanuel General Hospital Eket in Akwa Ibom State.

1. **MATERIALS AND METHODS**

**2.1 Study design and setting:** The study was a descriptive cross-sectional study involving 150 sputum-producing adult patients who were clinically diagnosed by a physician and suspected to have tuberculosis infection at Immanuel General Hospital Eket (IGHE). The hospital is a secondary health facility centrally located in the city of Eket to cater for the medical needs of people within and outside the local government area. Eket is located in the South Central territorial part of Akwa Ibom State. It is the major oil-producing Local Government Area in the Niger Delta Region of Southern Nigeria. The inhabitants are over 220,600 people and occupy a land area of 209.7 km2 with major landmarks such as Qua Iboe River and Stubb Creek Forest Reserve (Akoiyak). It is located within latitude 4033’ N, 4045’N and longitude 7052’E, 8002’E.

**2.2 Ethical considerations**: Ethical approval was sought and obtained from the Health Research Ethics Committee, Akwa Ibom State Ministry of Health with reference number: AKHREC/27/8/21/008 before the study commences. Informed consent was obtained from subjects prior to their inclusion in the study.

**2.3 Inclusion and exclusion criteria:** Patients of both gender aged 18 years and above who have been clinically diagnosed and suspected of TB infection were included in the study. Those excluded were pregnant women, those less than 18 years old, non-sputum producing individuals and patients on TB treatment. Sputum-producing TB negative individuals were used as control.

**2.4 Sample size determination:** Sample size was determined using 22.9% TB prevalence rate obtained in a study carried out in Akwa Ibom State, Nigeria by [13]. The Fisher’s formula: S=Z2QP/D2 was used to calculate the required sample size, where Z = standard value equivalent to 1.95 at 95% confidence interval, P = prevalence rate from previous study, Q = 1-P while D = .05 margin of sample error at 95% CL (5% being the max. accepted value).

**2.5 Administration of questionnaire:** A structured questionnaire was administered to consented patients for collection of relevant data. Information related to socio-demographic characteristics of participants, clinical and socio-economic data were obtained for the study.

**2.6 Sample Collection and Processing:** Deep cough out sputum samples were collected in sterile, wide- mouthed bottles from patients that were able to expectorate. Samples were decontaminated in concentrated sodium hypochlorite solution and preserved in a refrigerator (4 0C) at the site of collection after initial processing at the facility, following which they were stored in a deep freezer at -20 0C.

**2.7 Culture of *Mycobacterium tuberculosis* (MTB) in Lowenstein‑Jensen medium:** In a biosafety cabinet level II and using a sterile plastic pipette, two drops of the sediment of the sputum sample of each smear‑positive patient were inoculated onto Lowenstein‑Jensen (LJ) medium slope and incubated at 37 0C for up to 8 weeks. A standard strain H37RV *M. tuberculosis* strain was used as positive control while the sterile LJ medium was used as a negative control. The growth and morphology of the colonies were noted, and the colonies were identified as *M. tuberculosis* using ZN smear microscopy and SD BIOLINE rapid diagnostic test for MTB [14].

**2.8 Sputum microscopy to detect AFB:** Sputum smear made on a clean and grease‑free slide was stained using the Zeihl Neelsen technique to detect acid-fast bacilli (AFB). This procedure was performed using strong carbol‑fuchsin as the primary stain, 3% acid‑alcohol for decolorization, and methylene blue as the counterstain in accordance with standard procedure outlined by Cheesbrough. The dry stained smear was examined using light microscope for acid fast bacilli (AFB) using 100x oil immersion objective [15].

**2.9 Data analysis:** Data generated from the questionnaire were entered into Microsoft excel and analyzed using SPSS (Statistical package for social sciences) software version 27. Descriptive statistics was performed; odds ratio (OR) and 95% confidence interval (CI) were calculated for binomial variables. P-values were calculated using the Chi-Square test for categorical variables while socio-economic variables for TB prevalence in the study area were analyzed using multivariate logistic regression model. A *P*-value ≤ .05 was considered significant.

1. **RESULTS**

Out of the 150 sputum samples collected, 54 (36%) were AFB positive using Ziehl Neelsen techniqueas shown in Table 1. The level of infection was quantified as scanty (6.0%), 1+ (14.7%), 2+ (12.7%) and 3+ (4.6%) according to WHO standard [14].

Table 1: Microscopic detection of AFB in clinical samples using Ziehl Neelsen technique

|  |  |  |  |
| --- | --- | --- | --- |
| **No. of AFB** | **Fields** | **Interpretation** | **ZN Test (%)** |
| No AFB seen | Per 100 IF | Negative | 96(64.0) |
| 1 – 9 AFB | Per 100 IF | Positive, scanty | 6(4.0) |
| 10 – 99 AFB | Per 100 IF | Positive, 1+ | 22(14.7) |
| 1 – 10 AFB | Per 50 IF | Positive, 2+ | 19(12.7) |
| > 10 AFB | Per 20 IF | Positive, 3+ | 7(4.6) |
| **Total** |  |  | **150(100)** |

**Key:** AFB=acid fast bacilli; IF=immersion fields; ZN= Ziehl Neelsen

Culture and RDT results from AFB smear positive samples is presented in Table 2. Of the 54 AFB positive samples, 41 yielded culture‑positive organisms using LJ culture method. The percentage of AFB positive sputum samples which yielded growth on the LJ medium was 75.9%. The 41 isolates were confirmed to be *M. tuberculosis* using the SD BIOLINE Rapid Diagnostic test for MTB complex, giving the prevalence of *M. tuberculosis* infection in the study area to be 27.3%.

Table 2: Culture and RDT confirmatory results for *Mycobacterium tuberculosis* prevalence

|  |  |  |
| --- | --- | --- |
| **Test method** | **No. negative (%)** | **No. positive (%)** |
| LJ/RDT | 109(72.7) | 41(27.3) |
| Microscopy | 96(64.0) | 54(36.0) |

**Key:** LJ=Lowenstein-Jensen; RDT=rapid diagnostic test; %=percentage

The results of multivariate logistic regression analysis of socio-economic risk factors of tuberculosis among study participants are presented in Table 3. Out of 41 positive TB cases, 32 were males (29.4%) while 9 were females (22.0%). Among this population, the highest occurrence of TB infection was observed in the age group of 31-40 (72.7%) and least in the age group of 18-20 (18.2%). Age of participants was significantly associated with TB infection (*P* = .02). Also, married subjects (33.0%), those with formal education (30.5%) and the employed participants (63.2%) had the higher TB prevalence. Employment status of participants was strongly associated with TB prevalence in the study area. Participants that have one square meal per day (34.6%), or live in a family of 4-6 people (43.9%) and those that sleep in a single room with at least 6 persons (56.0%) were observed to have significantly higher rates of TB infection. Among the socio-economic factors, number of meals taken per day, number of people in the family and number of people sleeping in a room had strong statistically significant association with TB infection (*P* < .05). Participants with co-morbidity (32.3%) including those with no previous exposure to TB positive patients (70.4%) had higher MTB colonization rate. However, infection rate was strongly associated with previous exposure to TB patients (*P* < .001).

Table 3: Multivariate regression analysis of socio-economic risk factors of tuberculosis among study participants

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Characteristics** | **No. screened** | **Pos TB (%)** | **Neg TB (%)** | ***P*-value** | **OR** | **95% C.I.** |
| **Sex** |  |  |  | 0.36 |  |  |
| Male | 109 | 32 (29.4) | 77(70.6) |  | 1 |  |
| Female | 41 | 9 (22.0) | 32(78.) |  | 1.48 | (0.63-3.45) |
| **Age group (yrs)** |  |  |  | 0.02\* |  |  |
| 18 – 20 | 22 | 4 (18.2) | 18(81.8) |  | 1 |  |
| 21 – 30 | 65 | 18 (27.7) | 47(72.3) |  | 0.93 | (0.22-4.01) |
| 31 – 40 | 11 | 8 (72.7) | 3(27.3) |  | 1.61 | (0.53-4.91) |
| 41 – 50 | 26 | 6 (23.1) | 20(76.9) |  | 11.20 | (2.16-58.13) |
| 51 – 60 | 26 | 5 (19.2) | 21(80.8) |  | 1.26 | (0.33-4.79) |
| **Marital status** |  |  |  | 0.06 |  |  |
| Single | 59 | 11(18.6) | 48(81.4) |  | 1 |  |
| Married | 91 | 30(33.0) | 61(67.0) |  | 0.47 | (0.21-1.02) |
| **Education** |  |  |  | 0.09 |  |  |
| Formal | 118 | 36 (30.5) | 82(69.5) |  | 1 |  |
| Informal | 32 | 5 (15.6) | 27(84.4) |  | 0.42 | (0.15-1.18) |
| **Employment status** |  |  |  | <0.001\* |  |  |
| Student | 55 | 3 (5.5) | 52(94.5) |  | 1 |  |
| Employed | 19 | 12 (63.2) | 7(36.8) |  | 29.71 | (6.69-131.99) |
| Unemployed | 15 | 1 (6.7) | 14(93.3) |  | 1.24 | (0.12-12.84) |
| Business/artisan | 61 | 6 (9.8) | 55(90.2) |  | 1.89 | (0.45-7.96) |
| **Income level** |  |  |  | 0.003\* |  |  |
| High | 19 | 1(5.3) | 18(94.7) |  | 1 |  |
| Middle | 32 | 5(15.6) | 27(84.4) |  | 3.33 | (0.36-30.95) |
| Low | 99 | 35(35.4) | 64(64.6) |  | 9.84 | (1.26-76.88) |
| **Meals per day** |  |  |  | 0.001\* |  |  |
| Three | 30 | 1(3.3) | 29(96.7) |  | 1 |  |
| Two | 42 | 14(33.3) | 28(66.7) |  | 14.50 | (1.79-117.72) |
| One | 78 | 27(34.6) | 51(65.4) |  | 15.35 | (1.98-118.94) |
| **Family size** |  |  |  | 0.001\* |  |  |
| 1-3 | 32 | 2(6.3) | 30(93.7) |  | 1 |  |
| 4-6 | 41 | 18(43.9) | 23(56.1) |  | 11.74 | (2.47-55.79) |
| >6 | 77 | 21(27.3) | 56(72.7) |  | 5.63 | (1.23-25.63) |
| **No. of people sleeping in a room** |  |  |  | < .001\* |  |  |
| 1-2 | 89 | 9(10.1) | 80(89.9) |  | 1 |  |
| 3-5 | 36 | 18(50.0) | 1850.0) |  | 8.89 | (3.44-22.97) |
| ≥6 | 25 | 14(56.0) | 11(44.0) |  | 11.31 | (3.97-32.27) |
| **Co-morbidity** |  |  |  | 0.23 |  |  |
| No | 85 | 20 (23.5) | 65(76.5) |  | 1 |  |
| Yes | 65 | 21 (32.3) | 44(67.7) |  | 1.55 | (0.75-3.19) |
| **Exposure to TB patient** |  |  |  | < .001\* |  |  |
| Yes | 96 | 3 (3.1) | 93(96.9) |  | 1 |  |
| No | 54 | 38 (70.4) | 16(29.6) |  | 73.63 | (20.28-267.35) |

**Key:** ٭Statistically significant; Pos=positive; Neg=negative; OR=Odd Ratio; C.I.= Confidence Interval; TB=tuberculosis

1. **DISCUSSION**

Tuberculosis (TB) is an infectious air-borne disease caused by *Mycobacterium tuberculosis* (MTB) and remains one of the top 10 causes of death globally [16]. Historically, TB is associated with poverty and low socio-economic status [17]. As a means to curtail this menace, early investigation of *Mycobacterium tuberculosis* and associated socioeconomic risk factors for their increase prevalence is imperative for effective control and epidemiological purposes. In this study, culture on LJ medium yielded lesser *Mycobacterium tuberculosis* (MTB) growth than sputum AFB. This may be due to decontamination procedure of sputum before culture, a method widely used to prevent overgrowth by other microorganisms. The prevalence of TB infection in this study is slightly higher than the 22.9% previously reported by [13] in Uyo, Akwa Ibom State. However, it is lower than the TB infection prevalence of 40.4%, 31.4% and 37% reported in studies from Kaduna, Northern Nigeria [18], Akure, Nigeria [19], and Pakistan [20], respectively. However, a much higher TB prevalence has been reported from previous studies by [21] in Zaria, North Western Nigeria (88.6%) and by [22] among patients attending National Tuberculosis/Leprosy Center and Teaching Hospital, Saye Zaria (40.5%). In contrast, studies conducted in Makurdi [23], Ogun [24], Calabar [9] and Ethiopia [25] have reported a much lower prevalence rates of 19.1%, 25.5%, 16.7%, 24.8% and 23.2%, respectively. The reason for the observed differences in prevalence rates may be due to differences in diagnostic methods and endemicity of tuberculosis infection in the study areas [18].

In this study, the prevalence of TB infection varied according to sex and age of subjects. Although infection rate was higher in males than females, it was not significantly associated with sex of patients. This goes on to show that this observation may occur by chance or as a result of having more male participants from the sex category. Studies conducted in Ogun [24], Ethiopia [25] as well as reports by WHO [16] corroborate this finding. The reason for this may be due to the fact that males interact with the outer environment as a result of work and travelling engagements than females, thus exposing them to inhalation of the bacilli from the environment [26]. The females may also be immunologically stronger since oestrogen stimulates the immune system by upregulation of proinflammatory cytokines (TNF-α) while testosterone suppresses it by upregulating anti-inflammatory cytokines (IL-10) [26]. However, despite these claims, a previous study by [27] had reported more TB infections in females than their male counterparts.

The epidemiology of tuberculosis largely depends on key structural determinants such as global socio-economic inequalities, high immigration population, rapid urbanization and population growth [28,29]. The findings of this study showed that most of the TB patients were frequently found in the low socio-economic status. The age, employment status and income level of patients were found to be independently and significantly associated with a higher risk of tuberculosis. The current study found the highest prevalence of TB infection in the age group of 31-40 years. However, patients in the age group of 41-50 years had 11 times probability of being predisposed to TB infection compared to other age categories at multivariate level. This result is in agreement with [17]. The study findings also revealed high TB prevalence and risk of infection among the employed patients (*P* < .001; OR=29.7 at 95% C.I.). Unemployment is said to impact negatively on the socio-economic status of individuals, especially in areas of feeding, education and housing [30]. The reason for the high prevalence of TB infection observed among those who are employed compared to the unemployed may be due to the low number of participants in this category. It may also be associated with frequent exposure to high-risk groups due to work-related factors. This study also found a strong association between TB prevalence and economic or poverty level, as those who belonged to low income family suffered more from TB infection compared to those in the middle and high income family. Multivariate logistic regression analysis showed that patients belonging to the low income family had increased socio-economic chances (OR=10 approx. at 95% C.I.) of infection with TB than those in the middle income family (OR=3 at 95% C.I.). Low income families may find it difficult to feed or have a balanced diet per day thus leading to immune suppression and a concomitant increase in MTB progression.

The number of times meal is taken per day was also significantly associated with TB prevalence, and those that have only one square meal per day had 15 times higher chances of TB infection. According to a report by [30], poverty-based malnutrition increases the risk of TB even six to ten-fold. This study revealed no significant association between educational level and TB prevalence. However, a study by [31] on socioeconomic impact of TB and illiteracy level has revealed that tuberculosis imposes high direct and indirect costs on the patients leading to loss of wages for an average of 3 months and subsequently leads to school drop-outs in about 20% children [32]. This study also found that people with lower socio-economic status had a higher likelihood of being exposed to crowded and less ventilated places. This is evident in the high prevalence of TB infection seen in those that sleep in a single room with more than 5 persons. The study found strong significant association between the number of people in the family (*P* = .001) as well as the number of people sleeping in a room (*P* < .001) and TB infection rate. These findings are consistent with previous reports [33,34].

In this study, previous exposure to TB and co-morbidity are significant risk factors for TB infection. The rate of TB infection was higher in patients with co-morbidity. This agrees with reports of previous studies conducted in Edo State, Southern Nigeria [35] and Kaduna State, Northern Nigeria [18]. Previous studies have shown that patients with co-morbidities or underlying health condition such as diabetes or HIV are at high risk of TB infection due to immune system suppression, and those who had previously been treated with anti-TB drugs have increased chances of multi-drug resistant TB infection [29,36]. Tuberculosis is a major health risk, particularly for those individuals living with HIV, due to the fact that their immune system is compromised. Also, reports have implicated TB as one of the top causes of mortality among HIV-positive persons globally [18].

1. **CONCLUSION**

The result of this study significantly proves that there is a great relationship between TB prevalence and its determinants. This is indicated by a strong significant association obtained between TB prevalence and socio-economic determinants of subjects such as employment status, income level, meals times per day, number of people in the family, number of people sleeping in a room and exposure to TB patients. The findings of this study therefore provides evidence in support of the social and economic determinants of health theory and underscores the need for urgent policy implementation by relevant government agencies to improve the socioeconomic status of the people in Eket in order to reduce the prevalence of TB infection in the area and the state at large.

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