Haematological Indices and Predisposing Factors Associated with Tuberculosis at Federal Medical Center Owerri, Imo State, Nigeria

Gideon I. A. Okoroiwu[1*] and Leticia I. Ebere[2]

[1]*Department of Public Health Sciences, Faculty of Health Sciences, National Open University of Nigeria, Jabi, Abuja, Nigeria.*
[2]*Department of Medical Laboratory Sciences, Imo State University, Owerri, Imo, Nigeria.*

Authors' contributions

This work was carried out between author GIAO who designed the study, managed the analysis, final draft, statistical analysis and author LIE who wrote the protocol, first draft and literature searches. Both authors read the approved final manuscript.

Original Research Article

ABSTRACT

Introduction: Tuberculosis (TB) is a chronic infectious disease caused by bacterium "*Mycobacterium tuberculosis*". It is a systemic infection and has deleterious effect on both circulatory and respiratory systems, and thrives more in a society with little knowledge of its predisposing factors.
Aim of the Study: This study was carried out to identify the predisposing factors of tuberculosis and its effects on haematological indices of the positive patients at the Federal Medical Center, Owerri, Imo state, Nigeria.
Materials and Methods: The blood samples were analyzed manually for the indices while predisposing factors of Tuberculosis were obtained with the aid of a structured self-administered questionnair,these were administered simultaneously while the blood samples were been collected.
Results and Discussion: Results were considered to be statistically signifificant (P<0.05), (OR>1). Simple frequencies were also computed. The results revealed that Haemoglobin (P=0.001);

*Corresponding author: Email: okoroiwugia@yahoo.com;

Erythrocyte sedimentation rate (P=0.020); Neutrophils (P=0.002); Eosinophils (P=0.000); Monocytes (P=0.000); Platelets (P=0.001) of the Tuberculosis positive patients when compared with the controls, showed, statistically (P<0.05) significant haematological abnormalities. History of Tuberculosis in family (Odd ratio=9.3) and Alcoholism (OR=6.0) were significant predisposing factors of Tuberculosis. Other predisposing factors; smoking habits (OR=2.7), Educational status (OR=2.2), marital status (OR=1.3) were also associated with Tuberculosis infection, while employment status (OR=1.0) and socio-economic status (OR=0.1) were not. Tuberculosis infection in this study adversely affected Haemoglobin, Platelets, Erythrocyte sedimentation rate, Neutrophil, Eosinophil and Monocyte values, while family history of Tuberculosis and Alcoholism were significantly associated with the infection.

Conclusion: Quarrantine of Tuberculosis patients and creating more awareness on the predisposing factors of tuberculosis will help towards preventing, reducing and eliminating the disease.

1. INTRODUCTION

Tuberculosis is an ancient scourge and it has plagued humankind throughout known history [1]. Today, after the developmental methods for the disease, a third of the world's population has been exposed and is infected with the organism and the numbers are over 90% in developing countries. Furthermore, with the advent of Human Immunodeficiency Virus (HIV) infection, there is a dramatic resurgence of tuberculosis with more than 8 million new cases each year worldwide and more than 2 million persons dying from it [2].

Mycobacterium tuberculosis bacterium, the causative agent of Tuberculosis is acid fast, gram positive bacillus and is claimed to have originated in Africa at least 70,000 years ago and has claimed many lives. For instance, thousands of HIV and Tuberculosis (TB) infected people in South Africa, Eastern Cape Province are at risk of death and other diseases due to ongoing interruptions of their life-saving drugs [3].

The burden of Tuberculosis (TB) in Sub-Saharan Africa is far greater today and continuing poverty and political instability in parts of the continent has inhibited progress in implementing effective TB control measures [4]. TB is a top infectious disease worldwide [5] and in 2014, the World Health Organization (WHO) reported that 9.6 million people fell ill with TB and 1.5 million died from it. The report added that over 95% of TB deaths occur in low and middle income countries, and is among the top five [4] causes of death for women aged between 15 to 44 years. In 2014, an estimated one million children became ill with TB and 140,000 children died of it [5]. This revelation is alarming and require creating more awareness among the people. It is on this basis

and rationale that this investigation was designed and carried out.

The disease, causes ill-health among millions of people, in addition, to well established predisposing factors (such as Human Immunodeficiency Virus (HIV), malnutrition, and young age), emerging variables like diabetes, indoor air pollution, alcohol, use of immunosuppressive drugs and tobacco smoking play a significant role at both the individual and population level [6]. In a study by [7], on the "haematological profile and risk factors associated with Pulmonary TB patients in Pakistan", concluded that malnutrition, smoking, living in shared houses, illiteracy and poverty were the common risk factors contributing to the dissemination of TB in the target area population, while Erythrocyte Sedimentation Rate (ESR), platelets, leukocytes, work as hallmark and help the Clinician in early diagnosis of TB.

In 2010, Nigeria ranked 10th among the 22 high burden TB countries in the world. This according to WHO estimated that 210,000 new cases of all forms of TB occurred in the country in 2010, equivalent to 133/100,000 population while there were an estimated 320,000/100,000 prevalent cases of TB in 2010, equivalent to 199/100,000 cases [8]. However, in 2015, the National TB and Leprosy Control Programme (NTBLCP) announced that over 600,000 new cases of TB have occurred in Nigeria with 91,354 cases placed on treatment [9] and this brought Nigeria to the 3rd among the 22 highest prevalence of TB burden countries.

Despite the fact that this disease is on the increase globally, there is paucity of report on the role of predisposing factors and its effect on the haematological indices of the patients in Nigeria,

moreso, in Imo state of Nigeria. Nevertheless, there has been drop of cases notified in this State of Imo [8], its effect on the haematological indices of the patients and predisposing factors of TB are poor among the people. This study was therefore aimed at identifying the predisposing factors of TB and its impact on haematological indices of the patients at FMC Owerri, and will help towards creating more awareness among the people, reduce the scourge and encourage proper counselling.

2. MATERIALS AND METHODS

2.1 Study Design

This is a descriptive cross-sectional study aimed at identifying the predisposing factors of TB and the extent of its effect on haematological indices of the patients affected at the Federal Medical Center (FMC) Owerri. The patients were randomly selected by simple random sampling.

2.2 Study Population

This is a study on TB patients at FMC Owerri involving 50 TB positive patients made up of 25 males and 25 females, who have been diagnosed, tested and confirmed to have Tuberculosis and are indigenes of Imo state and 50 non-tuberculosis individuals as control from the same environment made up of 25 males and 25 females.

2.3 Determination of Sample Size

A suitable sample size of 100 individuls made up of 50 tuberculosis positive patients and 50 healthy non-tuberculosis individuals(as controls) were determined using n= $Z^2P(1-P)/d^2$ according to [10].

Z =1.96 (statistic for a level of confidence(95%)
P=7% (Population based on previous prvalence)
d=5%(0.05)=precision or margin error
n=sample size.

$$n= \frac{(1.96)^2 \times 0.07(1-0.07)}{(0.05)^2} = 99.66328 = 100$$

2.4 Eligibility Criteria

These included Tuberculosis positive patients at Federal Medical Center Owerri and non-TB patients(that is those without tuberculosis) as controls in the same hospital.

2.5 Healthy Control Population

Fifty (50) healthy individuals made up of 25 males and 25 females who were negative for tuberculosis were used as controls. The samples from this group of patients were collected at the point they were confirmed negative and this was an agreement reached with medical laboratory scientists in TB laboratory of the center.

2.6 Study Instrument

2.6.1 Questionnaire

A Structured self-administered questionnaire to collect information were simultaneously administered to the patients (at the point of collecting blood samples) at the FMC OWERRI (that is those who consented to the study).

2.7 Ethical Approval and Consent

Permission to study was obtained from the Ethics and research Committee of the Federal Medical Center Owerri, and verbal consent was obtained from the participants after explaining the purpose and what they will gain by participating.

2.8 Statistical Analysis

Two way analysis of variance and Odd ratio were used. SPSS(Version 20 was used for the analysis and statistical comparisons of haematological indices between the experimental and control groups were made using the statistical tests. Results were considered to be statistically signifficant (P<0.05), (OR>1). Simple frequencies were also computed.

2.9 Collection of Blood Samples for Haematological Indices

4 mls of venous blood samples were collected from the antecubital fossa of the patients' arms (2 mls into ethylene diamine tetra acetic acid (EDTA) containers, thoroughly mixed to avoid clotting, while the remaining 2 mls into sodium citrate were used for Erythrocyte Sedimentation Rate (ESR), using disposable sterile syringes, needles and tourniquet as described by [11]. Haemoglobin estimation, differentials, total white blood cell count (WBC), platelets, Packed Cell Volume (PCV) were done as described by [12,11].

3. RESULTS

In Table 1, the history of TB in families, Alcoholism, smoking habits and Educational status are the major predisposing factors of TB in this study.

Table 2 shows the impact of Tuberculosis on the haematological indices of the affected patients.

Haemoglobin (P=0.001), Erythrocyte Sedimentation Rate (P=0.020), Neutrophils (P=0.002), Eosinophils (P=0.000), Monocytes (P=0.000) and Platelets (P=0.001) of the tuberculosis positive patients when compared with the controls showed statistically (P=0.05) significant haematological abnormalities in both male and female tuberculosis positive patients.

4. DISCUSSION

Tuberculosis infection is a systemic infection that affects both circulatory and respiratory systems. It remains a major public health threat in the developing countries and this study reveals the predisposing factors associated with it as well as its effect on haematological indices of the patients at Federal Medical Center Owerri, Imo state. The major predisposing factors as revealed by this study were history of tuberculosis in family /close viscinity (OR=9.3); Alcoholism (OR=6.0). Others included smoking (OR=2.7), educational (OR=2.2) and marital status (OR=1.3) (Table 1). These findings corroborate the works of [6,7] describing them as risk factors that contribute immensely to the spread or distribution of tuberculosis infection in a community or environment. Smoking as a predisposing factor suppresses the immune system [13] of the patients, and this was shared by [14] who posited that it impairs clearance of mucosal secretion and this agreed with [15] who found out that smoking reduces phagocytic ability of alveolar macrophages which aid in decreasing the immune response and/or CD4 lymphopenia due to the nicotine in the cigarettes [16,17,18].

Table 1. Predisposing factors of TB positive patients

Factors	Frequency(%)	OR
Marital status		
Maried	26(52.0)	1.3
Unmaried	24(48.0)	
Educational status		
Literate	15(30.0)	2.2
Illiterate	35(70.0)	
Employment status		
Employed	20(40.0)	1.0
Unemployed	30(60.0)	
Smoking Habits (Men only)		
Smokers	19(76.0)	2.7
Non-smokers	6(24.0)	
Alcoholism		
Drinkers	30(60.0)	6.0
Non-drinkers	20(40.0)	
Residence		
Rural dwellers	26(52.0)	0.8
Urban dwellers	24(48.0)	
History of TB in family or close viscinity (Family members of TB positive PTS)	25(100.0)	9.3
Social economic status		
Upper	1(2.0)	
Middle	10(20.0)	0.1
Lower	39(78.0)	

OR=Odd Ratio; OR=1 (has no association), OR>1(has association), OR<1(negatively associated)

Table 2. The means, SDs, CI (95%)s and P-values of Hb, WBC, ESR, N, L, E, M, Platelets of TB positive patients when compared to TB negative (control) subjects

Haematological indices	TB positive patients		TB negative patients	
	Males	**Females**	**Males**	**Females**
Hb(g/100 ml): Means:	5.368	4.844	12.276	10.744
SD ±	±1.395	±1.199	±1.701	±1.507
CI (95%)	4.795-5.941	4.271-5.417	11.703-12.849	10.171-11.317
	P=0.001 df=1 R squared=0.841 (Adjusted R squared=0.836) Computed using P(alpha)=0.05			
WBC(/mm^3): Means:	14.120	14.656	5.584	5.872
SD:	± 2.743	±2.664	±0969	±1.258
CI(95%):	13.298-14.942	13.834-15.478	4.762-6.406	5.050-6.694
	P=0.765 df=1 Rsquared=0.820 (AdjustedR squared=0.815) Computed using P(alpha)=0.05			
ESR (mm/hr): Means:	78.360	86.200	5.920	7.920
SD:	±17.538	±10.924	±1.978	±1.847
CI(95%):	74.232-82.488	82.072-90.328	1.792-10.048	3.792-12.048
	P=0.020 df=1 R squared 0.932(Adjusted R squared=0.930) Computed using P(alpha)=0.05			
N (%): Means:	81.240	85.000	53.480	49.000
SD:	±6.990	±6.258	±6.960	±6.487
CI(95%):	78.615-83.865	82.375-87.625		
	P=0.002 df=1 R squared =0.860(Adjusted R squared=0.856) Computed using P(alpha)=0.05			
L (%): Means:	15.920	13.240	43.400	45.400
SD:	±5.916	±4.978	±6.468	±6.232
CI(95%):	13.568-18.272	10.888-15.592	41.048-45.752	43.048-47.752
	P=0.051 df=1 R squared=0.869(Adjusted R squared=0.865) Computed using P(alpha)=0.05			
E (%): Means:	2.120	1.480	2.120	3.600
SD:	±1.453	±1.475	±1.333	±1.291
CI(95%):	1.568-2.672	0.928-2.032	1.568-2.672	3.048-4.152
	P=0.000 df=1 R squared=0.246(Adjusted R squared=0.223) Computed using P(alpha)=0.05			
M (%): Means:	0.720	0.280	1.000	2.040
SD:	±0.891	±0.614	±0.817	±1.020
CI(95%):	0.383-1.057	0.057-0.617	0.663-1.337	1.703-2.377
	P=0.000 df=1 Rsquared=0.378(Adjusted R squared=0.359) Computed using P(alpha)=0.05			
PLT (10^9/L): Means:	74.560	82.400	229.480	162.240
SD:	±15.974	±17.557	±68.064	±78.240
CI(95%):	53.340-95.780	61.780-103.620	208.260-250.700	141.020-183.460
	P=0.001 df=1 Rsquared=0.594(Adjusted R squared=0.582) Computed using P(alpha)=0.05			

Male Hb normal range=14.0-14.4gm/100ml. Female Hb normal range=(12.4-13.2)g/100ml
Note: N=Neutrophil; L=Lymphocyte; E=Eosinophil; M=Monocyte; B=Basophil; Hb=Haemoglobin;
ESR=Erythrocyte Sedimentation Rate; WBC=White Blood Count; PLT=Platelet

In addition, family history of tuberculosis/close contacts to infectious Tuberculosis cases including household contacts and caregivers/healthcare workers are at high risk of becoming infected with Tuberculosis and development of primary active Tuberculosis [19]. This is in line with observation made by [20] who reported on risk factors for *Mycobacterium tuberculosis* infection among children in Greenland. All these buttress the findings of this study that recorded 100% (OR= 9.3) of those infected as being in close contacts with their relations who had the infection.

Moreover, alcohol recorded 60% (OR=6.0) in this survey, and is in conformity with the revelation of [21] who reported that alcohol causes alteration in the immune system specifically in altering the signaling molecules responsible for Cytokine production thereby reducing the active responses and feedbacks of the immune systems.

However, the result of this study did not agree with the works of [6] and [22], who variously reported residential status (OR=0.8) and socio-economic status (OR=0.1), as playing much role in predisposing people to Tuberculosis, which was also strongly supported by [23], who recorded that Tuberculosis burden follows a strong social economic gradient between and within countries with the poorest having the highest risk. Additionally, unemployment (OR=1), in this study was not associated with tuberculosis as claimed by [20]. Nevertheless, [24] posited that tuberculosis decreases appetite and changes in metabolic processes. The report of this study is also not in line with [25] who supported [20,6,22] saying that socio-economic status exposes people to social risk factors such as malnutrition, indoor air pollution, alcohol, and smoking which increases their risk for Tuberculosis.

Continuing, [25] explained that people with lower social economic status have a higher likelihood of being exposed to crowded, less ventilated places and have limited safe cooking practicing facilities, but statistically, in this study, residential status (OR=0.8), socio-economic status (OR=0.1) and employment status (OR=1) do not significantly affect or encourage the spread of tuberculosis in this area (Imo state), thus, corroborating the statement by [20] that predisposing or risk factors vary from one Environment or Community to the other.

Table 2 showed the impact of Tuberculosis on the haematological indices of the affected patients. Haemoglobin was significantly affected and this agreed with earlier reports [7,24,25] who variously reported the same low level of haemoglobins and this could be due to Cytokines secreted by macrophages active against tubercle bacilli resulting in decreased erythropoietic production leading to blockage in the reticuloendothelial transfer of iron in the developing Red Blood Cells [7]. Moreso, effects of antituberculosis drugs during the course of treatment and of course malnutrition [20,25].

Moreover, Erythrocyte Sedimentation Rate (ESR), Neutrophils, Eosinophils, Monocytes and Platelets were significantly abnormal and these results were in conformity with the reports of various authors [6,7,25].

However, Lymphocytes (P=0.051) and Total white blood cell count (P=0.765) were not significantly (P=0.05) affected.

5. CONCLUSION

The result of this survey has shown that tuberculosis is really a serious infectious disese that has a systemic damaging effect in both men and women and effort should be geared towards preventing it, if not total elimination. Predisposing factors namely; family history of tuberculosis/close viscinity, alcoholism, smoking, educational status and marrital status are the main contributing factors of the disease spread in Imo state. Prevention, reduction and elimination of this ugly experience, profound changes in approach, effective dieting, awareness, substantial political will and active community leadership to carry people along are needed.

The study, therefore, advocates for affordable education in Imo state. There should also be adequate advocacy against smoking and adequate counseling on how to care for their loved ones who are victims without endangering themselves. Furthermore, much awareness on the free treatment of tuberculosis throughout the country should be intensified in the area.

Quarrantine of Tuberculosis patients and creating more awareness on the predisposing factors of tuberculosis will help towards preventing, reducing and eliminating the disease.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Thomas MD. The history of tuberculosis. Respiratory Medicine. 2006;100(11):1862-1870.
2. Ananya M. History of tuberculosis; 2015. Available:www.news-medical.net/health/history-of-Tuberculosis.aspx
3. Abraham OJ, Odiba PA, Haruna I, Yusuf D, Amodu AE, Yahaya-Oruma UA. Analysis of white blood cells in patients attending tuberculosis clinic at Holley Memorial Hospital. Ochadamu, OFU Local Government Area of Kogi State, Nigeria. Journal of Medical and Applied Biosciences. 2015;7(1):64-75.
4. Cauthen GM, Pio A, Ten DHG. Annual risk of tuberculosis infection. 1988 Bulletin of the WHO. 2002;80:503-511.
5. World Health Organization. Tuberculosis. Media Centre; 2015. Available:www.who.int/mediacentre/facthe ets/fs104/en/
6. Padmanesan N, James W, Chandini RM, Dilip M. Risk factors for tuberculosis. Pulmonary Medicine. 2013;1-11.
7. Muhammad S, Ferhat A, Muhammad A, Mohammad A, Niamatuilahakakar ZA. Haematological profile and risk factors associated with pulmonary tuberculosis patients in Quetta, Pakistan. Pak. J. Med. Sci. 2014;30(1):36-40.
8. Nigeria TB Factsheet. Economic section. United States Embassy in Nigeria; 2012. Available:Photos.state.gov./libraries/Nigeri a/487468/pdfs/JanuaryTuberculosis-Factsheet.pdf
9. Guardian Newspaper. New cases of tuberculosis in Nigeria; 2015. Available:www.ngrguardiannews.com/201 5/03/600,000-new-cases-of-tb-in-nigeria-by-agency/
10. Naing L, Winn T, Rusli BN. Practical issues in calculating sample size. Archives of Orofacial Sciences. 2006;1:9-14.
11. Ochei J, Kolhatkar A. Medical laboratory: Theory and practice. 9th Reprint; Tata McGraw-Hill Pub.co Ltd. 2008;273-283.
12. Baker FJ, Silverton RE, Pallister CJ. Introduction to medical laboratory technology. 7th, Edition, Arnold, Bounty Press Ltd. 2011;354-372.
13. Ferrara G, Murray M, Winthrop K, Cantis R, Sotqiu G, Migliori GB. Risk factors associated with pulmonary tuberculosis: Smoking, diabetes and anti-TNF& drugs. Curr Opin Pulm Med. 2012;18(3):233-40.
14. Houtmeyers H, Gosselink R, Gayan-Ramirez G, Decramer M. Regulation of mucocilliary clearance in health and disease. European Respiratory Journal. 1999;13(5):1177-1188.
15. Sopori M, Wang H. Effects of cigarette smoke on the immune system. Nature. 2003;421(6921):384-388.
16. Wang H, Yu M, Ochani M. Nicotinic acetylcholine receptor & 7 subunits as an essential regulator of inflammation. Nature. 2003;421(6921):384-388.
17. Arcari L, Benowitz NL. Cigarette smoking and infection. Archives of Internal Medicine. 2004;164(20):2206-2216.
18. Moshin SS, Hafiz AMF, Waqas AB, Razialftikhar NK. Environmental and host-related factors predisposing to Tuberculosis in Karachi: A cross-sectional study. Journal of Pioneering Medical Sciences. 2011;1(1):13-18.
19. Joshi R, Reingold AL, Menzies D, Pai M. Tuberculosis among health-care workrs in low and middle income countries: A systemic review. PLOS Medicine. 2006;3(12):e494.
20. Bolette S, AaseBengaard A, Mada M, Jan W, Mikael A, Robert JB. Risk factors for *Mycobacterium tuberculosis* infection among children in Greenland. Bulletin of the World Health Organization. 2011;89:741-748E.
21. Szabo G. Alcohols contribution to compromised immunity. Alcohol Research and Health. 1997;21(1):30-38.
22. Lonnroth K, Jaramillo E, Williams BG, Dye C, Raviglione M. Drivers of tuberculosis epidemics: The role of risk factors and social determinants. Social Science and Medicine. 2009;68(12):2240-2290.
23. Muniyandi M, Ramachandran R, Gopi PG. The prevalence of tuberculosis in different

economic strata: A community survey from South India. Inter. Jour. Tuberculosis and Lung Disease. 2007;11(9):1042-1045.

24. Abba K, Sudarsanam TD, Grobler L, Volmink J. Nutritional supplements for people being treated for active tuber-

culosis. Cochrane Database of Systematic Review. 2008;4. ID: CD006086.

25. Grady O, Maeurer JM, Afum R, Abubakar I, Mwaba P. Tuberculosis in prisons: Anatomy of global neglect. European Respiratory Journal. 2011;38(4):752-754.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/47437