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Spatial Incidence of Tuberculosis in Enugu State, Nigeria

Igu N. I[1,2,*], Enete I. C[2] , Olaniyan F. A[3]

[1]Environment Department, University of York, UK, Y010 5DD
[2]Department of Geography and Meteorology, Nnamdi Azikiwe University, Awka, Nigeria
[3]Department of Geography, University of Ibadan, Nigeria

Abstract Tuberculosis is described as a global emergency; and is found more in the developing world. In this light, a retrospective study of the incidence of the disease was conducted in Enugu. The study focused on understanding if urbanization affects/promotes the disease, the most vulnerable; the age bracket that has it more, the gender differentials, among others. More urbanized centres were found to have a higher incidence and further analysis using Pearson product moment correlation coefficient showed a positive non-significant correlation of 0.309. Males were found to have a cumulatively higher incidence than the females with 57.4% and 42.6% occurrence respectively. Ages 25-34 years was found to have the highest percentage occurrence of 37.5%, while 0-14years with 1.7% occurrence was the least. Optimal location of more DOT centres was suggested to handle stigmatization, reluctance and inconsistency in treatment, which were identified contributory factors of the disease incidence, in the study area.

Keywords Tuberculosis, Dots, New-smear Positive, Enugu

1. Introduction

Tuberculosis is a chronic, infectious disease caused mainly by the bacteria generally referred to as 'mycobacterium tuberculosis complex'. Causing a quarter of all avoidable deaths, tuberculosis (TB) is the second largest cause of death from an infectious disease worldwide (after HIV), and is among the top ten causes of illness, death and disability in terms of years of healthy life lost overall.

It is seen as both a non-vectored as well as a chronic disease, and is promoted or inhibited as a result of factors like economic status, hygiene, congestion, migration, lifestyle and habits like smoking, as well as attitudes towards treatments.

Tuberculosis being an infectious disease, cannot be contained by political boundaries or more strict border controls. Even though the incidence is not much in Europe and North America, it cannot yet be controlled in the industrialized countries unless it is sharply reduced in the developing countries of Asia, Africa and Latin America. This is attributed to recent increases in human migration that have rapidly mixed infected with uninfected communities[1]. Because of its ease of transmission, tuberculosis anywhere in the world is a concern for everyone. While it remained a major health problem in developing countries, from the mid-1980s, the advent and spread of HIV, the virus that leads to AIDS, paved the way for tuberculosis to stage a comeback in the industrialized countries, and thus on the world scene. This is even more worrisome now that the prevalence of multi-drug resistant tuberculosis is increasing throughout the world[2], with an estimated 440,000 cases worldwide in 2008[3]. Infecting eight million new victims a year, tuberculosis also has a deadly link with AIDS, and this largely contributes to the increasing trend of the disease; and particularly so in sub-Saharan Africa, where the synergy between HIV/AIDS and tuberculosis is a grave problem[4].

It affects both the male and the female gender alike, but is seen to be higher in males after adolescence[5]. Globally, there are 1.7 times as many male pulmonary tuberculosis cases reported annually as female cases[5] and this is because tobacco smoking and other such lifestyles is prevalent almost exclusively among men. Although women may enjoy some kind of protection against tuberculosis, this protection may be offset by biological and sociological vulnerabilities at certain life stages.

Historically, tuberculosis has been associated with economic hardship, urbanization and other socio-economic factors. The evidence suggests that the prevalence of tuberculosis is disproportionately high among poor countries and among disadvantaged groups within countries; and equally seen to be associated with constrained macroeconomic conditions and periods of economic transition. Considering the multi-dimensional nature of poverty, its impact on the risk of tuberculosis might therefore best be accessed by looking independently at several types of deprivation such as income, food, housing, knowledge, power and access. The factors that make the poor more vulnerable to tuberculosis also make them more vulnerable to poor living conditions, malnutrition and other forms of

* Corresponding author:
nwabuezeigu@yahoo.com (Igu, N.I)
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illness, all of which may further exacerbate the risk of getting tuberculosis[6]; estimated that among the poor, tuberculosis could result in a loss of 20-30% of a household's annual wages. It could however, be hypothesized that tuberculosis can cause a relatively poor individual or household to fall into poverty, even if the decline in economic status is only temporarily.

The patients diagnosed with the disease, are referred to as the new smear-positive cases and the DOT strategy is used in the treatment. Globally, the DOTS (directly observed treatment, short-course strategy) have been recognized as the best cost-effective approach to tuberculosis control, to reduce the disease burden and to reduce the spread of infection[7]. Despite the success of this program among others, tuberculosis incidence and mortality are not falling rapidly enough to meet WHO targets, and in some areas, particularly in parts of Asia and throughout sub-Saharan Africa, they continue to climb.

2. Conceptual Framework

Social inequities in health, buttresses the systematic differences in health status between different socioeconomic groups. Within any country or region, difference in health can be observed across the population. Genetic and constitutional variations ensure that the health of individuals varies, as it does for any other physical characteristic. The prevalence of ill health also differs between age groups with older people tending to be sicker than younger people, because of the natural ageing process[8]. Biologically also, variations also exist between the male and female gender with respect to which among them exhibit an advantage in survival.

Tuberculosis in like manner, is a social disease, and as such healthcare-seeking behaviour among patients is influenced by gender, age, socioeconomic and social status, type of illness, access to services, and perceived quality of the service[9], which often interacts in a complex web. People can be confused as to the implications of tuberculosis symptoms, costs of transportation, the social stigma, the high cost of medication, and perceptions of patients about clinic facilities as unfriendly, and all these contribute to the complexity of the disease[10]. Understanding the aforementioned becomes then a necessity, as tuberculosis is one of the major public health problems in the world today, and no other disease has so much sociological, economic and health significance as tuberculosis[11].

This study is focused on studying the incidence of the disease in Enugu, with a view to address the above issues while seeking to understand the stratification of patients along their gender, geography and socioeconomic status.

3. Study Area

Enugu state is located between latitudes $5^0$55 and $7^0$08N, and longitudes $6^0$35 and $7^0$55E. It has a population of 3,161,295 (NPC (National Population Commission), 1991) within a total area of 12,791sq.kms. This gives a population density of about 214 persons per sq km which is high when compared with the average national density of about 96 persons per sq km. expectedly; the population concentration is highest in urban centres than in the rural areas; and an average population density of 254 persons per sq km across the state. The state is situated on the highland of the Awgu, Udi and Nsukka hills to the east as well as Oji-river to the west. It is made up of a total of seventeen local government areas and lies in the region of the tropical rainforest with an annual rainfall range of between 152- 203cm, and temperature range of between 32 ^{0}C and 37^{0}C.

4. Materials and Methods

Data for this study were collected from the Enugu state ministry of Health as well as from interviews conducted at the DOT centres in the area of study. The disease incidence data for the seventeen local government areas (LGAs) in the state were gotten from the quarterly report (1st – 4th quarters) of the new smear-positive cases from 1995-2005.

Population figures in this study are used to determine urbanization. L.G.As with high population figures were taken as more urbanized environments while lower population figures stood for rural L.G.As or L.G.As with lesser urbanized centres. 1991 population figure was used in the study since that was the available data (the next population census in the country was conducted in 2006 and was still being processed as at the time of the study). The 1991 census population figure was used to determine the proportion of population that is urban and then projected till 2005 at 2.83% per annum growth rate[12].

In determining the relationship between urbanization and disease incidence the Pearson Product Moment Correlation (PPMC) was employed. The value of r coefficient ranges from $-1 < r <$ The higher the r coefficient, the stronger the nature of the relationship between observations. Coefficients close to 0.0 represent a weak relationship. Coefficients close to 1.0 or -1.0 represent a strong relationship. To test the differences in the incidence of tuberculosis between men and women the chi-square test of independence was used. The chi-square test of independence is basically a nonparametric version of the interaction term in ANOVA. The mean plots derived from Analysis of variance (ANOVA) were used to graphically depict variation in incidence of tuberculosis across space.

5. Discussion

In understanding the variation across space, the incidence data of 2000-2005 (table 1) showed that Enugu North had the highest incidence rate, followed by Nsukka and Igbo-eze north local government areas with incidence rate totals of 1001, 815 and 700 respectively; while Nkanu west and Nkanu east had the least total incidences of 27 and 18

respectively. The mean plots in fig. 1 graphically depict the degree of variation in incidence of tuberculosis in the study area.

Table 1. Incidence Data for the Local Government Areas in the State

Year	Nkanu west	Aninri	Udi	Nkanu east	Igbo-eze south	Isi-uzo	Nsukka	Enugu-north	Enugu east
2000	2	13	13	2	11	37	166	170	17
2001	7	10	6	4	8	31	112	150	21
2002	3	12	10	2	17	23	141	163	25
2003	2	11	10	1	37	29	137	184	32
2004	5	10	3	1	28	33	129	183	37
2005	8	14	6	8	25	35	130	151	49
Total	27	70	48	18	126	188	815	1001	181
Year	Awgu	Ezeagu	Igbo-eze north	udenu	Oji-river	Igbo-etiti	Enugu south	Uzo-uwani	Total
2000	50	7	64	10	18	23	9	10	622
2001	43	21	51	29	46	18	9	17	583
2002	27	11	98	54	39	10	13	25	673
2003	32	12	163	44	39	16	5	15	769
2004	19	6	174	36	31	25	17	28	765
2005	22	8	150	37	33	18	33	17	744
Total	193	65	700	210	206	110	86	112	4156

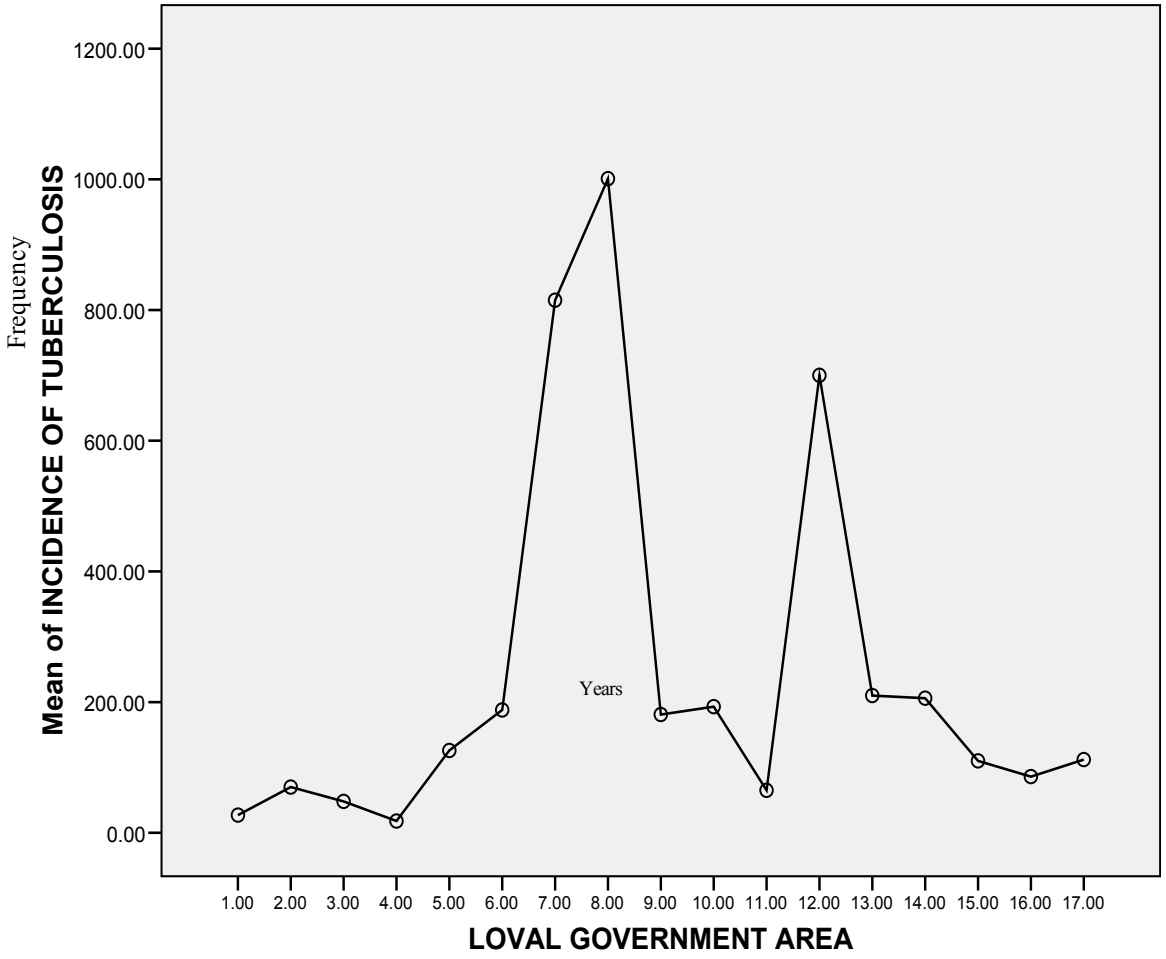

Figure 1. Mean plot showing the degree of variation of the disease incidence

Aside the fact that Enugu north L.G.A has the highest population apart from Enugu east[13], and equally has the highest urban population in the state, the University of Nigeria teaching hospital, Enugu is located in it. Most patients then, especially those from Enugu east and south[13] preferred going there because of a perceived better treatment from the hospital. Nsukka L.G.A on its own is a very strategic and important L.G.A in the region with the third highest urban population. Expectedly, it had the second highest number of new smear positive cases for the period under study. Igbo-eze north L.G.A with the third highest incidence is an exception to percentage urban population. Fieldwork revealed that its increased incidence record came from the neighbouring communities of Benue and Kogi states. Such patients found it more convenient accessing the DOT centre there, in order to avoid being stigmatized by their people on finding out that they were tuberculosis patients.

Nkanu-west and Nkanu-east with the least urban population percentage recorded the least new smear positive cases (Table 2).

Table 2. Urbanization and Incidence of Tuberculosis

L.G.AS	PERCENT POPULATION URBAN	NO OF CASES
Enugu east	99.4	33
Uzo-uwani	17.3	17
Udi	36.9	6
Enugu- north	98.2	151
Enugu south	94.3	49
Awgu	21.8	22
Aninri	39.6	14
Ezeagu	14.4	8
Igbo-etiti	56.9	18
Igbo-eze north	10.2	150
Isi-uzo	51.4	35
Udenu	47.7	37
Nkanu-east	14.8	8
Nkanu-west	15.7	8
Nsukka	63.5	130
Oji-river	21.8	33
Igbo-eze south	16.0	25

To verify the relationship between the incidence of the disease and urbanization, A Pearson correlation coefficient was calculated. A weak correlation of 0.309 that is not significant was obtained. This shows that urbanization is not strongly correlated with incidence of tuberculosis. It suggests that other factors are contributory to the disease incidence in the study area.

5.1. Sex of Patients

Patterns of health and illness in women and men show marked differences. Men and women experience different health risks that stem from their biological differences as well as social, economic and cultural roles[14]. The study revealed a higher incidence for females from ages 0-14 and 15-24 years; while for ages 25-65 years and above, the incidence for males outnumbered that of the females. However, males were seen to have a cumulatively higher incidence than the females (table 3), with 57.4% and 42.6% occurrence respectively. This supports the global view that more men are diagnosed with tuberculosis than women[15, 16, and 17]. This is because men are more widely exposed to other people with infectious TB, as a result of their greater social interaction outside the home. Results of chi-square test of independence confirm this assertion. A chi-square test of independence was calculated comparing the incidence of tuberculosis for men and women. A significant result was found ($X^2(1) = 23.2$, $p < .05$). Men are more likely to have tuberculosis (52.7%) than women (47.3%) (Appendix 1).

Table 3. New Smears Positive Cases (Incidence Data)

Year	0-14 years		15-24 years		25-34 years		35-44 years		45-54 years		55-64 years		65 + years		Total		Total
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	
1995	2	1	37	28	43	33	29	24	24	8	13	10	8	6	156	110	266
1996	5	4	45	42	48	33	43	19	28	22	21	7	15	6	205	133	338
1997	3	3	30	27	68	37	39	22	29	12	17	8	7	2	193	111	304
1998	2	6	42	53	71	49	53	36	41	28	22	9	16	1	247	182	429
1999	2	3	51	59	63	57	62	36	52	37	29	14	14	8	273	214	487
2000	6	7	56	58	97	75	70	56	62	49	29	16	31	10	351	271	622
2001	5	7	50	66	89	72	76	41	59	38	35	14	19	12	333	250	583
2002	2	9	62	72	113	90	66	46	62	41	37	26	34	13	376	297	673
2003	12	15	63	83	115	96	96	61	76	34	52	25	34	7	448	321	769
2004	5	7	62	86	123	114	80	67	65	31	58	27	20	20	413	352	765
2005	0	4	52	72	131	103	90	53	87	32	43	31	34	12	437	307	744
Total	44	66	550	646	961	759	704	461	585	332	356	187	232	97	3432	2548	5980

Source: Ministry of Health, Enugu State

5.2. Age of Patients

Age has a very significant role to play in the issues of health. It determines to a great extent the issue of health, since the level of exposure of the bacteria, level of progression from infection to disease amongst others, vary with age. The incidence data in the study shows ages 25-34 years as having the highest percentage of 37.5%. This was followed by 20% for ages 15-24, and 17.5% for 35-44years. 45-54years age range had 13.3%, 65years and above had 2.5%, while 0-14years range had 1.7% (table 4).

This could be explained by the degree of exposure that each age range has. The working population age range (15-54years) recorded a higher percentage incidence, while the dependents which made up the remaining category had the lower percentage occurrence. This further buttresses the fact that tuberculosis affects mostly people in their economically productive ages. The high level of infection at this stage could be attributed to the varying exposures and environmental insults that are highest at this stage.

Table 4. Ages of Respondents

AGE RANGE	FREQUENCY	PERCENT
0-14	2	1.7
15-24	24	20.0
25-34	45	37.5
35-44	21	17.5
45-54	16	13.3
55-64	9	7.5
65 and above	3	2.5
Total	120	100.0

Furthermore, as tuberculosis has formed a lethal combination with HIV, patients within the sexually active years tend to be more susceptible to the disease. As such, the three main sexually active age ranges being 15-24years, 25-34years and 35-44years with percentage occurrences of 20%, 37.5% and 17.5% respectively, were the most affected. This gives a ratio of 75% as against the remaining 25% for the other age groups.

6. Conclusions and Recommendations

In attempting to understand the disease trend in the state, it was found that the incidence varied from year to year and across space. Many of the patients for one (behavioural) reason or the other preferred accessing DOT centres that were farther from them because of a perceived better health care, while for others, it was to avoid being stigmatized. This, in effect, makes most of them not to complete their stipulated duration of treatment, as they get discouraged after some time, due to enormous transport cost. This has the implication of facilitating multi-drug resistant type of tuberculosis, which is more deadly as well as more infectious. Tuberculosis was seen to affect both sexes in the study, with males having more of the occurrence. Both sexes as a result of the disease are vulnerable to a lot of things like frequent sickness, death, social and economic consequences. The study revealed the male folk as having more of the incidence; this in effect leads to distress on their part because of loss of income and inability to contribute significantly to household upkeep of which he is the head.

The disease incidence was also found to be high particularly among those between the ages of 15 and 54, who constitute the work force and wage earners. This then goes on to affect the economy of the state and the nation at large both now and in future if not tackled. This is supported by reports from Thailand and India as follows: “one estimate, projects that the Thai economy will lose the equivalent or US $7 billion by the year 2015, solely to tuberculosis sickness and deaths. In India, the estimated loss of economic output due to tuberculosis deaths reaches more than US $370 million every year”[18].

There is every need for the formal and informal sector to unanimously contribute to the combating of the disease through matching and forceful efforts.

APPENDIX 1

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	110.000(a)	100	.232
Likelihood Ratio	52.754	100	1.000
Linear-by-Linear Association	9.506	1	.002
N of Valid Cases	11		

a 121 cells (100.0%) have expected count less than 5. The minimum expected count is .09.

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