

Prevalence of Tuberculosis and its association with Diabetes Mellitus in a Rural Community in Federal Capital Territory Abuja, Nigeria

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Abstract

Tuberculosis (TB) and Diabetes Mellitus (DM) are communicable and non-communicable diseases of public health importance globally with the highest burden occurring in low-income countries like Nigeria. Diabetes Mellitus is one of the risk factors to Tuberculosis and co-infection with TB/DM increases the mortality and morbidity rate of both infections. Therefore, the aim of this study was focused on the prevalence of Tuberculosis and its association with diabetes Mellitus in Jahi 1 village, a rural Community in Federal Capital Territory Abuja. This study was conducted in two hundred male and female participants between the ages of 10-70 years among the residents of Jahi 1 randomly selected. Participants were screened for active TB and DM using the following methods; for TB, symptoms screening (those who have been coughing for more than two weeks), serological method using one step TB cassette Rapid Test Device (RTD)(Skytec, USA) and GeneXpert; for DM the glucose oxidase method (Randox, UK). Participants blood pressure check (BP) was estimated using Omron automated Bp apparatus. The Direct Cynamethemoglobin method was used for participants Haemoglobin estimation. Data were analyzed statistically using Graphpad prism version 7. Among the 200 participants screened, the active TB prevalence was 2.0% (4/200) using RTD method and 3% (6/200) with GeneXpert method. The mean glucose level for participants with symptoms was ± 19.5 mmol, the mean glucose level for participants without symptoms was ± 4.9 mmol/l. Of the 6 prevalent TB cases, 33% (n = 2; 95% CI; 20-30 years) had no TB symptoms, and 67% (n = 4; 95% CI 40-70) were co-infected with DM. Out of the 4 (67%) positive with TB-DM, 1 (25%) had anemia and hypertension. The prevalence of active TB in that rural community is 2-fold lower than the nation's prevalence of TB but DM patients were the most affected. GeneXpert yielded more sensitive result than the serological method, therefore, its practice should be highly encouraged by the government as it is very expensive. Hypertension and anemia could be risk factors to TB, subject to further investigation. Routine community-based TB screening of both rural and urban communities at least at 6 months interval will help achieve the End TB Strategy milestone of 20% reduction.

1. Introduction

Tuberculosis is an air-borne disease caused by a bacterium known as *Mycobacterium tuberculosis*. It

is a global health challenge, ranking as the second leading infectious cause of death and one of the most burden-inflicting diseases in the world, with

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the highest burden occurring in low-income countries. The bacteria can infect any part of the body such as the kidney, spine, brain but most especially, the lungs ([Abdurrahman](#), 2015). There are an annual estimated of 9.6 million new patients with active TB globally out of which one million people have both TB and DM (Lönroth, *et al*, 2014). Nigeria is among the eight countries in the world accounting for two third of the total 30 high TB burden countries, ranking the first in Africa and the sixth country globally accounted for 86% TB new cases (WHO, 2020). About 1.7 billion people were infected with TB in 2018 and Irrespective of the availability of curative treatment, it is the second leading infectious killer next to COVID-19 and the 13th leading cause of death globally with a total of 1.5 million death documented in 2020. (WHO, 2020). Not everyone infected with TB bacteria becomes sick. As a result, two TB-related conditions exist: latent TB infection (LTBI) and TB disease. If not treated properly, TB disease can be fatal. Latent tuberculosis infection (LTBI) and TB disease at both individual and population levels can result from numerous risk factors (Remmy, 2016). Thus, DM is one of the chronic diseases that are risk factors for the conversion of latent to active tuberculosis (Hartman-Adams *et al*, 2014).

On the other hand, Diabetes Mellitus (DM) is a metabolic abnormality rising from a deficiency in insulin secretion, insulin action, or both. DM has been recognized as risk factor for TB burden amidst other risk factors like alcohol abuse, smoking and vitamin D deficiency (Jeon and Murray, 2018). Other researchers have demonstrated that the prevalence of active TB among DM patients was 4-fold higher than the national prevalence and it varies between 3% and 36% (Natacha *et al*, 2018). The prevalence of sputum smear positive cases were 17.3% (Adedamola, 2016), and the prevalence of GeneXpert *Mycobacterium tuberculosis* is 16% in Federal Capital Territory Abuja ([Abdurrahman](#), 2015).

Centuries ago, the association of diabetes mellitus with Tuberculosis has been noted (Montiel-Jarquín *et al*, 2017). Pulmonary tuberculosis was reported three times more often among diabetic patients than non-diabetic patients even after the introduction of insulin therapy (Christian *et al.*, 2017; Mendenhall *et al*, 2017). Between 1920s and

1970s, the proportion of deaths attributable to tuberculosis among diabetic patients fell dramatically, the published record on the subject came to a virtual halt as the tuberculous diabetic became rare (Mendenhall *et al*, 2016). The incidence of Tuberculosis is decreasing gradually at the pace of 2% per year. Between the year 2015 and 2020, the cumulative decrease has been documented as 11% which is more than half way to the End Tuberculosis Strategy milestone of 20% between 2015 and 2020. An estimated 66 million lives were saved through TB diagnosis and treatment between 2000 and 2020

The rural communities are often neglected especially in under developing countries like Nigeria, therefore, this study aimed to investigate the prevalence of TB, irrespective of the presence of symptoms, and its association with Diabetics Mellitus as a risk factor in a rural Community in Federal Capital Territory Abuja.

2. Methodology

This study was conducted in Jahi 1 a satellite community, situated behind the popular Next Cash and Carry supermarket in the Federal Capital Territory (FCT), Jahi is a developing district with a rural settlement for the low-income earners. Its coordinates are 9°6'15" N and 7°26'33" E in DMS (Degrees Minutes Seconds). Two hundred (200) Subjects who are residence of the community between the ages of 15-75 who have been coughing for more than two weeks were recruited for this study. Five (5) ML of whole blood sample was collected from each of the participants, three (3) ml was dispensed into an Ethylene Diamine Tetra acetic Acid bottle (EDTA) and two (2) ml was dispensed into fluoride bottle for glucose test. Each participating individual provided spot sputum sample in a wide mouthed sample bottle for a standard diagnostic practice. Participants were asked to provide about 3 ml of sputum sample into the wide mouthed sputum cups with a wide mouth and a line to mark the amount. Some volunteers had difficulty producing such amount of sputum, therefore volunteers who submitted specimens less than 1 ml were asked to produce further specimens because it would not have allowed testing of specimens in GeneXpert. Participants were screened for active TB and DM using rapid serological technique including one step TB cassette Rapid Test Device (RTD) (Skytec,

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USA) and GeneXpert. For the GeneXpert method, the number of cartridges needed were brought out. The pouches were opened and each cartridge labelled accordingly. 2 volumes of the sample reagent were added to one volume of each of the sample separately and the lid closed. The mixture was shaken vigorously up to 15 times and incubated at room temperature for 5minutes. The specimen was shaken vigorously again up to 15 times and incubated for 10minutes until the samples were completely liquified. The liquified sample was aspirated into the pipette until the meniscus is above the minimum mark (=2.0ml) using the sterile pipette provided. The cartridge lid was opened and the sample transferred into the open port of the Xpert MTB/RIF cartridge. The sample was slowly dispensed to minimize the risk of aerosol formation. The cartridge lid was closed ensuring the lid snaps firmly into place. Start-up of

GeneXpert Instrument process was performed. The samples were analyzed according to the manufactures instruction using the GeneXpert MTB/RIF fully automated system. Xpert reports with nonvalid results (error, an invalid result, or no result) were retested, provided sufficient sample was available.

The participants glucose level was estimated from the samples in fluoride bottles using the glucose oxidase method (Randox, UK). Their haemoglobin levels were estimated from the blood samples in EDTA bottles using the Direct Cyanmethemoglobin. Participants blood pressure check (BP) was estimated using Omrom automated Bp apparatus. Data were analyzed statistically using Graphpad prism software (version 7).Ethical approval was obtained from the Chief of the rural community and all the participants gave their informed consent.

3. Result

Table 1: Prevalence Of Tb Using Rtd And Gene Xpert Methods

Gender of participants	+ve RTD %(n)	+ve Gene Xpert
Male	0.5(1/200)	1(2/200)
Female	1.5 (3/200)	2(4/200)
Total	2(4/200)	3(6/200)

Key

+ve = Positive
 RTD = Rapid Test Device

Table 2: Prevalence Of Tb-Dm-An-Hbp With Respect To Age

Age	+ve PWS	+ve PWOS	+veTB-DM-AN	TB-DM-HBP-AN
15-25	0/6 (0%)	0/6(0%)	0/4(0%)	0/4(0%)
25-35	0/6 (0%)	2/6(33%)	0/4(0%)	0/4(0%)
35-45	1/6(16.7%)	0/6 (0%)	1/4(25%)	1/4(25%)
45-55	1/6(16.7%)	0/6 (0%)	0/4(0%)	1/4(25%)
55-65	1/6(16.7%)	0/6 (0%)	0/4(0%)	0/4(0%)
65-75	1/6(16.7%)	0/6 (0%)	0/4(0%)	0/4(0%)
Total	4/6 (67%)	2/6(33%)	1/4(25%)	1/4(25%)

TB-DM-HBPAN = Participants with tuberculosis, diabetes and hypertension

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Table 3: Mean Glucose Level And Haemoglobin Level

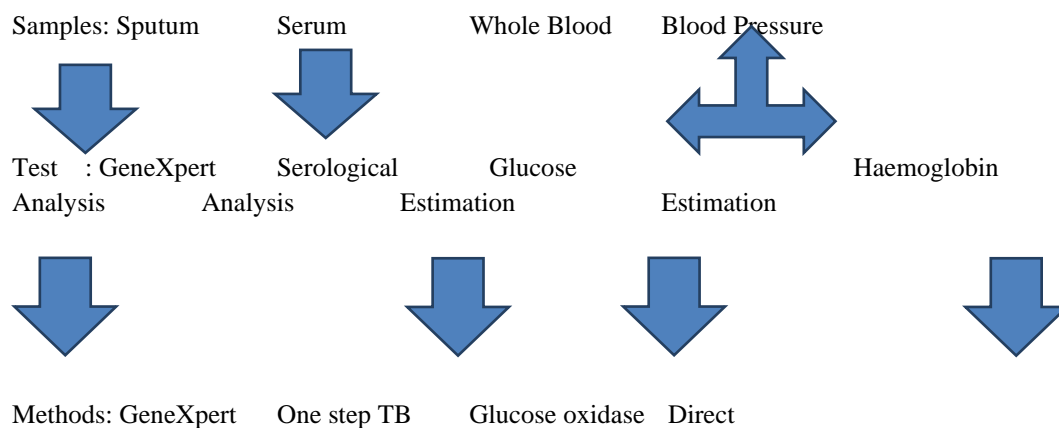
Mean glucose level	PWOS (mmol/l)	PWS (mmol/l)
Mean	±4.9	±19.5
Mean Haemoglobin level	PWOS(g/dl)	PWS(g/dl)
Mean	± 13.0	±5.3
P-value	P>0.05	P>0.05

Key

PWS = Participants with symptoms

PWOS = Participants without symptoms

Participants: 200 Subjects Age 15-75



4. Discussion

Out of the 200 subjects screened for TB using RTD serological method, 2.0% (4/200) came out positive, with GeneXpert method, 3% (6/200) came out positive. The mean glucose level for participants with symptoms was ± 19.5mmol, the mean glucose level for participants without symptoms was ± 4.9mmol/l. Out of the 6 prevalent TB cases, 33% (n = 2; 95% CI; 15-35 years) had no TB symptoms, and 67% (n = 4; 95% CI; 35-75) who showed symptoms were co-infected with DM. Out of the 4(67%) positive with TB-DM, 1(25%) had anemia and hypertension. Female participants were most infected. The prevalence of active TB in that rural community is low but DM patients were the most affected.

5. Conclusion

GeneXpert yielded more sensitive result than the serological method, therefore, its practice should be highly encouraged by the government as it is very expensive. The association of TB and diabetes could be risk factors to hypertension and anemia,

subject to further investigation. Routine community-based TB screening of both rural and urban communities at least at 6 months interval will help achieve the End TB Strategy milestone of 20% reduction. The prevalence of TB in Jahi community is 2-fold lower than the nation's TB prevalence.

6. References

[1] Abdurrahma, S. T., Mbaaso, O., Lawson, L., Oladimeji, O., Blakiston, M., Obasanya, J., Dacombe, Adams, R. E., Emenyonu, N., Sahu, S., Creswell, J. Cuevas, L. E. (2015). Testing Pooled Sputum with Xpert MTB/RIF for Diagnosis of Pulmonary Tuberculosis To Increase Affordability in Low-Income Countries. *ASM Journals, Journal of Clinical Microbiology*, 58(8): 1859. DOI: <https://doi.org/10.1128/JCM.00864-15>

[2] Lönnroth, K. Roglic, G. and Harries, A. D (2014). "Improving tuberculosis prevention and care through addressing the global diabetes epidemic: from evidence to policy and practice," *The Lancet Diabetes & Endocrinology*, 2(9),:730-

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739.

[3] WHO (2020). Global Tuberculosis Report. Creative Commons Attribution-NonCommercial-Share Alike 3.0 IGO. CC BY-NC-SA 3.0 IGO;

<https://creativecommons.org/licenses/by-nc-sa/3.0/igo>).

[4] Remy, W. L. (2016). "The association between latent tuberculosis infection and diabetes mellitus control in the United States," Theses and Dissertations-Public Health, 122.

[5] Hartman-Adams, H., Clark, K. and Juckett, G. (2014). "Update on latent tuberculosis infection," American Family Physician, 89(11).

[6] Jeon, C. Y. and Murray, M. B. (2008). "Diabetes mellitus increases the risk of active tuberculosis: a systematic review of 13 observational studies," PLoS Medicine, 5(7): 152, 2

[7] Natacha Berkowitz 1., Adaeze Okorieb, 1., Rene Goliatha, Naomi Levittc, Robert J., Wilkinson, d., Tolu Onia, B. (2018). The prevalence and determinants of active tuberculosis among diabetes patients in Cape Town, South Africa, a high HIV/TB burden setting. Elsevier,

138: 16-25

[8] Adedamola Amos Ogundeji, I Ahmadu, J Awotoye, J Ogwu, S Laraban, J Ajobiewe, O.M Akinsola. (2017). Factors Associated With Health-Care Service Delay In Diagnosis Among Tuberculosis Patients In National Tuberculosis And Leprosy Training Centre In Zaria-Nigeria. *Texila International Journal Of Public Health*, 6(4): 1-11. DOI: 10.21522/TIJPH.2013.06.04.Art002.

[9] Montiel-Jarquín, A. J., Alvarado-Ortega, I., Romero-Figueroa, M. D. S., Rodríguez-Pérez, F., Rodríguez-Lima, Loria-Castellanos, J. (2017). Acute abdomen probably caused by acute tuberculous appendicitis. A case report. *Iatreia*, 30(3):321-325

<https://doi.org/10.17533/udea.iatreia.v30n3a07>

[10] Christian Gutsfeld, Ioana D. Olaru, Oliver Vollrath, Christoph Lange. (2014). Attitudes about Tuberculosis Prevention in the Elimination Phase: A Survey among Physicians in Germany. *PLoS ONE* 9:11, e112681.

[11] Mendenhall (2016). Beyond Comorbidity: A Critical Perspective of Systemic Depression and Diabetes in Cross cultural Contexts. *Medical Anthropology Quarterly* 30:4, 462- 478