VOLUME 39, NUMBER 12
December 2022

ISSN 0189 - 160X

WAJM

WEST AFRICAN JOURNAL OF MEDICINE

ORIGINALITY AND EXCELLENCE IN MEDICINE AND SURGERY

OFFICIAL PUBLICATION OF
THE WEST AFRICAN COLLEGE OF PHYSICIANS *AND*
WEST AFRICAN COLLEGE OF SURGEONS

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WEST AFRICAN JOURNAL OF MEDICINE

ORIGINAL ARTICLE

Bidirectional Screening for Tuberculosis, Diabetes Mellitus and other Comorbid Conditions in a Resource Constrained Setting: A Pilot Study in Lagos, Nigeria

Dépistage Bidirectionnel de la Tuberculose, du Diabète Sucré et d'Autres États Comorbides dans un Contexte de Ressources Limitées : Une Étude Pilote à Lagos, au Nigeria

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ABSTRACT

BACKGROUND: The epidemiological transition in developing countries is increasing the burden of non-communicable diseases such as diabetes. We aimed to determine the outcomes of bidirectional screening for TB and diabetes (DM) in resource constrained communities, Lagos, Nigeria.

METHODS: A quasi-experimental study without control was conducted from March 1–31st, 2017 as part of the series of activities to mark the World TB Day. Community screening took place at multiple locations in multiple days. Participants were registered and screened for Tuberculosis (TB), Diabetes Mellitus (DM) and other comorbid conditions (viral hepatitis and HIV) during open medical outreaches carried out across six resource constrained communities in Lagos, Nigeria. Relevant data were collected and analyzed. Yield of TB among DM patients and vice-versa was analyzed. Associations between MTB detection among those with DM (versus those with no DM) and among those who were HIV positive (compared with those HIV negative) were determined at $p \leq 0.05$.

RESULTS: Some (24.7%) of the participants were between the ages 25–34 years. Majority were males (65.8%), Christians (55.7%), Married (73.7%), and 37.8% had secondary education. Many (41.0%) of the participants had 3–4 persons per household, and 1–2 persons per room (44.5%). 109(26%) of individuals screened were presumptive and 18(16.5%) of the 109 presumptive were MTB detected. Also, hyperglycemia (Fasting Blood Sugar, FBS >126 mg/dl or random blood sugar, RBS level >200mg/dl) was diagnosed in 31(5%) of the 620 patients screened. Overall, 1(3.2%) of the 32 patients with DM were diagnosed with TB while 1(5.5%) of the 18 patients with MTB detected were diagnosed with DM and no significant difference in TB or DM detection in either of the groups (p=1.000). The overall yield (in all participants) of HIV in this intervention was 1.27%, DM was 5.0% and HBsAg was 2.1%.

CONCLUSION: This intervention showed that approximately one out of every twenty newly diagnosed TB patients in resource constrained communities had DM as a comorbid condition. This finding underlines the need to strengthen bidirectional screening for TB–DM in order to achieve additional gains in tuberculosis case findings in resource constrained and high TB burden countries. **WAJM 2022; 39(12): 1305–1311.**

Keywords: Comorbidities, diabetes mellitus, bidirectional screening, Tuberculosis.

RÉSUMÉ

CONTEXTE: La transition épidémiologique dans les pays en développement augmente le fardeau des maladies non transmissibles telles que le diabète. Nous avons cherché à déterminer les résultats du dépistage bidirectionnel de la tuberculose et du diabète (DM) dans les communautés à ressources limitées de Lagos, au Nigeria.

MÉTHODES: Une étude quasi-expérimentale sans contrôle a été menée du 1er au 31 mars 2017 dans le cadre de la série d'activités marquant la Journée mondiale de la tuberculose. Le dépistage communautaire a eu lieu à plusieurs endroits en plusieurs jours. Les participants ont été enregistrés et dépistés pour la tuberculose (TB), le diabète sucré (DM) et d'autres conditions de comorbidité (hépatite virale et VIH) lors d'actions de proximité médicales ouvertes menées dans six communautés à ressources limitées de Lagos, au Nigeria. Les données pertinentes ont été collectées et analysées. Le rendement de la TB parmi les patients atteints de DM et vice-versa a été analysé. Les associations entre la détection de la tuberculose chez les personnes atteintes de DM (par rapport à celles qui n'en sont pas atteintes) et chez les personnes séropositives (par rapport aux personnes séronégatives) ont été déterminées à une $p \leq 0{,}05$.

RÉSULTATS: Certains (24,7 %) des participants étaient âgés de 25 à 34 ans. La majorité était des hommes (65,8 %), chrétiens (55,7 %), mariés (73,7 %) et 37,8 % avaient une éducation secondaire. Beaucoup (41,0%) des participants avaient 3-4 personnes par foyer, et 1-2 personnes par chambre (44,5%). 109(26%) des individus dépistés étaient présomptifs et 18(16,5%) des 109 présomptifs ont été détectés par MTB. De plus, une hyperglycémie (glycémie à jeun, FBS >126 mg/dl ou glycémie aléatoire, RBS >200mg/dl) a été diagnostiquée chez 31(5%) des 620 patients dépistés. Dans l'ensemble, 1(3,2 %) des 32 patients atteints de DM ont reçu un diagnostic de tuberculose, tandis que 1(5,5 %) des 18 patients chez qui le bacille du charbon a été détecté ont reçu un diagnostic de DM. Il n'y a pas de différence significative dans la détection de la tuberculose ou du DM dans l'un ou l'autre des groupes (p=1,000). Le rendement global (chez tous les participants) du VIH dans cette intervention était de 1,27%, le DM était de 5,0% et l'HBsAg de 2,1%.

CONCLUSION: Cette intervention a montré qu'environ un patient tuberculeux sur vingt nouvellement diagnostiqué dans des communautés aux ressources limitées avait un diabète comme comorbidité. Ce résultat souligne la nécessité de renforcer le dépistage bidirectionnel de la tuberculose et du diabète afin d'obtenir des gains supplémentaires dans la découverte de cas de tuberculose dans les pays à ressources limitées et à forte charge de tuberculose. **WAJM 2022; 39(12): 1305–1311.**

Mots clés: Comorbidités, Diabète sucré, Dépistage bidirectionnel, Tuberculose.

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Abbreviations: AIDS, Acquired Immunodeficiency Syndrome; **DM,** Diabetes Mellitus; **DOTS,** Directly Observed Therapy Short Course; **ELISA,** Enzyme Linked Immunosorbent Assays; **FBS,** Fasting Blood Sugar; **HIV,** Human Immunodeficiency Virus; **HbsAg,** Hepatitis B surface antigen; **LFT,** Liver Function Test; **LGA,** Local Government Area; **MTB,** Mycobacterium Tuberculosis; **OGTT,** Oral Glucose Tolerance Test; **PLHIV,** People Living with HIV; **RBS,** Random Blood Sugar; **SPSS,** Statistical Program for Social Sciences; **TB,** Tuberculosis; **WHO,** World Health Organization.

INTRODUCTION

Nigeria is a high burden country for TB, TB/HIV and Multi-drug resistant TB (MDR-TB) with an estimated annual incident TB cases of 407,000.[1] The 2019 National TB Program annual report stated that 106,533 of the estimated 407,000 TB cases (26% treatment coverage) were notified giving a gap of 300,467 cases yet to be notified including 40,479 missed HIV positive incident TB Cases [1]. Unarguably, there are strong interactions and linkages between tuberculosis and non-communicable disease such as diabetes.[2] In Nigeria, HIV testing is routinely offered to TB patients due to an increased prevalence of co-infection, but diabetes screening is not routinely offered and might be of value if the background prevalence of these diseases is significant in patients with active TB. The association between diabetes and TB has been known for many years but studies in the last decade have highlighted that diabetes increases the risk of active TB and that patients with TB/DM comorbidities have worse TB treatment outcomes such as treatment failure, relapse and mortality compared with those who have just TB alone.[3] Previously, studies from Ogun , Lagos and Oyo State, Nigeria reported prevalence of diabetes among TB patients at 11%, 4.8% and 7.9% respectively.[4–6] The impact of comorbid chronic viral hepatitis with TB through indirect effect of hepatitis and HIV medications on blood sugar levels have also been demonstrated.[7–10] For instance, interferon-gamma used in the management of Hepatitis C as well as anti-retroviral therapy for People Living with HIV (PLHIV) both increase the risk of diabetes which in turn alter the clinical course and outcome of tuberculosis.

Since 2011, the WHO has recommended collaborative care and control of tuberculosis and diabetes in recognition of established link between TB and diabetes.[11] Despite the high burden of both diabetes and tuberculosis in Nigeria, there is currently no public health strategy for bidirectional TB-DM screening. Most available data are facility-based and there is lack of representativeness of the two diseases (TB and Diabetes) at community level. Epidemiological data at community level will provide baseline information for the burden of diabetes and TB coexistence and generate evidence for priority setting in bidirectional policy implementation. We therefore aimed to assess the prevalence of DM (and other comorbidities) and among newly diagnosed adult tuberculosis cases in resource constrained communities, Lagos, Nigeria.

SUBJECT, MATERIAL AND METHODS

Study Design

This was a quasi-experimental study without control to assess the yield of TB and co-infections with DM, viral hepatitis and HIV among urban dwellers in Lagos, Nigeria. The intervention was carried out from March 1–31st, 2017 as part of the multi-venue outreaches organized in commemoration of the annual World TB Day. Community based medical screening outreaches were carried out across 6 purposively selected urban communities in high TB prevalent Local Government Areas (LGAs) in Lagos, Nigeria.

Study Setting

The study was carried out in Lagos, Nigeria. Lagos is an urban city in Southwestern Nigeria with a population of over 20 million people, 20 Local Government Areas (LGAs) and 57 Local Council Development Areas (LCDA).[12] However, only five LGAs (Ikeja, Ojo, Ifako Ijaiye, Apapa and Ajeromi-Ifelodun) with high TB prevalence were purposively selected for this study. TB control activities in Lagos State is being coordinated by the Lagos State TB, Leprosy and Buruli Ulcer Control Programme. Genexpert was the mainstay of TB diagnosis and was offered free of charge while chest x-ray services were largely paid for with the exception of children. The selected communities were densely populated with congested residential conditions, dense mix of migrants and temporary settlers characteristic of typical urban communities.

Selection of Study Settings

One community was purposively selected per LGA with the exception of Ajeromi with 2 outreach locations. The five LGAs selected for this study were the top five with the highest reported TB Case Notification Rate (CNR) according to available data from Lagos State TB and Leprosy Control Programme.

Description of Intervention

The intervention was used to provide community members with free medical screening and diagnosis which include TB, DM and other conditions (viral hepatitis B and HIV). Each outreach location had a team of healthcare workers consisting of medical doctors, laboratory scientist (Genexpert focal person for the collection of sputum for TB test), TB Local Government Supervisor, health educator, community health extension workers, referral coordinator and a nurse. Testing for these diseases was preceded by pretest counselling while post-test counselling and immediate escort referral to the appropriate health facility was done when indicated. Results were available to participants within 24 hours. Patients who could not collect TB results same day were followed up within 48 hours via phone number collected during the screening. Advocacy visits were made to the community heads and traditional rulers of the participating communities where they were briefed about the intervention. Benefits, risks and inclusion criteria were explained and approval for the intervention was sought. In the preceding 2 days before the intervention, research assistants visited the respondents, provided information on screening location, timing and other details such as the need to fast 8 hours before the free medical screening. Patient weight, height, blood pressure and other investigations were carried out. Participants were offered 3 tests-hepatitis B, DM and HIV. TB was diagnosed by collecting one sputum sample from presumptive TB case for Genexpert after positive response to cough of two weeks. Rapid test kits were used to make diagnosis of hepatitis B as well as HIV. DM was diagnosed by taking either fasting blood sugar or random blood sugar. Patients with confirmed diagnosis were provided escorted referral services to the nearest health facility and treated accordingly.

Screening Procedures

In diagnosing TB, one spot sputum sample was collected on the outreach day and this was taken to the nearest genexpert site for analysis. Genexpert remains the first line in the diagnosis of TB in Nigeria and is available free of charge. All sputum samples were taken following standard infection control protocol and results made available within 48 hours of sample collection. All known TB and DM patients on drugs were excluded from the study after initial verbal screening. Diabetes was diagnosed based on the 1999 WHO diagnostic criteria for DM. According to the 1999 WHO diagnostic criteria,[13] the cut-off plasma glucose values for diagnosing DM are as follows: Fasting Blood Sugar $\geq$ 126mg/dl OR Random Blood Sugar $\geq$ 200mg/dl OR Plasma glucose 2-h post-glucose load (75 g) $\geq$ 200mg/dl. Fasting Blood Sugar (FBS) less than or equal to 99mg/dl was classified as normal while a value of 100–125mg/dl was regarded as impaired blood sugar. Blood glucose was measured using Accu-check rapid glucose meter. All known diabetes patients on drugs were excluded from the study after initial verbal screening. In diagnosing HIV, participants were investigated for antibodies to HIV using 2 rapid screening strips and a commercially available enzyme-linked immunosorbent assay (ELISA)-based kit for determination of HIV-1/2/P24/O. Testing for HBsAg was based on the Accu-chek rapid test kits and results were read and made available immediately. The tests were conducted following quality assurance mechanism and adherence to national testing algorithms. All samples were taken following a standard infection prevention procedure.

Study Size

The total sample size was 625, average of 104 respondents per community.

Sampling Technique

Six communities were purposively selected across 5 LGAs because of the high burden of tuberculosis in Lagos, Nigeria. A multistage sampling technique was adopted. In the first stage, using simple random sampling, three streets were selected in each six study communities. Systematic random sampling was subsequently used to select houses in the street. One household was then selected in each house using simple random sampling. Eligible respondents were then selected per household consecutively for mobilization on the day of the outreach until the sample size was reached for that community. In houses with no eligible household members/not willing to participate/resident not met, the next household was approached.

Participants

A total of 632 participants were recruited for the study with average of 104 subjects per community.

Inclusion and Exclusion Criteria

Participants were eligible if aged 18 years old or more; had history of cough of 2 weeks or more, had lived for at least 3 months in the slum community and not previously diagnosed for TB and DM. Those who did not provide consent or failed tom meet the inclusion criteria were excluded from the study.

Independent Variables

The independent variables include age, sex, ethnicity, religion, marital status, education, social history, average household size and body mass index, BMI calculated as Weight/(Height)^2.

Outcome Variables

Primary outcome variables of interest include the number/proportion of newly diagnosed TB patients with HIV comorbidity, the number/proportion of newly diagnosed TB patients with viral hepatitis B comorbidity, the number/proportion of newly diagnosed TB patients with DM comorbidity.

Data Sources and Measurement

The researchers designed semi-structured questionnaire to collect basic information from the participants during the screening process. The information collected were the sociodemographic data, and anthropometric data (weight and height). The questionnaire was also used for the documentation of the participants screening results for diabetes (FBS or RBS), HBV, HIV, and TB (genexpert). Results of fasting blood sugar were categorized into normal glucose (<100mg/dl), prediabetes/impaired FBS(>126mg/dl) and diabetes (>126mg/dl). For participants who did not fast overnight and subject to random blood sugar(RBS) test, RBS results were also categorized into Normal (<159 mg/dl), impaired (160–199 mg/dl) and diabetes (>200 mg/dl). Four trained data entry clerks entered the information from the completed questionnaire into Microsoft Excel data entry spreadsheet.

Bias

Several measures were put in place to minimize study bias. All study participants were asked if they fasted overnight to avoid misclassification of sugar test as either random or fasting sample. Individuals currently on TB or DM medications were also excluded from the study to avoid falsely elevated sugar level that may further bias the study results.

Data Analysis

Participants information and results were entered into Microsoft Excel and later categorized, coded and cleaned before being transferred into Statistical Software for Social Science (SPSS) version 22 for additional statistical analyses. In addressing the research objective, we applied descriptive statistics to summarize the socio-demographic status, described the yield of TB among DM patients and vice-versa, TB comorbidity with HIV, Diabetes mellitus and viral hepatitis. Numbers and the proportion of total respondents confirmed with MTB positive results in each section were recorded and aggregated. The rate of comorbid conditions among those with MTB detected (positive) result was obtained by taking the proportion of participants with comorbid conditions of the universe of confirmed TB patients. Considering the small number of MTB positive patients and effect size considerations, between group comparison of DM comorbidity among MTB positive and MTB negative participants was based on frequency and percentage. Also,

comparison of the rate of MTB detected among DM patients (versus non-DM) as well as among HIV positive patients (versus HIV negative) was made at $p<0.05$.

RESULTS

Descriptive Data

A total of 632 community members participated in this intervention with average of 104 subjects per location. Some (24.7%) of the participants were between the age group 25–34 years, Males (65.8%), Christians (55.7%), married (73.7%), and 37.8% had a secondary education. Many (41.0%) of the participants had 3–4 persons per household (Table 1).

Some (14.4%) out of the 90 participants who fasted for more than 8 hours overnight and screened for fasting blood sugar (FBS) had >126 mg/dl level while 3.4% out of the 530 participants screened for random blood sugar level had glucose level >200mg/dl. Overall, 5.5% of TB patients had DM (Table 2).

The yield (among all respondents of HIV infection in this intervention was 1.27%, DM was 5.0% and HBsAg was 2.1%. Out of the 18 patients who had bacteriologically confirmed TB, 5.5% had HIV co-infection, 5.5% had diabetes mellitus as a co-morbid condition and none had HBsAg coinfection (Table 3).

Overall, 1(3.2%) of the 32 patients with DM were diagnosed with TB while 1(5.5%) of the 18 patients with MTB detected were diagnosed with DM. There was no significant difference in MTB detection among those with DM (versus those with no DM) and no significant difference in MTB detection among those who were HIV positive (compared with those HIV negative) (Table 4).

DISCUSSION

The study aimed to determine the yield of TB and comorbidity with diabetes and other conditions (HIV and hepatitis) in resource constrained communities, Lagos, Nigeria. The overall yield (among all respondents) of HIV infection was 1.27%, DM (5.0%) and HBsAg (2.1%). TB yield was 16.0% in this population. TB comorbidities with Diabetes, HIV and hepatitis B were respectively 5.5%, 5.5% and 0.0%. TB/HIV comorbidity in this

Table 1: Socio-demographic Characteristics of Respondents N=632

Characteristics	Number	Frequency
Age(years)		
<15	8	1.3
15 – 24	33	5.2
25 – 34	156	24.7
35 – 44	151	23.9
45 – 54	138	21.8
55 – 64	82	13.0
>65	64	10.1
Sex		
Male	416	65.8
Female	216	34.2
Religion		
Christianity	352	55.7
Islam	277	43.8
Traditional Religion	3	0.5
Ethnicity		
Yoruba	469	74.2
Ibo	69	10.9
Hausa/Fulani	44	7.0
Others	50	7.9
Marital Status		
Single	91	14.4
Married	466	73.7
Separated/Divorced	23	3.7
Widowed	52	8.2
Education		
No formal education	132	20.9
Primary	170	26.9
Secondary	239	37.8
Tertiary	91	14.4
Average no of Household		
1 – 2	99	15.7
3 – 4	259	41.0
5 – 6	180	28.5
7 – 8	51	8.1
8 – 10	16	2.5
>10	27	4.3
No of persons per room		
1 – 2	281	44.5
3 – 4	243	38.4
5 – 6	90	14.2
>6	18	2.9
Social History		
Family history of Diabetes	35	18%
Family history of hypertension	52	26%
Drinks alcohol	86	43%
Smoke cigarette	25	13%
BMI (kg/M^2 n=619 (missing data excluded)		
<18.5 (underweight)	78	12.6
18.5 – 24.9 (Normal)	297	48.0
25 – 29.9 (overweight)	145	23.4
30 – 34.9 (‘obesity Class I)	73	11.8
35 – 39.9 (‘obesity Class II)	13	2.1
40 and above (‘obesity Class III) (extreme obesity)	13	2.1

Table 2: Pattern of Fasting and Random Blood Sugar Level of Respondents (Missing Data Excluded)

	Frequency	Percentage
FBS mg/dl N=90		
<100(normal glucose)	69	76.7
100 – 125		
(Impaired fasting glucose or pre-diabetes)	8	0.9
>126 (diabetes)	13	14.4
Total	90	
RBS (N=530)		
<159	500	94.3
160 – 199	12	2.3
>200	18	3.4
Total	530	
Diagnosed DM (FBS >126 g/dl or RBS >200g/dl (N=620)	31	5.0

Table 3: Co-morbid Conditions among Bacteriologically Diagnosed TB Patients

	MTB Positive N=18 (%)	MTB Negative N=91 (%)	MTB unknown (non- presumptive) N=523 (%)	MTB negative and unknown N=614 (%)	Total (%)
HIV positive	1(5.5)	4(4.4)	3((0.6)	7(1.1)	8 (1.27)
Diabetes mellitus	1(5.5)	4(4.4	26(4.9)	30(4.9)	31(5.0)
HBV positive	0(0)	1(1.1)	12(2.3)	13(2.1)	13(2.1)

intervention was lower than 18.4% in a facility-based study in Lagos, Nigeria.[14] The study was conducted in 2011 and the decline in new HIV infections as a result of improved anti-retroviral therapy (ART) coverage over the last decade could explain current finding.

Our finding on TB/DM comorbidity was similar to reported TB/DM comorbidity of 5.5%, 5.9% and 5% in studies carried out in Nigeria, Spain and India respectively,[15–17] higher than results from Guinea-Bissau (2.8%) and Benin (1.9%)[18,19] but lower than 8.3%, 8.5% and 21% among newly diagnosed TB patients in Ethiopia, Uganda and Kerala India respectively.[20–22] The low prevalence of DM among TB patients in Benin and Guinea-Bissau may be as a result of low TB burden in those countries and higher prevalence in the younger population who usually have low prevalence of DM when compared with those above 45 years. The Kerala study with higher DM comorbidity (when compared with current findings) utilized glycosylated haemoglobin levels criteria, which is recognized by World Health Organization (WHO) as a more sensitive diagnostic tool for DM.

1(3.2%) of the 32 patients with DM were newly diagnosed with TB while 1(5.5%) of the 18 patients with MTB detected were newly diagnosed with DM, indicating that the bidirectional strategy of routinely screening all TB patients for DM and vice-versa is likely to be feasible and cost-effective. A study from Lagos, Nigeria reported DM prevalence of 3.7% among TB patients, TB/DM comorbidity of 5.7% and TB/HIV coinfection of 4.8%.[23] This study also reported that the most common symptom of TB was weight loss found in 94% of the 351 enrolled TB patients. Our study relied solely on presumptive cough symptom and genexpert as the only means of TB diagnosis. The use of chest x-ray would have probably increased the TB yield in this intervention and increase the universe of diagnosed TB patients among patients who may neither show symptom of cough nor produce sputum including some individuals with diabetes. In Pakistan, despite efforts to promote bi-directional screening of TB and DM, the uptake of TB testing among pre-diabetes and diabetes cases was only 4.7%, while the uptake of DM testing among MTB positive cases was 21.8%.[24] Also, a cross-sectional study from New Jersey earlier observed that the extent of TB disease on chest x-ray was significantly higher for DM+ cases compared with DM negative cases.[25] A total of 24% of DM+ cases had evidence of cavitation on chest x-ray compared with 5% of cases in the study further supporting the evidence of high possibility of missing out some TB cases among diabetic patient in our study as a result of reliance on genexpert only without radiological diagnosis. Scaling up radiological diagnosis as part of TB-DM bidirectional screening policy will therefore help to identify additional missing TB cases in this population. Despite the lack of significant within-group difference in the TB and DM detection, the 18 and 31 individuals found in this study were newly diagnosed for TB and DM respectively, further advancing the evidence for bidirectional TB and DM screening. The pattern of DM in our study also appears to follow prevalence of DM in the general population reported by the Lagos state Ministry of Health as 4.2%.[26]

This community-based intervention has some limitations; hence the results should be carefully interpreted. First, the Oral Glucose Tolerance Test (OGTT) is a more reliable test for diabetes while glycosylated hemoglobin is the most sensitive recommended test for the diagnosis of DM. This may not have much impact since participants were newly diagnosed and previously diagnosed TB and DM patients and those on drugs were excluded from this intervention. Also, the power to observe statistically significant findings is limited because the study included only small numbers of newly diagnosed, genexpert-confirmed tuberculosis cases. Similarly, we used Accu-chek rapid test kit for the diagnosis of viral hepatitis in this intervention without further use of Enzyme Linked Immunosorbent Assay (ELISA) or Polymerase Chain Reaction test. Despite some of the limitations, the strength of the study lies in the selection of individuals with no previous diagnosis of any of the comorbid conditions. Therefore, some confounders have been

Table 4: Characteristics of Respondents by MTB Positive vs Negative Diagnosis

	MTB Positive N=18	MTB Negative N=89	
Age (Years)			
<45	15	47	
>45	3	42	0.005
Sex			
Male	15	35	
Female	3	54	0.0007
Marital Status			
Single	8	14	
Married/Separated	10	75	0.011
Religion			
Christianity	7	39	
Islam	11	50	0.797
Ethnicity			
Yoruba	9	57	
Hausa/others	9	32	0.295
Education			
No Formal Education	4	18	
Some Education	14	71	1.00
No of persons per room			
1–2	6	36	
>3	12	53	0.79
Alcohol			
Yes	7	7	
No	11	82	0.001
Smoking			
Yes	2	2	
No	16	87	0.241
BMI			
<25	16	64	
>25	2	25	0.23
History of Contact			
Yes	1	18	
No	17	71	0.145
DM status			
DM	1	4	
No DM	17	87	1.000
HIV status			
HIV+	1	4	
HIV–ve	17	87	1.000

addressed-being on anti-TB or anti-DM medications or being diagnosed with TB or DM in the past which could influence the screening outcomes of both diseases in the context of transient and new onset diabetes as a result of interactive effect of anti-TB and anti-DM medication on glycaemic control.

In conclusion, pilot implementation of bidirectional screening for TB and DM shows tuberculosis yield of 3.2% among newly diagnosed diabetes patients and diabetes detection rate of 5.5% among newly diagnosed TB patients, further advancing the evidence base for bidirectional screening of TB and DM in Nigeria. Bidirectional screening for TB and HIV is a well-established and implemented policy in Nigeria. The collaboration between TB and HIV program over the last three decades has led to improved management and outcome of HIV associated TB patients, minimized duplication, and promoted coordination and use of scarce resources. These successes need to be replicated for DM and TB through a joint DM and TB steering committee that will guide national planning, implementation, resource mobilization, advocacy, research and training to achieve the goal of TB/DM bidirectional screening in the most cost-effective way.

ACKNOWLEDGEMENTS

The authors wish to thank the LGA TB supervisors and the Lagos State Tuberculosis, Leprosy and Buruli Ulcer Control Program. Our special thanks go to the leadership of the surveyed communities who gave us access to interview the community members.

Conflict of Interest

The author(s) declare that they have no competing interests.

Authors Contributions

VAA conceived and designed the study; VAA,OEA and OAA coordinated the data collection; VAA, JI and OAA developed the data analysis plan; WI, VAA and OEA analyzed the data and interpreted the results; VAA OEA and JI wrote the first draft; JI,WI and OAA critically reviewed the manuscript; JI and WI provided resources; All authors approved the final version of the paper.

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