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# Prognostic factors among TB and TB/DM comorbidity among patients on short course regimen within Nairobi and Kiambu counties in Kenya

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ABSTRACT

*Background:* The double burden of diabetes mellitus (DM) and pulmonary tuberculosis (TB) is one of the global health challenges. Studies done in different parts of the world indicate that 12%-44% of TB disease is associated with DM. In Kenya TB-DM co-morbidity data is scarce and is not readily available. In this study we set to determine the difference in treatment outcomes among TB and TB/DM comorbidity patients and their respective clinical and socio-demographic characteristics.

*Objective:* To determine prognostic factors among TB and TB/DM comorbidity among patients on short course regimen within Nairobi and Kiambu counties in Kenya.

*Methods:* We carried out a prospective cohort study of non-pregnant patients aged 15 years and above that tested positive for TB in two peri-urban counties in Kenya between February 2014 and August 2015. Clinical and socio demographic data were obtained from a questionnaire and medical records of the National TB program patient data base at two, three, five and six months. The data consisted of TB status, HIV status, TB lineage, County, (Glucose, %HbA1c, creatinine) weight, height, BMI, regimen, sex, level of education, employment status, distance from health facility, number of cigarettes smoked, home size, and diet. Univariate analysis was then used to compare each potential risk factor in the TB and TB/DM patients by the Pearson $x^2$ test of proportions or fisher exact test, as appropriate.

*Results:* DM prevalence (HbA1c > 6%) among TB infected patients was 37.2%. Regimen, employment status, alcohol intake, smoking, age and household size were some of the factors associated with DM among TB patients at $p$-value < 0.05. The number of cigarettes smoked per day and the value of the BUN were significant risk factors of developing DM among TB patients ($p$ values = 0.045). Mean time to conversion from positive to negative was slightly higher for the TB-DM patients compared to the TB patents, though not statistically significant ($p$ = 0.365).

*Conclusion:* Patients regimen, employment status, alcohol intake, smoking, age and are associated with DM among TB patients.

## Introduction

Infectious and chronic disease co-morbidity is often due to mutual risk factors as well as direct interaction [1–3]. Currently one of the global health challenges is the double burden of diabetes mellitus (DM) and pulmonary TB [4,5]. In 2015WHO global reports indicated an annual new tuberculosis (TB) case detection of 10.4 million out of which 1.8million resulted in death (WHO, 2016), while DM had 415 million cases out of which 5 million resulted in fatalities [6–8]. TB and DM co-morbidity is well documented in low and medium income countries (LMIC) accounting for 95% and 75% of TB, and DMcases respectively [2,4]. This rising DM epidemic in LMIC already burdened with TB, may threaten some of the gains made by TB control programs [5].

Studies done in different parts of the world indicate that 12–44% of TB disease is associated with DM [4,9]. DM triples the risk of developing active TB among infected individuals [10–12] by directly impairing the innate and adaptive immune responses that are necessary to counter the progression of the infection [10,11]. Association between TB and DM is supported by the fact that DM is a known to impair mediated immunity that increases susceptibility to develop TB disease and increase the risk of relapse. In addition active DM adversely affects TB treatment outcomes by delaying microbiological response [13,14].

Despite the collaborative framework for care and control by WHO guidelines on TB-DM co-morbidity management (WHO 2011), most

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sub-Sahara African countries still lag behind in screening all TB patients seeking care for DM [15,16]. With a point prevalence of 558 per 100,000 according to the National Tuberculosis, Leprosy and Lung Program (NLTD) prevalence survey of 2017, Kenya is one of the top 22 countries in the world in regards to high TB disease burden. Though unpublished reports indicate higher rates of non-communicable resultant deaths, reported data indicates it contributed to 1% of notified fatalities [17–19]. This indicates a dearth of data or underestimation of the disease burden and consequently TB-DM co-morbidity worldwide. In Kenya, TB-DM co-morbidity data is scarce and is not readily available. In this study we set to estimate the prevalence of DM among newly diagnosed TB cases and associated risk factors at randomly selected health facilities in Nairobi and Kiambu counties in Kenya. We evaluated the difference in treatment outcomes among TB and TB-DM co-morbidity patients in line with the Kenya National TB Program treatment guidelines recommending that all patients with TB use standardized short regimens for treatment.

## Material and methods

### *Study design*

We carried out a prospective cohort study in two counties, Kiambu and Nairobi, in Kenya between February 2014 and August 2015. Patients aged above15 years who tested positive for Mycobacterium tuberculosis complex on sputum smear microscopy and were not pregnant at the time of diagnosis were eligible to participate. Ethical approval for the study was obtained from the Kenyatta National Hospital Ethical Research Committee (KNH/UoN-ERC) and the study was undertaken in accordance with the principles of the Helsinki Declaration.

Written consent was obtained from patients who agreed to participate. Venous blood drawn was collected at baseline in two separate tubes (one for fasting or random blood glucose levels and the other for HbA1c levels). This was followed by physical examination and questionnaire administration by trained healthcare personnel where detailed history, including signs and symptoms of diabetes mellitus, cigarette smoking and other life-style information were ascertained. Patients were then followed at two, three, five and six months and at end of therapy to assess adherence and clinical evaluation with sputum microscopy examination at each time when possible. The initial sputum examination was submitted for culture and pathogen identification. Patients were examined at each visit for both TB and DM.

### *Care and treatment*

Newly diagnosed tuberculosis patients were put on a six-month category I regimen comprising of 2 months of isoniazid, rifampin, pyrazinamide and ethambutol followed by four months of isoniazid and rifampin. Previously treated patients, including those who had failed prior therapy were put on category II regimen which is similar to category I except, streptomycin is included in first two months, while pyrazinamide is prolonged by one month and isoniazid, rifampin and ethambutol are given for an additional five months. Dosing was as per daily fixed dose combinations formulations as per NTLD and WHO guidelines, which were given using Directly Observed Treatment, Short-Course (DOTs) [20].

### *Data analysis*

Clinical and social demographic data were obtained from the administered questionnaire and medical records of the National TB program patient data base. The data consisted of TB status, HIV status, TB lineage, County, (Glu, %HbA1c, Creatinine) weight, height, BMI, regimen, sex level of education, employment status, distance from facility, number of cigarettes smoked, home size, and diet. Univariate

**Table 1**
Socio-demographic characteristics of the patients with TB and TB-DM co-morbidity.

| | TB ($n$ = 347) n (%) | TB-diabetic ($n$ = 129) n (%) | TB-not diabetic ($n$ = 218) n (%) |
|---|---|---|---|
| **Age categories** | | | |
| **Median age (IQR)** | 31 (13) | 32 (13) | 31 (13) |
| Under 30 | 163 (47) | 59 (45.74) | 104 (47.71) |
| 31–40 | 130 (37.5) | 54 (41.9) | 76 (34.9) |
| 41–50 | 40 (11.5) | 9 (7) | 31 (14.2) |
| 51–60 | 11 (3.2) | 6 (4.7) | 5 (2.3) |
| Over 60 | 3 (0.9) | 1 (0.8) | 2 (0.9) |
| **Gender** | | | |
| Female | 98 (28.2) | 36 (27.9) | 62 (28.4) |
| Male | 249 (71.8) | 93 (72.1) | 156 (71.6) |
| **Education level** | | | |
| No school | 15 (4.3) | 5 (3.9) | 10 (4.6) |
| Primary | 116 (33.4) | 37 (28.7) | 79 (36.2) |
| High school | 158 (45.5) | 61 (47.3) | 97 (44.5) |
| College | 58 (16.7) | 26 (20.2) | 32 (14.7) |
| **Employed** | | | |
| Yes | 233 (67.1) | 79 (61.2) | 154 (70.6) |
| No | 114 (32.9) | 50 (38.8) | 64 (29.4) |
| **Income** | | | |
| <1000 | 87 (25.1) | 29 (22.5) | 58 (26.9) |
| 1001–5000 | 66 (19) | 29 (22.5) | 37 (17.1) |
| 5001–10,000 | 84 (24.2) | 27 (20.9) | 57 (26.4) |
| >10,000 | 108 (31.1) | 44 (34.1) | 64 (29.6) |
| Missing data | 2 (0.6) | | |
| **Ever drank alcohol** | | | |
| Missing data | 1 (0.3) | 0 (0) | 1 (0.5) |
| NA | 54 (15.6) | 26 (20.2) | 28 (12.8) |
| No | 137 (39.5) | 53 (41.1) | 84 (38.5) |
| Yes | 155 (44.7) | 50 (38.8) | 105 (48.2) |
| **Ever smoked** | | | |
| Missing data | 1 (0.3) | 0 (0) | 1 (0.5) |
| NA | 7 (2) | 4 (3.1) | 3 (1.4) |
| No | 240 (69.2) | 90 (69.8) | 150 (68.8) |
| yes | 99 (28.5) | 35 (27.1) | 64 (29.4) |
| **No of cigarettes daily*** | | | |
| Missing data | 67 (67.7) | 21 (60) | 46 (71.9) |
| <20 | 24 (24.2) | 9 (25.7) | 15 (23.4) |
| >20 | 8 (8.1) | 5 (14.3) | 3 (4.7) |
| **Health seeking frequency** | | | |
| Missing data | 1 (0.3) | 0 (0) | 1 (0.5) |
| Once a year | 163 (47) | 63 (48.8) | 100 (45.9) |
| Other | 75 (21.6) | 30 (23.3) | 45 (20.6) |
| RARE | 1 (0.3) | 0 (0) | 1 (0) |
| Twice a_year_more | 107 (30.8) | 36 (27.9) | 71 (32.6) |
| **Distance from the facility** | | | |
| Missing data | 1 (0.3) | 0 (0) | 1 (0.5) |
| 0–10KM | 245 (70.6) | 95 (73.6) | 150 (68.8) |
| 11–20KM | 84 (24.2) | 28 (21.7) | 56 (25.7) |
| 21–30KM | 16 (4.6) | 5 (3.9) | 11 (5) |
| >30KM | 1 (0.3) | 1 (0.8) | 0 (0) |
| **Facility** | | | |
| Missing data | 1 (0.3) | 0 (0) | 1 (0.5) |
| Government | 224 (64.6) | 80 (62) | 144 (66.1) |
| Government_ NGO_mission | 4 (1.2) | 2 (1.6) | 2 (0.9) |
| Government_ other | 1 (0.3) | 0 (0) | 1 (0.5) |
| Government_ Traditional | 2 (0.6) | 0 (0) | 2 (0.9) |
| NG0_mission | 5 (1.4) | 2 (1.6) | 3 (1.4) |
| Private_clinic | 60 (17.3) | 27 (20.9) | 33 (15.1) |
| Private_clinic Government | 49 (14.1) | 18 (14) | 31 (14.2) |
| Private_clinic other | 1 (0.3) | 0 (0) | 1 (0.5) |
| **Household members** | | | |
| <2persons | 194 (55.9) | 65 (50.4) | 129 (59.2) |
| >2persons | 153 (44.1) | 64 (49.6) | 89 (40.8) |
| **Diet** | | | |
| Fats | 59 (17) | 27 (20.9) | 32 (14.7) |
| Sugars, Vegetables | 4 (1.2) | 0 (0) | 4 (1.8) |
| Vegetables, Meat | 3 (0.9) | 2 (1.6) | 1 (0.5) |
| Vegetables | 1 (0.3) | 0 (0) | 1 (0.5) |
| Sugars, Vegetables, Meat | 2 (0.6) | 0 (0) | 2 (0.9) |
| Fats, Meat | 1 (0.3) | 0 (0) | 1 (0.5) |
| Fats, Sugars | 28 (8.1) | 13 (10.1) | 15 (6.9) |

(*continued on next page*)