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Prevalence and determinants of tuberculosis-diabetes comorbidity in the Democratic Republic of Congo: a multi-provincial cross-sectional study

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Abstract

Background :

Tuberculosis (TB) and diabetes mellitus (DM) represent a growing syndemic in low- and middle-income countries, yet data on their comorbidity remain scarce in sub-Saharan Africa. The Democratic Republic of Congo (DRC), a high TB-burden country experiencing a diabetes transition, lacks comprehensive evidence on TB-DM prevalence and associated factors. This study aimed to estimate hyperglycaemia prevalence among TB patients and identify sociodemographic and clinical determinants of comorbidity

Methods:

We conducted a cross-sectional and analytical study from October 2023 to March 2024 in four provinces of the DRC (Sud Kivu, Kasaï Oriental, Lomami, Tanganyika). Using multi-stage stratified random sampling, we recruited 449 adults with confirmed pulmonary TB from 37 TB diagnosis and treatment centres. Fasting capillary glucose ≥ 126 mg/dL was used to define probable diabetes. Multivariate logistic regression identified independent determinants.

Results:

Of 449 participants, 85 (18.9%, 95% CI: 15.4–22.8%) had fasting glucose ≥ 126 mg/dL. In adjusted analysis, independent predictors of TB-DM comorbidity were: age ≥ 50 years (aOR = 3.23, 95% CI: 1.32–7.87), residence in Sud Kivu (aOR = 2.03, 1.79–3.17) or Kasaï Oriental (aOR = 2.48, 1.96–3.45), family history of diabetes (aOR = 1.84, 1.65–2.40), hypertension (aOR = 1.92, 1.28–3.45), presence of other chronic diseases (aOR = 1.76, 1.26–4.25), and multidrug- resistant TB (aOR = 3.04, 1.44–6.44).

Conclusion:

Nearly one-fifth of TB patients in the DRC have undiagnosed hyperglycaemia, with substantial geographic and clinical heterogeneity. These findings support integrating systematic diabetes screening into TB programs, particularly for older adults, those with MDR-TB, and patients in high-burden provinces. Targeted interventions may improve treatment outcomes and reduce TB-DM morbidity.

Introduction

Tuberculosis (TB) and diabetes mellitus (DM) represent two major global health challenges whose convergence poses an increasing threat, particularly in low- and middle-income countries (LMICs).[1] In 2022, an estimated 10.6 million people developed TB, while over 500 million individuals worldwide live with diabetes, a figure projected to rise substantially in coming decades.[2] The coexistence of these

conditions constitutes a growing "syndemic," driven by demographic transitions, rapid urbanization, and fragile health systems in resource-limited settings.[3]The relationship between TB and DM is bidirectional and biologically synergistic. Diabetes approximately triples the risk of developing active TB through impaired cell-mediated immunity, while TB infection and its treatment can worsen glycaemic control or unmask previously undiagnosed diabetes.[4,5] Furthermore, diabetes is associated with delayed TB diagnosis, increased risk of treatment failure, relapse, and death.[6] This bidirectional pathophysiology underscores the need for integrated screening and management approaches.

Sub-Saharan Africa (SSA) faces a particularly complex epidemiological situation, characterized by a persistent high burden of infectious diseases alongside a rapidly increasing prevalence of non-communicable diseases, including diabetes.[7] Despite this epidemiological transition, routine integration of diabetes screening into TB control programs remains limited in most SSA countries, largely due to insufficient epidemiological data, competing health priorities, and operational constraints.[8,9] A recent systematic review estimated diabetes prevalence among TB patients in SSA at approximately 9–15%, substantially higher than general population prevalence.[10] However, country-specific data remain geographically fragmented, with most studies conducted in single urban centres or tertiary hospitals, limiting generalizability.[11]

The Democratic Republic of Congo (DRC) is among the 30 countries with the highest TB burden globally, with an estimated incidence of 321 cases per 100,000 population in 2022.[2]Simultaneously, diabetes prevalence is rising, particularly in urbanizing populations, with national estimates ranging from 4–6% but likely underestimated due to limited screening. [12] Despite this dual burden, data on TB-DM comorbidity in the DRC is critically scarce. A recent hospital-based study in Lubumbashi (Sud eastern DRC) reported diabetes prevalence of 8.3% among newly diagnosed TB patients, [13] but this represents only one urban Centre. No multi-provincial, population- representative study has assessed TB-DM comorbidity across diverse DRC contexts, nor identified context-specific determinants to inform targeted interventions.

Understanding the prevalence and determinants of TB-DM comorbidity across the DRC's heterogeneous provinces varying in urbanization, health system capacity, conflict exposure, and socioeconomic conditions, is essential to:

1. Inform targeted screening strategies in high-risk populations
2. Guide integrated TB-DM care models adapted to local contexts
3. Strengthen national TB and NCD programs with evidence-based policies

This study therefore aimed to: (i) Estimate the prevalence of hyperglycaemia suggestive of diabetes (fasting glucose ≥ 126 mg/dL) among adult TB patients across four provinces of the DRC; (ii) Identify sociodemographic and clinical factors independently associated with TB-DM comorbidity; (iii)Provide evidence to support integration of diabetes screening into routine TB care in the DRC. To our knowledge,

this is the first multi-provincial, randomly sampled study of TB-DM comorbidity in Central Africa, addressing a critical evidence gap for policy and program planning.

Patients and Methods

Study Design and Period

This was a cross-sectional analytical study conducted from October 1, 2023, to March 30, 2024, nested within the TB LON SASA IVI project, a USAID-funded initiative supporting tuberculosis control in the DRC.

Study Setting

The study was conducted in four of six provinces where the TB LON SASA IVI project operates: (i) Suf Kivu (eastern DRC, conflict-affected, semi-urban); (ii) Kasai Oriental (central DRC, mining region, mixed urban-rural); (iii) Lomami (central DRC, predominantly rural); (iv) Tanganyika (Sud eastern DRC, rural, low health infrastructure). These provinces were selected to represent diverse epidemiological, socioeconomic, and health system contexts.

Health Facilities

Participants were recruited from TB Diagnosis and Treatment Centres (TBDTCs) supported by the TB LON SASA IVI project. By March 2023, the project supported 568 TBDTCs (498 public, 70 private) across six provinces, where 33,259 pulmonary TB cases were diagnosed and initiated treatment.[14]

Participants

Eligibility Criteria

Inclusion criteria

(i) Age ≥ 18 years; (ii) Confirmed diagnosis of pulmonary TB (sputum smear microscopy or Xpert MTB/RIF positive) within 6 months preceding enrolment; (iii) Receiving care at a TB LON SASA IVI-supported TBDTC.

Rationale for 6-month window: Limiting recruitment to recently diagnosed patients (≤ 6 months), minimized recall bias regarding symptoms, healthcare-seeking behaviour, and facilitated field logistics within study timeframe.

Exclusion criteria

None (observational design, no intervention).

Sampling Strategy

Sample Size Calculation

Based on expected TB-DM prevalence of 15% (Based on expected TB-DM prevalence of 15% (conservative estimate from SSA systematic review),[10] a desired precision of ± 5%, a confidence level of 95%, design effect of1.5 (accounting for cluster sampling) and non-response rate of 20%, the calculated sample size was 481 participants.

Sampling Procedure

A multi-stage stratified random sampling design was used: **Stage 1**: Province stratification: Four provinces purposively selected for geographic diversity. **Stage 2**: Urban/rural stratification: Within each province, health zones (HZ) were classified as urban or rural. **Stage 3**: TBDTCs were selected using probability proportional to size (PPS), where size = number of pulmonary TB cases diagnosed in preceding 6 months. **Stage 4**: Patient selection: Within each selected TBDTC, investigators compiled sampling frame from laboratory registers (Ziehl-Neelsen, Xpert results); listed all eligible patients chronologically by diagnosis date; randomly selected 13 patients per facility using Microsoft Excel random number generator. A total sampled of 37 TBDTCs × 13 patients = 481 target participants.

Data Collection. A structured questionnaire programmed into Open Data Kit (ODK) mobile application was administered via face-to-face interviews in local languages (French, Lingala, Swahili, Tshiluba). Interview duration: 60–90 minutes.

Variables Collected

Sociodemographic

Age, sex, marital status, education, occupation, Residence (urban/rural), household size. Socioeconomic status (composite score).

Clinical and behavioral: TB type (drug-susceptible, multidrug-resistant), TB treatment status (first-line, second line). **Self-reported history**: Prior diabetes diagnosis, Family history of diabetes, Hypertension, Other chronic diseases, Tobacco and alcohol use. **Glucose Measurement**: Fasting capillary blood glucose was measured using Humɑσens 2.0 plus glucometer (Human GmbH, Germany), finger-prick capillary sample after ≥ 8-hour fast, measured immediately before interview (in the early morning). Single-use lancets, alcohol disinfection, biohazard waste disposal per protocol were used. Diabetes was considered with a fasting glucose ≥ 126 mg/dL (7.0 mmol/L) based on WHO criteria. [15] Participants with glucose ≥ 126 mg/dL, 100–125 mg/dL (pre-diabetes), or < 70 mg/dL (hypoglycaemia) were referred to facility clinician for confirmatory testing and management.

Statistical analysis

The data collected on ODK was stored on the SANRU Asbl server, then extracted on Excel 2016 before being exported to SPSS 25 for statistical analysis. The qualitative data were represented in absolute and relative frequency (%), and the quantitative data in the form of means ± standard deviations (SD). The Pearson's Chi-square test or Fisher's Exact test had been used to compare proportions. The students' t-test had been used to compare the means of two groups with normal distributions. To identify the factors associated with DM, the stepwise logistic regression test was used with the calculation of aOR to estimate the degree of association. The p-value < 0.05 was used as the threshold for statistical significance for all tests used.

Results

Prevalence of comorbidity

Figure 1 presents the distribution of patients according to fasting blood glucose levels, distinguishing those with blood glucose levels below 126 mg/dl (normoglycemia) from those with blood glucose levels ≥ 126 mg/dl. Out of a total of 449 patients included in the study, 18.9% (n = 85) had a fasting blood glucose level ≥ 126 mg/dl, indicating a probable presence of diabetes, while 81.1% (n = 364) had a blood glucose level below this threshold.

Sociodemographic characteristics

Table 1 presents the bivariate analysis that highlighted the sociodemographic characteristics of patients based on their glycemic status. The average age of diabetic patients was significantly higher (45.9 ± 14.9 years) compared to that of non-diabetic patients (39.6 ± 14.4 years), with a p-value < 0.001, indicating a statistically significant association between age and the presence of diabetes in tuberculous patients. The proportion of men was higher among diabetic patients (65.9%) than among non-diabetic patients (57.4%), but the difference was not statistically significant (p = 0.095). Married patients represented the majority in both groups (approximately 68%), with most participants belonging to Christian religious denominations (Catholics, Protestants, Revival Churches). Although not significant (p = 0.136), it was observed that patients living in rural areas were more numerous among diabetics (67.1%) than among non-diabetics (59.9%). Household size is not significantly associated with comorbidity (p = 0.493), with an equitable distribution between households of less than six people and those of six people or more (Table 1).

Table 1
Sociodemographic characteristics based on TB-DS comorbidity

Variable	Overall (n = 449)	Glycemia < 126 mg/dL (non-diabetes mellitus) (n = 364)	Glycemia ≥ 126 mg/dL (diabetes mellitus) (n = 85)	p
Average age (years)	40.8 ± 14.7	39.6 ± 14.4	45.9 ± 14.9	**< 0.001**
Age group				**0.003**
18–29 years old	114(25.4)	103(28.3)	11(12.9)	
30–39 years old	116(25.8)	96(26.4)	20(23.5)	
40–49 years old	95(21.2)	76(20.9)	19(22.4)	
50 years old and above	124(27.6)	89(24.5)	35(41.2)	
Gender				0.095
Male	265(59.0)	209(57.4)	56(65.9)	
Female	184(41.0)	155(42.6)	29(34.1)	
Marital status				0.110
Single/never married	69(15.4)	63(17.3)	6(7.1)	
Cohabiting but not married	20(4.5)	15(4.1)	5(5.9)	
Married	308(68.6)	246(67.6)	62(72.9)	
Divorced/widowed	52(11.6)	40(11.0)	12(14.1)	
Level of education				0.113
Primary or less	225(50.1)	181(49.7)	44(51.8)	
Secondary	189(42.1)	155(42.6)	34(40.0)	
University	19(4.2)	17(4.7)	2(2.4)	
Other	16(4.7)	11(3.0)	5(5.9)	
Socioeconomic status				0.166
Low	312(69.5)	258(70.9)	54(63.5)	
Medium	126(28.1)	99(27.2)	27(31.8)	
High	11(2.4)	7(1.9)	4(4.7)	

Variable	Overall (n = 449)	Glycemia < 126 mg/dL (non-diabetes mellitus) (n = 364)	Glycemia ≥ 126 mg/dL (diabetes mellitus) (n = 85)	p
Occupation				0.131
Civil servant	17(3.8)	13(3.6)	4(4.7)	
Teacher	22(4.9)	20(5.5)	2(2.4)	
Businessperson	31(6.9)	24(6.6)	7(8.2)	
Student	21(4.7)	21(5.8)	0(0.0)	
Housewife	71(15.8)	63(17.3)	8(9.4)	
Unemployed	149(33.2)	116(31.9)	33(38.8)	
Other	130(29.0)	100(27.5)	30(35.3)	
I don't know	3(0.7)	3(0.8)	0(0.0)	
I prefer not to answer	5(1.1)	4(1.1)	1(1.2)	
Religion				0.955
Catholic	134(29.8)	106(29.1)	28(32.9)	
Protestant	109(24.3)	91(25.0)	18(21.2)	
Revivalist church	158(35.2)	127(34.9)	31(36.5)	
Muslim	4(0.9)	4(1.1)	0(0.0)	
Kimbanguist	6(1.3)	5(1.4)	1(1.2)	
No religion	19(4.2)	15(4.1)	4(4.7)	
Other	18(4.0)	15(4.1)	3(3.5)	
I prefer not to answer	1(0.2)	1(0.3)	0(0.0)	
Environment				0.136
Rural	275(57.2)	218(59.9)	57(67.1)	
Urban	174(38.8)	146(40.1)	28(32.9)	
Household size				0.493
< 6 peoples	130(29.0)	106(29.1)	24(28.2)	
≥ 6 peoples	319(71.0)	258(70.9)	61(71.8)	

Clinical and therapeutic characteristics

Table 2 presents the results of a bivariate analysis comparing tuberculous patients with normal blood glucose levels (< 126 mg/dl) to those with diabetes (≥ 126 mg/dl) according to clinical and therapeutic variables. This table shows that the proportion of patients with a family history of TB is slightly higher among diabetics (44.7%) than among non-diabetics (38.2%). A significantly higher proportion of diabetic patients reported having been previously diagnosed with diabetes: 17.6% versus 3.0% in non-diabetics ($p < 0.001$). Family history of diabetes is significantly more frequent among diabetic patients (27.1%) than among non-diabetic patients (17.3%) ($p = 0.031$). The proportion of patients previously diagnosed with hypertension is higher among diabetics (23.5%) than among non-diabetics (16.8%) ($p = 0.005$). Diabetic patients also report the presence of other chronic diseases (14.1% vs 7.1%), with a significant difference ($p = 0.003$). The prevalence of multidrug-resistant TB is significantly higher in diabetic patients (23.5%) than in non-diabetic patients (9.1%), with a p-value < 0.001.

Table 2
Clinical and therapeutic characteristics based on comorbidities

Variables	**Overall (n = 449)**	**Glycemia < 126 mg/dL (non-diabetes mellitus) (n = 364)**	**Glycemia ≥ 126 mg/dL (diabetes mellitus) (n = 85)**	**p**
TB in the family	177(39.4)	139(38.2)	38(44.7)	0.162
Diagnosed with DM	26(5.8)	11(3.0)	15(17.6)	**< 0.001**
Diabetes in family	38(13.8)	63(17.3)	23(27.1)	**0.031**
Diagnosed with HTA	81(18.0)	61(16.8)	20(23.5)	**0.005**
Diagnosed with chronic diseases	38(8.5)	26(7.1)	12(14.1)	**0.003**
Tobacco	43(9.6)	37(10.2)	6(7.1)	0.276
Alcohol	68(15.1)	57(15.7)	11(12.9)	0.416
Multidrug-resistant TB				**< 0.001**
No	396(88.2)	331(90.9)	65(76.5)	
Yes	53(11.8)	33(9.1)	20(23.5)	
TB treatment				0.674
First-line treatment	402(89.5)	327(89.8)	75(88.2)	
Second-line treatment	43(9.6)	34(9.3)	9(10.6)	
Don't know	4(0.9)	3(0.8)	1(1.2)	

DM: Diabetes mellitus ; HTA : hypertension ; TB Tuberculosis

Determinants of TB-DM comorbidity in DRC

Belonging to the provinces of Kasai Oriental, Sud Kivu; age 30–39 years, 40–49 years, and 50 years or older; married marital status, family history of DM; hypertension; presence of chronic diseases; and multidrug-resistant TB had emerged as factors associated with TB-DM comorbidity. After adjusting these variables in multivariate analysis, only the Sud Kivu province (aOR: 2.03; 95% CI: 1.79–3.17), the Kasai Oriental province (aOR: 2.48; 95% CI: 1.96–3.45), age ≥ 50 years (aOR: 3.23; 95% CI: 1.32–7.87), family history of DM (aOR: 1.84; 95% CI: 1.65–2.40), hypertension (aOR: 1.92; 95% CI: 1.28–3.45), the presence of chronic diseases (aOR: 1.76; 95% CI: 1.26–4.25), and multidrug-resistant TB (aOR: 3.04; 95% CI: 1.44–6.44) persisted as factors independently associated with DM in the study population (Table 3).

Table 3
Factors associated with TB-DM comorbidity in the study population

Variable	Bivariate analysis		Multivariate analysis	
	p	OR (95%CI)	p	aOR (95%CI)
Province				
Lomami		1		1
Tanganika	0.600	0.76(0.27–2.12)	0.882	0.92(0.32–2.69)
Sud Kivu	**0.040**	2.22(1.94–5.27)	**0.038**	2.03(1.79–3.17)
Eastern Kasai	**0.009**	2.19(1.88–5.40)	**0.005**	2.48(1.96–3.45)
Age				
< 30 years		1		1
30–39 years	**0.096**	1.95(0.89–4.28)	0.239	1.69(0.71–4.04)
40–49 years	**0.037**	2.34(1.05–5.21)	0.117	2.05(0.84–5.06)
≥ 50 years	**0.001**	3.68(1.76–7.68)	**0.010**	3.23(1.32–7.87)
Marital status				
Other categories		1		1
Married	**0.034**	1.40(1.03–1.92)	0.404	1.18(0.80–1.76)
DM in family				
No		1		1
Yes	**0.041**	1.77(1.02–3.07)	**0.018**	1.84(1.65–2.40)
HTA				
No		1		1
Yes	**0.046**	1.53(1.26–2.71)	**0.036**	1.92(1.28–3.45)
Chronic disease				
No		1		1
Yes	**0.041**	2.14(1.03–4.43)	**0.021**	1.76(1.26–4.25)
Multidrug-resistant TB				
No		1		1
Yes	**< 0.001**	3.09(1.67–5.71)	**0.004**	3.04(1.44–6.44)

DM: Diabetes mellitus ; HTA : hypertension; TB Tuberculosis ; aOR : Adjusted Odd Ratio

Discussion

This multi-provincial study reveals a substantial burden of undiagnosed hyperglycaemia among TB patients in the DRC, with nearly one in five (18.9%) presenting fasting glucose levels ≥ 126 mg/dL, more than double typical general population diabetes prevalence in SSA (4–6%).[16] Independent determinants included older age (≥ 50 years), geographic location (Kasaï Oriental and Sud Kivu provinces), family history of diabetes, hypertension, presence of other chronic diseases, and notably, multidrug- resistant tuberculosis (MDR-TB). To our knowledge, this is the first multi-provincial, population-representative study of TB-DM comorbidity in Central Africa, addressing a critical evidence gap for integrated disease control strategies. Our prevalence estimate (18.9%) falls within the range reported in a recent systematic review of SSA studies (9–25%),[10] but is notably higher than: (i) Previous studies conducted in DRC;[17,18] (ii) Lubumbashi hospital-based TB cohort:8.3%[13] and (ii) Ethiopia national TB survey: 3.3%.[18] However, it aligns closely with North African data (Algeria: 16.9%),[19] suggesting TB cohorts consistently show 3–4× higher diabetes burden than

general populations, consistent with the biological plausibility of TB-DM synergy.[4,6] The substantially higher prevalence in our study compared to the Lubumbashi cohort (18.9% vs 8.3%) may reflect: (i) multi-provincial sampling capturing diverse contexts vs single urban centre; (ii) Inclusion of MDR-TB patients (23.5% diabetes prevalence vs 9.1% in drug-susceptible TB); (iii) Older population (27.6% ≥50 years vs younger Lubumbashi cohort). The 3.2-fold increased odds of hyperglycaemia among patients ≥ 50 years aligned with global evidence that aging is associated with both insulin resistance (β-cell senescence, visceral adiposity) and immunosenescence (reduced T-cell mediated immunity), creating a "double vulnerability" to TB-DM comorbidity. [20,21] This finding supports age-stratified screening strategies, prioritizing older TB patients who face compounded risk. The marked provincial heterogeneity, with Kasaï Oriental (aOR = 2.48) and Sud Kivu (aOR = 2.03) showing 2–2.5× higher odds compared to Lomami, likely reflects complex interactions of: -Health system factors, - Diagnostic capacity: Kasaï Oriental and Sud Kivu host larger referral hospitals, potentially attracting more complex/severe TB cases (Berkson's bias), - TB program maturity: Earlier implementation of DOTS in these provinces may have improved case detection, including comorbid patients. Sociodemographic factors: - Urbanization: Both provinces include major urban centres (Mbuji-Mayi, Bukavu) with higher diabetes prevalence linked to dietary transitions, sedentary lifestyles,[22] and Conflict exposure. The marked elevation in TB-DM comorbidity observed in Sud Kivu (aOR: 2.03) warrants particular attention, as this province has experienced protracted armed conflict for over two decades, resulting in recurrent population displacement, health system disruption, and profound socioeconomic insecurity. [12,23,24]

Armed conflict may amplify TB-DM comorbidity risk through multiple, interconnected pathways: (i) Health system fragmentation and service disruption. Conflict-related destruction of health infrastructure,

displacement of health workers, and disruption of pharmaceutical supply chains directly compromise both TB control programs and diabetes care. In Sud Kivu, recurrent insecurity has led to: - Interruptions in tuberculosis directly observed therapy (DOT), increasing treatment failure and acquired drug resistance - Stock-outs of essential medicines (rifampicin, isoniazid, metformin, insulin), forcing patients to purchase medications out-of-pocket or discontinue treatment - Closure or reduced functionality of health facilities, delaying TB diagnosis and diabetes screening. A 2018 assessment documented that 42% of health facilities in conflict-affected Sud Kivu health zones were non-functional or only partially operational, compared to 18% in non-conflict zones.[25]

Limitations.

Despite its strengths, this study has several limitations. Diabetes was defined using a single fasting capillary glucose measurement (≥ 126 mg/dL) without confirmatory testing (repeat fasting glucose or HbA1c), which may have resulted in some misclassification. Studies suggest 10–15% of hyperglycaemia in active TB may be transient and resolve post-treatment. [4] In addition, the cross-sectional design does not allow the establishment of temporality or causality between tuberculosis and diabetes. Nevertheless, this study provides important multi-provincial evidence to inform integrated TB-diabetes control strategies in the DRC and similar settings.

Conclusion

Among 449 tuberculosis patients in the Democratic Republic of Congo, 18.9% had undiagnosed hyperglycaemia, strongly associated with age ≥ 50 years, geographic vulnerability, and notably, multidrug-resistant TB (aOR: 3.04). This threefold increased odds among MDR-TB patients suggests bidirectional mechanisms warranting urgent investigation. Systematic diabetes screening should be integrated into TB programs, prioritizing high-risk groups. Implementation requires strengthening laboratory capacity, supply chains, workforce training, and health information systems. Addressing TB–diabetes comorbidity demands shifting from vertical programs toward integrated chronic care models. This study provides evidence to catalyze that transformation in resource-limited, high-burden settings across sub-Saharan

Africa.

Abbreviations

aOR Adjusted Odds Ratio

BMI Body Mass Index

CI Confidence Interval

DM Diabetes Mellitus

DOTS Directly Observed Treatment, Short-course

DRC Democratic Republic of Congo

FBG Fasting Blood Glucose

HbA1c Glycated Haemoglobin

HPA Hypothalamic-Pituitary-Adrenal (axis)

HZ Health Zone

IDF International Diabetes Federation

IDP Internally Displaced Person(s)

LMIC(s) Low- and Middle-Income Country(ies)

MDR-TB Multidrug-Resistant Tuberculosis

mg/dL Milligrams per Deciliter

MSP Ministère de la Santé Publique (Ministry of Public Health)

NCD Non-Communicable Disease(s)

ODK Open Data Kit

OR Odds Ratio

PPS Probability Proportional to Size

SANRU Santé Rurale (Rural Health)

SD Standard Deviation

SSA Sub-Saharan Africa

TB Tuberculosis

TBDTC Tuberculosis Diagnosis and Treatment Centre

UNHCR United Nations High Commissioner for Refugees

USAID United States Agency for International Development

WHO World Health Organization

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and national guidelines for research involving human participants in DRC. Ethical approval for the pilot project and the use of programmatic routine data for research purposes was obtained from the Institutional ethics committee of the Université Protestante au Congo (**Réf: CEUPC:0204**). Administrative authorization was granted by the Ministry of Health and the Provincial Health Divisions in the selected provinces. All participants provided informed consent prior to inclusion in the study. Confidentiality and anonymity of participants were strictly ensured throughout the data collection and analysis process.

Consent for publication

Not applicable

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests.

The authors declare no competing interests.

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Authors' contributions

All authors have read and approved the final manuscript. **Conceptualization:** Philippe Lukanu Ngwala (PLN); **Methodology:** PLN, ANN, Jean-Felly Numbi (JFN); **Investigation (data collection):** Jeanne Tshibungu Ntumba (JTN), Mamie Shoma Matota (MSM), Isabelle Kufundu Kilonda (IKK), Nické Mukambilwa Ngoyi (NMN), Adrien Nsiala Kumbi (ANK), Ntumba Albert Kalonji (NAK), Felix Minuku Kinzonzi (FMK); **Formal analysis:** ANN, PLN; **Resources (funding acquisition, materials):** JLL, PLN; **Data curation:** ANN, JTN; **Writing – original draft:** PLN, JLL; **Writing – review & editing:** All authors; **Visualization (figures/tables):** ANN, PLN, **Supervision:** PLN, JLL, JFN; **Project administration:** PLN

Validation: All authors

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Figures

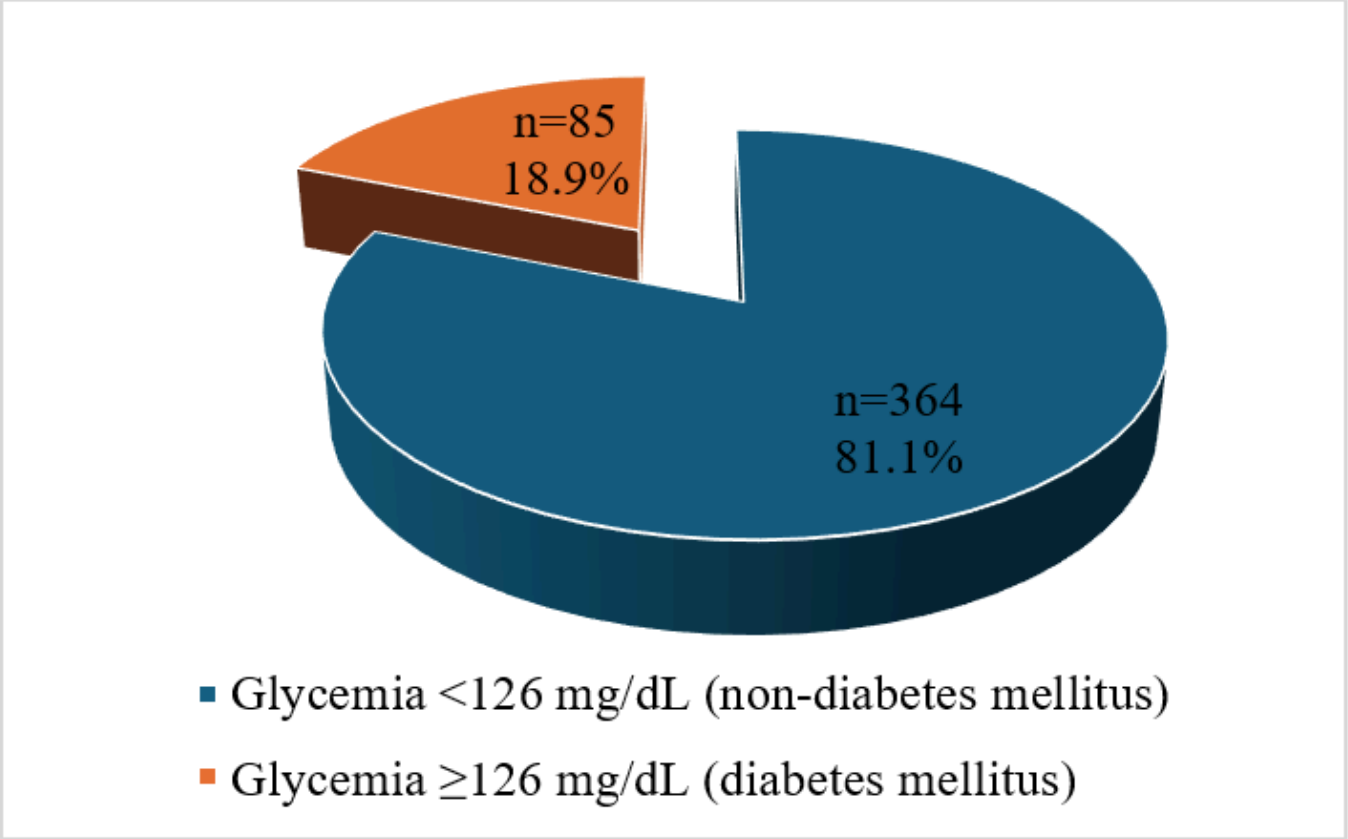


Figure 1

Prevalence of comorbidity in the study population

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