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Prevalence Of Diabetes Mellitus Among Tuberculosis Patients Attending PHC/TU/Dmcs In Rohtas District, Bihar

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Abstract
Tuberculosis (TB) and diabetes mellitus (DM) co-morbidity is an emerging public health concern, with growing evidence identifying DM as an important risk factor for TB. This study aimed to estimate the prevalence of DM among newly detected sputum-positive pulmonary TB patients and to assess associated risk factors at PHC/TU/DMCs in Rohtas District, Bihar. This cross-sectional study was conducted from 2023 to 2025 at 18 PHCs, TUs, and DMCs in Rohtas among newly detected sputum-positive pulmonary TB patients for individuals aged 1-90 years. Diabetes mellitus was diagnosed using blood glucose levels ≥200 mg/dL measured by autoanalyser. Descriptive statistics, correlation analysis, and two-way ANOVA were applied, with $p < 0.05$ considered statistically significant.OPD attendance and population coverage increased significantly over the study period, indicating improved service utilization, though marked inter-centre disparities persisted. Suspected TB detection also increased over time, reflecting strengthened screening, but with significant variability across centres and in associated diabetes detection. Among 3,299 TB patients included, the prevalence of DM was 3.3%, substantially lower than reported in many other studies, possibly reflecting local population characteristics. Routine diabetes screening among TB patients is necessary for early detection and integrated management, which may reduce complications and improve TB treatment outcomes.

Keywords: Diabetes mellitus, prevalence, risk factors, tuberculosis.

1. Introduction

Diabetes mellitus (DM) has become a major public health concern due to rapid urbanization and socio-economic development. Individuals with DM have a compromised immune response and a two- to three-fold higher risk of developing active tuberculosis (TB) compared to non-diabetic individuals [1]. Globally, DM is associated with approximately 10% of TB cases and a considerable proportion of TB–DM co-morbid cases remain undiagnosed or are detected late, leading to poor treatment outcomes [2, 3].

Diabetes mellitus adversely affects TB treatment by delaying sputum culture conversion, increasing the risk of drug resistance, mortality, and post-treatment relapse [4]. Infectious diseases such as TB further complicate glycaemic control; however, effective glycaemic management has been shown to improve TB treatment outcomes [5].

Recent evidence suggests that nearly 20% of smear-positive TB cases are associated with DM, and the rising prevalence of diabetes in India poses a significant challenge to TB control efforts [1, 6]. Despite this, data on TB–DM co-morbidity in Rohtas District, Bihar, remain limited. Hence, the present study aimed to estimate the prevalence of DM among TB patients, assess their socio-demographic characteristics, and identify associated risk factors in this region.

2. Materials and Methods

2.1. Study area:

Rohtas district, located in south-western Bihar within the Patna Division, lies between 24°30′–25°20′ N latitude and 83°14′–83°20′ E longitude, at an average elevation of about 108 m above mean sea level. The district is predominantly rural and agrarian, with demographic, socio-economic, and health characteristics typical of the Indo-Gangetic plains. Rohtas district has a predominantly rural population, with about 85.55% residing in rural areas and 14.45% in urban areas. It has a population density of 763 persons per km², which is lower than the state average. Population projections for 2025–2026 estimate the district's total population at around 36–37 lakh (3.6–3.7 million).
Administratively, it comprises 19 development blocks and is served by 13 Primary Health Centres that provide essential services, including tuberculosis (TB) care under the National Tuberculosis Elimination Programme (NTEP).

2.2. Study design:
This design was well-suited to assess the current prevalence of tuberculosis, describe its distribution across age groups, body-weight categories, and socio-demographic variables, and evaluate the reach and effectiveness of existing TB control services under the National Tuberculosis Elimination Programme (NTEP). By capturing both current and recent TB-related data at the community level, the study provides valuable evidence to inform local public health planning, targeted. A community-based cross-sectional study was conducted in Rohtas for individuals aged 1-90 years from 2023 to 2025 in Sasaram, Rohtas District, Bihar.

2.3. Data Collection Tools and Procedures:
All enrolled participants underwent a systematic clinical assessment at the Primary Health Centres. The assessment included: a. Persistent cough for ≥2 weeks, b. Fever, particularly the evening rise in temperature, c. Unintentional weight loss, d. Night sweats, e. Hemoptysis, f. Fatigue and loss of appetite, and g. Co-morbid conditions such as diabetes mellitus and HIV.

2.4. Laboratory/Diagnostic Methods:
All suspected tuberculosis cases identified during clinical assessment underwent appropriate diagnostic evaluation in accordance with the National Tuberculosis Elimination Programme (NTEP) guidelines.
1. **Molecular Testing (TruNAT)**: Rapid molecular diagnostic testing was performed to detect Mycobacterium tuberculosis and assess rifampicin resistance, wherever available. The TruNAT assay is a chip-based, real-time micro–polymerase chain reaction (RT-PCR) molecular diagnostic technique used for the rapid detection of the Mycobacterium tuberculosis complex (MTBC) and rifampicin resistance. The assay is endorsed by the World Health Organization (WHO) and implemented under India's National Tuberculosis Elimination Programme (NTEP) as a frontline molecular diagnostic tool, particularly suited for decentralized and resource-limited settings.
2. **Autoanalyser for Sugar:** Autoanalysers commonly estimate blood glucose using enzymatic methods**,** which provide high accuracy and specificity. The Glucose Oxidase–Peroxidase (GOD–POD) Method is the most frequently employed method in routine clinical laboratories.

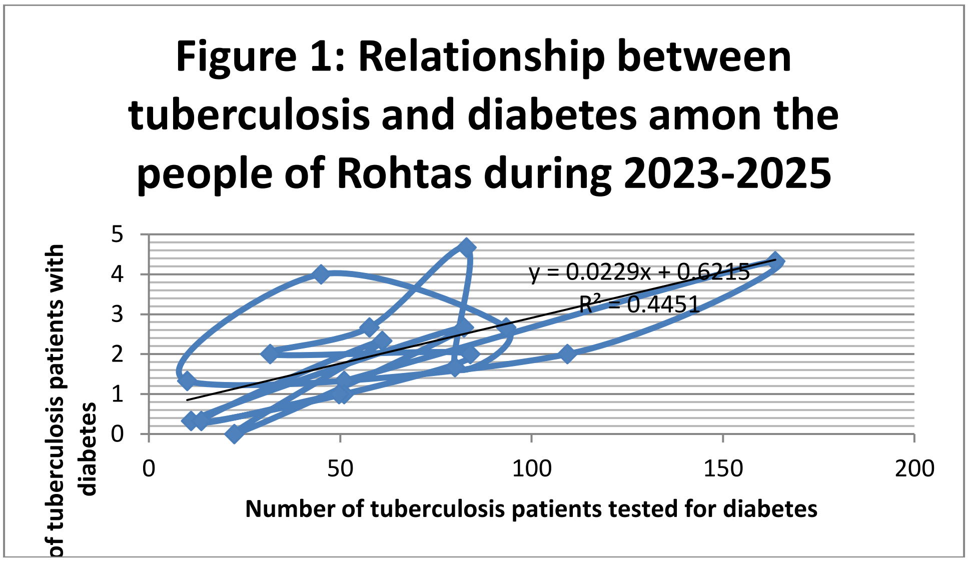
2.5. Ethical clearance was obtained from the Institutional Review Board (IRB)/Institutional Ethics Committee before initiation of the study, ensuring compliance with ethical standards for research involving human participants.

3. RESULTS AND DISCUSSION

A. OPD Attendance and Percentage of Population Coverage: Table 1 summarizes OPD attendance across PHCs, TUs, and DMCs in Rohtas from 2023–2025, showing a steady increase in service utilization with notable inter-centre variation. Total OPD visits rose from 400,518 (2023) to 406,120 (2024) and sharply to 522,156 (2025), with average population coverage improving from 13.77% to 16.26%. Higher and consistently increasing attendance was observed at centres such as Chenari, Tilauthu, Suryapura, and Bikramganj, while Karakat and Shivsagar showed persistently lower utilization.
Statistical analysis revealed a significant difference among PHC/TU/DMC units ($Fr\ (17,34) = 20.29$, $p < 0.001$), indicating substantial heterogeneity across centres. Variation in visit percentages was also

observed (Fc (2,34) = 9.55, p < 0.001), confirming temporal improvement alongside persistent spatial disparities in OPD utilization.

B. Year-wise Distribution of Suspected Tuberculosis Cases: A comparative analysis of PHC/TU/DMC units in Rohtas district (2023–2025) shows a steady rise in suspected tuberculosis (TB) cases, from 7,556 in 2023 to 10,665 in 2025, with the proportion of suspected cases among OPD visits increasing from 35.78% to 53.06% (Table 2). Detection remained consistently high at Nasariganj and Nauhatta, while centres such as Kochas, Karakat, and Kargahar showed improvement by 2025; however, inter-centre variation persisted.



Statistical analysis confirmed significant differences among centres and across years (Fr (17, 34) = 6.02, p < 0.001) and (Fc (2, 34) = 7.13, p < 0.001), indicating temporal strengthening of TB screening alongside spatial heterogeneity. Overall, TB surveillance has improved over time, although disparities in screening intensity and associated diabetes detection remain evident across centres.

C. Pattern of Diabetes Screening and Diabetes Prevalence among Tuberculosis Patients Attending PHC/TU/DMCs: Despite global attention on emerging infections, the dual burden of tuberculosis (TB) and diabetes mellitus (DM) remains a major public health challenge in India. The WHO Global TB Report 2024 estimates that diabetes accounted for approximately 0.4 million incident TB cases worldwide [7]. As India contributes nearly one-quarter of the global TB burden, it bears a substantial share of this diabetes-attributable risk. To address this, integrated management strategies have been implemented, including the National Framework for Joint TB–Diabetes Collaborative Activities launched in 2017, which enables routine diabetes screening at TB detection centres across the country.

Table 3 summarizes diabetes screening among sputum-positive tuberculosis (TB) patients at 18 PHC/TU/DMCs from 2023–2025. The number screened increased from 1,000 (2023) to 1,189 (2024) and then declined slightly to 1,110 (2025), while diabetes detection remained stable at 31–39 cases, indicating an overall prevalence of about 3.3% among TB patients. The observation seems much lower than other reports most probably due to the agricultural practices of maximum people of this area.

Regression analysis ($y = 0.022x + 0.621$; $R^2 = 0.445$) and pooled correlation ($r = 0.667$, $p < 0.001$) showed a moderate positive association between screening volume and diabetes detection. Marked inter-centre variation was observed, with higher screening and diabetes detection at centres such as Bikramganj and Chenari, and consistently low or absent detection at others, indicating uneven implementation of bidirectional TB–diabetes screening.

Statistical analysis showed significant inter-centre variation for both sugar testing (Fr (17, 34) = 7.77, p < 0.001) and diabetes detection (Fr (17, 34) = 4.70, p < 0.001) with heterogeneity in patient load and screening outcomes across facilities. However, no significant (F_c (2, 34) = 0.85 and 1.04; $p > 0.05$) variation across years was observed for either sugar testing or diabetes detection, suggesting that the overall pattern of TB–diabetes co-morbidity remained relatively stable during the study period.

The evidence linking diabetes to TB treatment outcomes is mixed. Some studies, such as that by Rekha et al. [8], found no difference in sputum conversion rates between TB and TB-diabetes patients. Others, such as Viswanathan and Gawde [9], demonstrated a significant delay in conversion among diabetic patients. These discrepancies likely stem from different methodologies, variations in glycaemic control, adherence to TB treatment regimens, and heterogeneity in study populations, particularly between urban tertiary centres and rural primary care settings. For instance, a meta-analysis by Baker et al. [10] found that diabetes increased the risk of treatment failure, death, and relapse. Limitations such as the inability to adjust for age, socioeconomic status, and sugar control further cloud the picture [11, 12].

The absence of significant year-wise variation indicates stable TB–diabetes screening outcomes despite expanded testing, highlighting the need for more uniform implementation across centres. Recent evidence and WHO operational guidance (2025) emphasize the Integrated bidirectional TB–diabetes screening for early detection, improved treatment outcomes, and effective control of the growing comorbidity burden.

4. CONCLUSION

The study demonstrates a consistent increase in OPD utilization, suspected tuberculosis detection, and diabetes screening among TB patients from 2023 to 2025, reflecting improved service access and strengthened surveillance. However, significant inter-centre variability persists across PHC/TU/DMCs, indicating the need for targeted interventions to reduce disparities and ensure uniform healthcare delivery.

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Table 1: Year-wise OPD Attendance and Percentage of Population Coverage at PHC/TU/DMCs in Rohtas District, Bihar (2023–2025)

Sl. No.	PHC/TU/DMC	Population	Total visit in OPD					
			2023	Percent of visit	2024	Percent of visit	2025	Percent of visit
1.	Akhodi Gola	158229	21192	13.39	22192	13.39	25199	15.93
2.	Bikramganj	220087	43802	19.90	45528	20.69	45156	20.51
3.	Chenari	172292	32672	13.74	34938	20.28	43617	25.30
4.	Dawath	149091	20270	13.59	21067	14.13	22658	15.10
5.	Dehri	377823	32678	8.65	44200	11.70	47800	12.67
6.	Dinara	310357	28040	9.03	29079	9.37	41136	13.26
7.	Karakat	289089	21784	7.54	25997	8.99	26577	9.10
8.	Kargahar	289677	30713	10.60	28104	9.70	32024	11.06
9.	Kochas	192273	29144	15.16	29749	15.47	30983	16.11
10.	Nasariganj	192237	15189	7.90	17482	9.09	18576	9.66
11.	Nauhatta	121286	17958	14.81	19183	15.82	18435	15.20
12.	Nokha	234795	35200	14.99	36363	15.49	48189	20.52
13.	Rajpur	96514	17237	17.86	18578	19.24	22449	23.26
14.	Rohtas	125770	18479	14.69	20104	15.98	17186	14.86
15.	Sanjhauli	81662	11904	14.58	12760	15.62	14973	18.33
16.	Shivsagar	232221	24256	10.44	26968	11.61	18548	7.98
17.	Suryapura	76393	15730	20.59	18157	23.77	16353	21.41
18.	Tilauthu	144583	29409	20.34	32203	22.27	32297	22.38
Total		3243403	400518	247.8	406120	272.61	522156	292.64
		Average	22251	13.77	22562	15.15	29009	16.26
		($F_r(17, 34) = 20.29, p < 0.001$)				($F_c(2, 34) = 9.55, p < 0.001$)		

Table 2: Year-wise Distribution of Suspected Tuberculosis Cases in Relation to OPD Visits at PHC/TU/DMCs in Rohtas District, Bihar (2023–2025)

Sl. No.	PHC/TU/DMC	Population	Suspected cases of tuberculosis					
			2023	Percent of suspected cases in comparison to total visit	2024	Percent of suspected cases in comparison to total visit	2025	Percent of suspected cases in comparison to total visit
1.	Akhodi Gola	158229	420	1.98	466	2.10	593	3.52
2.	Bikramganj	220087	672	1.53	473	1.04	312	1.04
3.	Chenari	172292	432	1.32	429	1.23	429	1.47
4.	Dawath	149091	288	1.42	325	1.54	335	2.22
5.	Dehri	377823	319	0.98	457	1.03	866	2.72
6.	Dinara	310357	456	1.63	508	1.75	935	3.40
7.	Karakat	289089	756	3.47	843	3.24	660	3.72

8.	Kargahar	289677	729	2.37	720	2.56	756	3.54
9.	Kochas	192273	302	1.04	795	2.67	813	3.93
10.	Nasariganj	192237	693	4.56	702	4.02	764	6.17
11.	Nauhatta	121286	705	3.92	1056	5.50	588	4.78
12.	Nokha	234795	291	0.83	348	0.96	570	1.77
13.	Rajpur	96514	184	1.07	244	1.31	359	2.40
14.	Rohtas	125770	596	3.22	1066	5.30	1185	1.04
15.	Sanjhauli	81662	254	2.13	265	2.08	357	3.57
16.	Shivsagar	232221	459	1.89	560	2.08	375	3.03
17.	Suryapura	76393	125	0.79	254	1.40	258	2.37
18.	Tilauthu	144583	481	1.63	435	1.35	510	2.37
Total		3243403	7556	35.78	9257	41.16	10665	53.06
		($F_r(17, 34) = 6.02, p < 0.001$)				($F_c(2, 34) = 7.13, p < 0.001$)		

Table 3: Pattern of Diabetes Screening and Diabetes Prevalence among Tuberculosis Patients Attending PHC/TU/DMCs (2023–2025)

Sl. No.	**Patients with tuberculosis visiting PHC/TU/DMC with symptoms of Diabetes**	**2023**		**2024**		**2025**		**Average**	
		Sugar test of Sputum positive new patients	**Diabetes**	**Sugar test of Sputum positive new patients**	**Diabetes**	**Sugar test of Sputum positive new patients**	**Diabetes**	**Sugar test of Sputum positive new patients**	**Diabetes**
1.	Akhodi Gola	37	0	60	2	56	2	51	1.33
2.	Bikramganj	138	2	195	5	158	6	163.67	4.33
3.	Chenari	126	3	173	1	29	2	109.33	2
4.	Dawath	8	0	10	3	12	1	10	1.33
5.	Dehri	24	5	19	2	92	5	45	4
6.	Dinara	76	2	94	4	110	2	93.33	2.67
7.	Karakat	84	1	90	3	66	1	80	1.67
8.	Kargahar	83	5	88	6	78	3	83	4.67
9.	Kochas	24	2	69	3	80	3	57.67	2.67
10.	Nasariganj	27	1	32	2	36	3	31.67	2
11.	Nauhatta	71	2	86	2	95	2	84	2
12.	Nokha	60	1	40	0	53	2	51	1
13.	Rajpur	0	0	0	0	33	1	11	0.33
14.	Rohtas	73	3	88	3	86	2	82.33	2.67
15.	Sanjhauli	25	0	28	0	14	0	22.33	0

16.	Shivsagar	60	3	66	2	57	2	61	2.33
17.	Suryapura	12	0	15	0	14	1	13.67	0.33
18.	Tilauthu	72	1	36	1	41	1	49.67	1
		1000	31 (3.1%)	1189	39 (3.3%)	1110	39 (3.5%)	($r = 0.667$, $p < 0.001$)	
		ANOVA value for sugar test from 2023-2025 ($F_r (17, 34) = 7.77$, $p < 0.001$) ($F_c(2, 34) = 0.85$, $p > 0.05$)				ANOVA value for diabetes from 2023-2025 ($F_r (17, 34) = 4.70$, $p < 0.001$) ($F_c (2, 34) = 1.04$, $p > 0.05$)			