

Prevalence of Prediabetes and Associated Risk Factor Assessment Among Urban Adult Population in North Bihar, India

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Abstract:

Background: Type 2 Diabetes Mellitus (T2DM) and Impaired Glucose Tolerance (IGT) are major public health concerns globally, with increasing prevalence in India. The study assessed the prevalence of T2DM and IGT among, and to recognize key associated risk factors.

Methods: 1050 persons were involved in the study selected by rigorous random sampling. To diagnose T2DM and IGT, data were gathered via in-person interviews using a pre-made questionnaire, which were then followed by clinical exams and blood testing.

Results: The incidence of IGT was 12.48% and T2DM was 9.24%, respectively. In the 61–70 age range, the highest incidence of T2DM (20.86%) and IGT (21.58%) was noted. The incidence of T2DM was somewhat higher in men (9.87%) than in women (8.58%). The incidence rates of T2DM (21.84%) and IGT (36.78%) were considerably greater in those with a positive family record of diabetes. Additionally, there was a substantial correlation found between obesity and hypertension and a higher incidence of T2DM and IGT.

Conclusion: The study reveals a considerable incidence of T2DM and IGT in the Sharifganj area of Katihar, with advanced age, male gender, family history of diabetes, obesity, and hypertension identified as key risk factors.

Recommendations: Targeted public health interventions, including lifestyle modifications, regular screenings, and health education, are essential to manage and reduce the risk of diabetes in this community.

Keywords: Prediabetes, T2DM, Impaired Glucose Tolerance, IGT, Impaired Fasting Glucose, IFG, Risk Factors, Katihar, Bihar.

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Introduction

Due to its substantial influence on morbidity and mortality, diabetes mellitus, especially Type 2 Diabetes Mellitus (T2DM), has become a global public health crisis. Its prevalence is rising. The

International Diabetes Federation (IDF) estimates that 537 million people globally were affected by diabetes in 2021, with a global incidence of 10.5% among adults aged 20 to 79 years [1]. The fact that this

sum is expected to increase to 783 million by 2045 emphasises how rapidly this illness is spreading [2]. Insulin resistance and ultimately pancreatic beta-cell malfunction, which result in chronic hyperglycemia and a host of related problems, are hallmarks of type 2 diabetes.

In India, the diabetes epidemic is particularly severe, with a prevalence of 9.6% among adults as of 2021, affecting an estimated 77 million people [3]. The rising burden of diabetes in India is driven by a combination of genetic predisposition, lifestyle factors, and socio-economic conditions. Urbanization, dietary changes, decreased physical activity, and increasing rates of obesity have been identified as significant contributors to the rising prevalence of T2DM. Furthermore, recent studies indicate that a significant proportion of the adult population is at risk for developing diabetes, with a growing number of individuals exhibiting prediabetic conditions like Impaired Glucose Tolerance (IGT) and Impaired Fasting Glucose (IFG).

Age, gender, family history, lifestyle, and other factors are among the many interplaying factors that impact the incidence of T2DM and IGT in India. Studies have indicated that growing older is a significant risk factor for T2DM, with a notable rise in prevalence seen in people over 50 [4]. In addition, men are frequently more vulnerable than women, which could be attributed to variations in the distribution of fat and lifestyle choices. A considerable risk of T2DM is associated with a first-degree relative who has the condition, indicating the importance of family history in diabetes. Obesity, especially central obesity, has been shown to be a major risk factor for T2DM and IGT. Of particular worry is the increasing number of Indian adults who are obese.

Given the increasing incidence of T2DM and prediabetes in India, there is a pressing need for community-based screening programs to identify at-risk individuals

early and implement preventive measures. Effective public health strategies should focus on promoting healthy lifestyles, enhancing early detection, and improving disease management to address this growing epidemic.

The study aims to evaluate the incidence of T2DM and IGT among adults in of Urban Population of Katihar, a City of North Bihar and to identify key associated risk factors.

METHODOLOGY

Study Design

A community-based cross-sectional observational study.

Study Setting

The study took place in the Sharifganj area of Katihar. Which is an Urban area in the Katihar City, The study was conducted over one year, from January 2018 to December 2018.

Study Population

A total of 1050 individuals were comprised in the study.

Inclusion Criteria

- Adults aged 20 years and above be present in in the study area for at least 3 years.
- Known cases of T2DM.

Exclusion Criteria

- Secondary causes of hyperglycemia include any organic illness that produces hyperglycemia, corticosteroid therapy, chronic calcific pancreatitis and pregnancy.
- Known cases of Type 1 Diabetes.

Sample Size

Based on WHO's reported diabetes prevalence of 8.7% in India in 2015, the study's sample size was calculated,

The sample size was calculated using the formula:

$$n = \frac{Z^2 \times pq}{L^2}$$

Where n = sample size

p = prevalence rate of disease,

here $p=8.7\% = 0.087$

$q= 1-p =$ complement of p

here $q=1-0.087 = 0.913$

$L=$ permissible error (Beta error) = 20% of p

20% of $0.087= 0.0174$

$Z=$ alpha error (level of significance)

5% error with a probability of 0-0.5

$=1.96=2$

$=Z^2=2^2 = 4$

and $L^2= (0.0174)^2 = 0.0003028$

$\therefore n= 4 \times \underline{0.087} \times \underline{0.913} = 1049.28$
0.0003028

Thus, the study's sample size was rounded to 1050.

Study Technique

Approximately 2500 houses in the area, each with at least one person aged 20 years or above, were numbered. Households chosen for the survey were chosen by systematic random sampling. A list of homes was made, and each alternate home was chosen, yielding a final sample of 1050 people (537 men and 513 women).

Data Collection

A pre-designed and pre-tested questionnaire was used for in-person interviews to gather data, which was then followed by a clinical evaluation. Socio-demographic characteristics and factors associated with diabetes were recorded.

Variables

The study considered various variables including age, sex, BMI, family history of diabetes, blood pressure.

Measurements

Anthropometric Data:

Height was measured using a standardized stadiometer, ensuring accuracy and consistency. Weight was recorded using a portable weighing machine, calibrated regularly to maintain precision. The Body Mass Index (BMI) was estimated using the formula: $BMI = \text{Weight (kg)} / \text{Height (m)}^2$.

Blood Pressure:

A mercury sphygmomanometer that was standardised was used to monitor blood pressure. The final blood pressure value was calculated by averaging the two readings that were collected at intervals of five minutes.

Blood Sugar Estimation:

Blood samples obtained during fasting and after glucose administration were examined using the GOD/POD technique to estimate blood glucose levels. By using glucose oxidase, glucose is converted to gluconic acid and hydrogen peroxide. This is then combined with phenol and 4-aminoantipyrine to create a red quinonimine dye complex. The colour intensity, which is determined colorimetrically at 530 nm, is directly correlated with the sample's glucose concentration.

Diagnostic Criteria:

If one or more of the following conditions were satisfied, diabetes was diagnosed: > 7.0 mmol/L for fasting plasma glucose or > 11.1 mmol/L for 2-hours after an oral glucose load of 75 grammes. If both Fasting Plasma Glucose < 7.0 mmol/L and 2-Hour Plasma Glucose 7.8-11.1 mmol/L were noted, Impaired Glucose Tolerance (IGT) was identified. When both Fasting Plasma Glucose 6.1-6.9 mmol/L and 2-Hour Plasma Glucose < 7.8 mmol/L were seen, IFG was identified.

Statistical Analysis

Data was digitized and analyzed using MS Office Excel 2019. The variables were presented as frequency and percentages.

Ethical Considerations

The study was approved by the Institutional Ethical Committee (IEC) of Katihar Medical College, Katihar, Bihar and Informed consent was obtained from all participants, and confidentiality was maintained.

Out of 1050 study subjects, the majority were in the age group of 51-60 years (314, 29.90%), and only 20 (1.90%) were above 70 years. Most of the subjects were males (537, 51.15%), with females constituting 513 (48.85%).

RESULT

Table 1: Distribution of Study Subjects According to Age and Gender

Age Group	Male	Female	Total (%)
20-30	52	56	108 (10.28%)
31-40	84	98	182 (17.33%)
41-50	152	135	287 (28.13%)
51-60	163	151	314 (29.90%)
61-70	74	65	139 (13.23%)
> 70	12	08	20 (1.90%)
Total (%)	537 (51.15%)	513 (48.85%)	1050 (100%)

The incidence of T2DM was 9.24%, and the prevalence of IGT was 12.48%.

Table 2: Prevalence of T2DM and IGT Among Study Population

Study Population	Number	Percentage
T2DM	97	9.24%
IGT	131	12.48%
Normal	822	78.28%

Distribution of T2DM and IGT according to key factors.

1. Age Group: The incidence of T2DM was highest in the 61-70 years age group (20.86%), and the highest incidence of IGT was also in this group (21.58%).

Table 3: Distribution of T2DM and IGT according to Age group.

Age Group	T2DM	IGT	Normal	Total (%)
20-30	4 (3.70%)	10 (9.26%)	94 (87.04%)	108
31-40	11 (6.04%)	25 (13.74%)	146 (80.22%)	182
41-50	24 (8.36%)	33 (11.50%)	230 (80.14%)	287
51-60	25 (7.96%)	32 (10.19%)	257 (81.85%)	314
61-70	29 (20.86%)	30 (21.58%)	80 (57.56%)	139
> 70	4 (20%)	1 (5%)	15 (75%)	20
Total (%)	97 (9.24%)	131 (12.48%)	822 (78.28%)	1050

2. Gender: The incidence of T2DM was higher amongst males (9.87%) compared to females (8.58%).

Table 4: Distribution of T2DM and IGT according to Gender.

Gender	T2DM	IGT	Normal	Total (%)
Male	53 (9.87%)	68 (12.66%)	416 (77.47%)	537
Female	44 (8.58%)	63 (12.28%)	406 (79.14%)	513
Total (%)	97 (9.24%)	131 (12.48%)	822 (78.28%)	1050

3. Family History of Diabetes: The incidence of T2DM was substantially higher among those with a positive family history (21.84%).

Table 5: Distribution of T2DM and IGT according to Family History of Diabetes.

Family History	T2DM	IGT	Normal	Total (%)
Present	38 (21.84%)	64 (36.78%)	72 (41.38%)	174
Absent	59 (6.74%)	67 (7.64%)	750 (85.62%)	876
Total (%)	97 (9.24%)	131 (12.48%)	822 (78.28%)	1050

4. Body Mass Index: The incidence of T2DM and IGT was highest among obese individuals.

Table 6: Distribution of T2DM and IGT according to BMI

BMI	T2DM	IGT	Normal	Total (%)
Underweight (<18.5)	0 (0.00%)	3 (2.54%)	115 (97.46%)	118
Normal (18.5-24.9)	24 (4.55%)	37 (7.02%)	466 (88.43%)	527
Overweight (25-29.9)	57 (17.33%)	68 (20.66%)	204 (62.01%)	329
Obese (>30)	16 (21.05%)	23 (30.26%)	37 (48.66%)	76
Total (%)	97 (9.24%)	131 (12.48%)	822 (78.28%)	1050

5. Blood Pressure: The incidence of T2DM and IGT was substantially higher among hypertensive individuals.

Table 7: Distribution of T2DM and IGT according to Blood Pressure

Blood Pressure	T2DM	IGT	Normal	Total (%)
>140/90	72 (21.30%)	89 (26.33%)	177 (52.37%)	338
<139/90	25 (3.51%)	42 (5.90%)	645 (90.59%)	712
Total (%)	97 (9.24%)	131 (12.48%)	822 (78.28%)	1050

Discussion

Among the 1050 study subjects, most of the participants were aged between 51-60 years (29.90%), and males slightly outnumbered females, constituting 51.15% of the sample. The results showed a notable prevalence of T2DM at 9.24% and IGT at 12.48%, indicating that a substantial portion of the population is either diabetic or pre-diabetic. This underscores the need for targeted health interventions in this community.

Diabetes prevalence was significantly influenced by age. In the 61-70 age range, the highest incidence of T2DM (20.86%) and IGT (21.58%) was noted. This implies that as people age, their chance of acquiring diabetes rises. Conversely, the lowest incidence of T2DM (3.70%) was found in the 20-30 years age group, reflecting a lower risk in younger individuals. These findings highlight the importance of age-

specific preventive measures and early detection strategies.

Gender differences in diabetes prevalence were also noted, with males exhibiting a slightly higher incidence of T2DM (9.87%) in contrast to females (8.58%). Similarly, the incidence of IGT was marginally higher in males (12.66%) than in females (12.28%). This gender disparity suggests that males in this population may be at a greater risk of developing diabetes, pointing to the need for gender-sensitive health interventions.

Family history emerged as a strong predictor of diabetes. Individuals with a positive family record of diabetes had a significantly higher incidence of T2DM (21.84%) and IGT (36.78%) in contrast to those without a family record. This robust correlation emphasises the hereditary susceptibility to diabetes and the

significance of a family record as a risk factor. These results imply that early screening and preventive interventions should be given priority for people with a family record of diabetes.

Body Mass Index was another critical factor associated with diabetes prevalence. The highest incidence of T2DM (21.05%) and IGT (30.26%) was found among obese individuals. This indicates a strong correlation between higher BMI and the risk of diabetes, emphasizing the need for weight management as a preventive measure. Public health initiatives promoting healthy eating and physical activity could significantly impact diabetes prevention in this population.

Blood pressure also played a significant role in diabetes prevalence. Hypertensive individuals showed a much higher prevalence of T2DM (21.30%) and IGT (26.33%) compared to non-hypertensive individuals. This suggests that hypertension is a considerable risk factor for diabetes, necessitating regular monitoring and control of blood pressure in the population. These results highlight the importance of integrated health interventions addressing both hypertension and diabetes.

Prediabetes is a critical public health issue that represents an intermediate stage between normal glucose regulation and diabetes. A study assessed prediabetes using glycated hemoglobin (HbA1c) levels among healthcare professionals over 40 years in Patna, Bihar. The study found that 15.7% of the participants had prediabetes. There was a positive association among BMI and HbA1c levels ($R=0.3$), indicating that higher BMI is associated with increased risk of prediabetes [5].

Among the Tharu tribal people in Bihar, a community-based study was conducted. Diabetes was 4.8% common, and age, smoking status, and tobacco chewing were important risk factors. The population's high rates of physical inactivity and hypertension were also noted by the study

[6]. An analysis took place to determine the incidence of diabetes and prediabetes among Kashmir's tribal community. It was discovered that 11.64% of the subjects had prediabetes, and that ageing, BMI, and a family record of diabetes were important risk factors [7].

Tamil Nadu was the site of the STRiDE-I study, which revealed a ten-year rise in the incidence of prediabetes. The study discovered that, regardless of location or socioeconomic status, abdominal obesity was substantially linked to a higher frequency of prediabetes [8]. A rural South Indian population's incidence of diabetes and prediabetes was investigated. They stated that 8.03% of people had undiagnosed prediabetes. In order to properly manage diabetes, the study highlighted the need for more awareness and community-based screening programmes [9].

Conclusion

The study highlights the substantial prevalence of T2DM and IGT in the Sharifganj area of Katihar, with significant associations with age, gender, family history, BMI, and blood pressure. These findings underscore the need for targeted public health interventions, including lifestyle modifications, regular screenings, and education to manage and reduce the risk of diabetes in this community. Addressing these risk factors through comprehensive health programs could significantly reduce the burden of diabetes in this population.

Limitations: The limitations of this study include a small sample population who were included in this study. Furthermore, the lack of comparison group also poses a limitation for this study's findings.

Recommendation: Targeted public health interventions, including lifestyle modifications, regular screenings, and health education, are essential to manage and reduce the risk of diabetes in this community.

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List of abbreviations:

T2DM: Type 2 Diabetes Mellitus

IGT: Impaired Glucose Tolerance

IDF: International Diabetes Federation

IFG: Impaired Fasting Glucose

BMI: Body Mass Index

IEC: Institutional Ethical Committee

GOD/POD: Glucose Oxidase-Peroxidase

HbA1c: Hemoglobin A1c

STRiDE-I: Study to Test the Reduction in Diabetes Incidence

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