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# A Comparative Study of Risk Factors Associated with Diabetes Mellitus in Rural and Urban Populations

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**Abstract: Diabetes mellitus is a major public health concern worldwide, with increasing prevalence in both rural and urban populations. Various demographic, clinical, and lifestyle-related risk factors contribute to its development and progression. Understanding these risk factors is essential for effective prevention and management strategies. To compare the risk factors associated with diabetes mellitus among rural and urban populations. : A cross-sectional comparative study was conducted among 97 diagnosed diabetic patients. Data were collected using a structured data collection form, including demographic details, clinical parameters (age, BMI, HbA1c, duration of diabetes, blood pressure) and lifestyle factors such as smoking, alcohol consumption and physical activity. Socioeconomic status was assessed using the Kuppuswamy scale. Statistical analysis was performed using Jamovi software. Independent sample t-test was applied to assess differences between rural and urban groups, with $p < 0.05$ considered statistically significant. Among the participants, 44 were from urban areas and 53 from rural areas. The mean BMI was significantly higher in urban patients compared to rural patients ($p = 0.002$). However, no statistically significant differences were observed in age, HbA1c levels, duration of diabetes, systolic and diastolic blood pressure between the two groups ($p > 0.05$).**

***Keywords:***

- *DM- Diabetes Mellitus*
- *IDDM-Insulin Dependent Diabetes Mellitus*
- *NIDDM-Non-Insulin Dependent Diabetes Mellitus*
- *HG-Hyperglycaemia*
- *IR-Insulin Resistance*

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## I. INTRODUCTION

As per the WHO, diabetes mellitus (DM) is defined as a heterogeneous metabolic disorder characterised by common feature of chronic hyperglycaemia with disturbance of carbohydrate, fat and protein metabolism.

Diabetes mellitus (DM) is commonest endocrine disorder that affects more than 100 million people worldwide (6% population). It is caused by deficiency or ineffective production of insulin by pancreas which results in increase or decrease in concentrations of glucose in the blood. It is found to damage many of body systems particularly blood vessels, eyes, kidney, heart and nerves. Diabetes mellitus has been classified into two types i.e. insulin dependent diabetes mellitus (IDDM, Type I) and non-insulin dependent diabetes mellitus (NIDDM, Type II).

Type I diabetes is an autoimmune disease. Type II diabetes is characterized by peripheral insulin resistance and impaired insulin secretion.

The presence of DM shows increased risk of many complications such as cardiovascular diseases, peripheral vascular diseases, stroke, neuropathy, renal failure, retinopathy, blindness.

Insulin replacement therapy is the mainstay for patients with type 1 DM while diet and lifestyle. Modifications are considered the cornerstone for the treatment and management of type 2 DM. Various types of hypo glycemic agents such as biguanides and sulfonylureas are also available for treatment of diabetes.

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➢ *Epidemiology*

- DM is a leading cause of morbidity and mortality world over. It is estimated that approximately 1% of population suffers from DM. The incidence is rising in the developed countries of the world at the rate of about 10% per year, especially of type 2 DM, due to rising incidence of obesity and reduced activity levels.
- It is anticipated that the number of diabetics will exceed 250 million by the year 2010.
- It is estimated that 366 million people had DM in 2011; by 2030 this would have risen to 552 million.
- The number of people with type 2 DM is increasing in every country with 80% of people with DM living in low- and middle-income countries. DM caused 4.6 million deaths in 2018.
- It is predicted that the prevalence of DM in adults of which type 2 DM is becoming prominent will increase in the next two decades and much of the increase will occur in developing countries where the majority of patients are aged between 45 and 64 years.

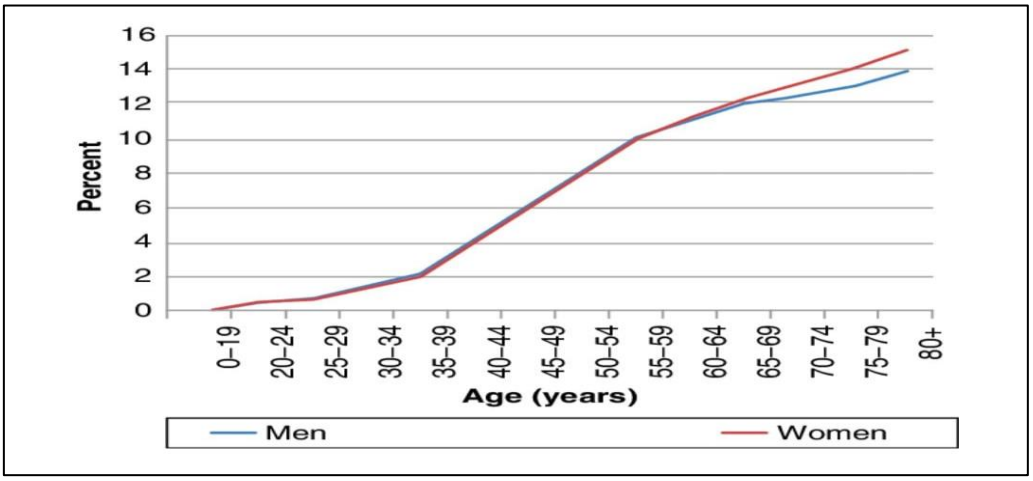


Fig 1 Epidomiology of Diabetes: A Global View

It constitutes about 10% cases of DM. It was previously termed as juvenile-onset diabetes (JOD) due to its occurrence in younger age, and was called insulin dependent DM (IDDM) because it was known that these patients have absolute requirement for insulin replacement as treatment.

Type 1 diabetes is an organ-specific autoimmune condition. It happens when your body attacks your pancreas with antibodies. The organ is damaged and doesn't make insulin. It affects 2 million people, including about 304,000 children and teens in the U.S.

Type 1 diabetes cannot be prevented. Type 1 diabetes symptoms happen quickly, in a few days to weeks. They include:

- Feeling thirst and hunger often
- Peeing more
- Blurry vision
- Fatigue
- Unexplained weight loss

About 30% of people with type 1 diabetes have a life-threatening condition that causes loss of consciousness, called diabetic coma, as their first symptom.

➢ *Type 2 DM*

Diabetes is a chronic disease. It is characterized by high levels of sugar in the blood. Type 2 diabetes is also called type 2 diabetes mellitus and adult-onset diabetes. That's because it used to start almost always in middle and late adulthood. However, more and more children and teens are developing this condition. Type 2 diabetes is much more common than type 1 diabetes, and is really a different disease.

During digestion, food is broken down into basic components. Carbohydrates are broken down into simple sugars, primarily glucose. Glucose is a critically important source of energy for the body's cells. To provide energy to the cells, glucose needs to leave the blood and get inside the cells. Type 2 diabetes occurs when your body's cells resist the normal effect of insulin, which is to drive glucose in the blood into the inside of the cells. This condition is called insulin resistance.

- *The Symptoms of Diabetes are Related to High Blood Glucose Levels. They Include:*

✓ Excessive urination
✓ Thirst hunger and weight loss
✓ Increased susceptibility to infections
✓ Yeast or fungal infections

➢ *Pathophysiology*

- Main features: Insulin resistance, reduced insulin production, β-cell failure.
- Effect: ↓ Glucose uptake by liver, muscle, fat → hyperglycemia.
- Fat metabolism: ↑ Fat breakdown → worsens hyperglycemia.

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✓ *Type 1 vs Type 2:*

- Type 1: Autoimmune β-cell destruction, insulin deficiency.
- Type 2: Insulin resistance + impaired secretion, usually in obese adults.

- Neuro link: Insulin resistance → Aβ plaque formation & tau hyperphosphorylation → cognitive decline.
- Pathogenesis of Type 2 Diabetes Mellitus Main metabolic defects:

✓ Impaired insulin secretion (delayed response to glucose).
✓ Insulin resistance (peripheral tissues fail to respond).

➢ *Complications of Diabetes:*

Due to chronic hyper glycaemia, all body tissues undergo biochemical and structural changes, leading to two main types of complications:

- *Acute Metabolic Complications:*

✓ Diabetic Ketoacidosis (DKA):Seen in Type 1 DM due to severe insulin deficiency and excess glucagon.
✓ Causes fat breakdown → ketone body formation metabolic acidosis.
✓ Symptoms: Nausea, vomiting, deep breathing, confusion, coma.
✓ Hypoglycaemia: Due to excess insulin, missed meals,or stress.

- *Chronic (Late) Systemic Complications :*

✓ Develop after years of uncontrolled diabetes; cause major morbidity and mortality.
✓ Atherosclerosis: Early, severe arterial damage → coronary disease, stroke
✓ Microangiopathy: Thickening of small vessel basement membranes (skin, kidney, nerves).

➢ *Diagnosis*

According to the Americal Diabetes Association (ADA), the fasting glucose concentration should be used in routine screening for diabetes; but postprandial blood sugar, random blood sugar and glucose tolerance test are also used for blood sugar determination. For the diagnosis of diabetes, at least one criterion must apply:

- Symptoms of diabetes (polyurea, polydipsia, unexplained weight loss, etc) as well as casual plasma glucose concentration = 11.1 mmol/L (200 mg/dL).
- Fasting plasma glucose = Its normal range is 70-110 mg/dl with no caloric intake for at least 8 h.
- The World Health Organization (WHO) classification includes both clinical stages (normoglycaemia, impaired glucose tolerance/impaired fasting glucose (IGT/IFG), diabetes) and etiological types of diabetes mellitus, identical to the ADA except that WHO group includes classification formerly known as gestational impaired glucose tolerance (GIGT) and GDM: fasting glucose = 7.0 .mmol/L (126 mg/dL) and/or 2-h glucose = 7.8 mmol/L (140 mg/dL) after a 75-g .

➢ *Treatment:*

- *Lifestyle Modifications:*

✓ Diet: Eat whole grains, fruits, and vegetables; avoid refined sugars and fats.
✓ Exercise: At least 150 minutes of moderate activity weekly improves insulin sensitivity
✓ Weight Loss: Losing 5–10% body weight reduces insulin resistance.
✓ Pharmacological Treatment:
✓ Metformin: First-line drug; lowers hepatic glucose and improves insulin sensitivity.Sulfonylureas (e.g., Glimepiride): Stimulate insulin secretion.

The comparative study highlights that diabetes mellitus is influenced by different but overlapping risk factors in rural and urban populations. Urban populations show a higher prevalence of diabetes, largely due to lifestyle-related factors such as sedentary behavior, unhealthy dietary patterns, obesity, stress, and reduced physical activity. Increased consumption of processed foods, higher rates of overweight and central obesity, and limited time for exercise contribute significantly to the urban burden of diabetes.

In contrast, rural populations, while traditionally considered at lower risk, are experiencing a gradual rise in diabetes prevalence. This increase is associated with changing lifestyles, reduced physical labor due to mechanization, poor awareness about diabetes, limited access to healthcare facilities, and delayed diagnosis. Dietary transitions toward refined carbohydrates and fats, along with lack of routine health screening, further elevate risk in rural areas.

## II. MATERIALS AND METHODS

All patients who were visit the study site during December 2025 to March 2026 and fulfilling all inclusion criteria and none of exclusion criteria was included in the study. Detailed information of study will be given to the patients and consent of patients were taken by taking signature in informed consent form. Only those participants were enrolled for the study who will give their consent. Face to face communication was used for the interaction with patients. this was done through oral presentation in the local language. Participants will be encouraged to ask any questions and clarify the doubts regarding any aspects of the study. Participant details, socio-demographic data, medical history, lifestyle factors, clinical parameters and laboratory results were included in this study. All the obtained data was documented for analysis and follow up was not made.

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## III. RESULT AND DISCUSSION

➢ *Descriptive Statistics:*

Table 1 Descriptive Statistics

| Descriptives | Residence | Age | BMI | HbA1c_ % | Duration DM Years | Systolic BP | Diastolic BP |
|---|---|---|---|---|---|---|---|
| Mean | 1 | 53.7 | 28.4 | 1.70 | 5.23 | 136 | 87.4 |
| | 2 | 55.1 | 25.5 | 1.62 | 5.25 | 139 | 87.2 |
| Standard deviation | 1 | 8.78 | 5.96 | 0.462 | 3.05 | 11.4 | 6.54 |
| | 2 | 9.67 | 2.41 | 0.491 | 2. 75 | 12.3 | 5.95 |
| Minimum | 1 | 38 | 22.9 | 1 | 1.00 | 120 | 70 |
| | 2 | 39 | 22.3 | 1 | 1.00 | 120 | 70 |
| Maximum | 1 | 73 | 64.0 | 2 | 12.0 | 160 | 100 |
| | 2 | 80 | 33.3 | 2 | 11.0 | 169 | 100 |

A total of 96 diabetic patients were included in the study, consisting of 44 urban patients and 52 rural patients.

The mean age of the study population ranged from 38 to 80 years. Urban patients had a mean age of 53.66 ± 8.77 years, while rural patients had a mean age of 55.06 ± 9.66 years.

The mean BMI was higher in urban patients (28.37 ± 5.96

Regarding blood pressure, the mean systolic blood pressure was 136 mmHg in urban patients and 139 mmHg in rural patients, while the mean diastolic blood pressure was 87.4 mmHg in urban patients and 87.2 mmHg in rural patients.
The minimum and maximum values observed were:

➢ *Age: 38–80 years*

- BMI: 22.3–64.0 kg/m²
- Duration of diabetes: 1–12 years
- Systolic BP: 120–169 mmHg
- Diastolic BP: 70–100 mmHg

The mean systolic blood pressure was 136.41 ± 11.40 mmHg in urban patients and 139.23 ± 12.32 mmHg in rural patients.

kg/m²) compared to rural patients (25.45 ± 2.41 kg/m²).

The mean HbA1c score was 1.70 ± 0.46 in urban patients and 1.62 ± 0.49 in rural patients.

The mean duration of diabetes was 5.23 ± 3.04 years for urban patients and 5.25 ± 2.74 years for rural patients, indicating similar disease duration in both groups

The mean diastolic blood pressure was 87.39 ± 6.54 mmHg in urban patients and 87.15 ± 5.94 mmHg in rural patients.

These findings provide an overview of the demographic and clinical characteristics of the study population.

➢ *Independent Samples t-Test:*

An independent samples t-test was performed to determine whether there were significant differences between urban and rural diabetic patients.

There was no statistically significant difference in age between urban and rural patients ($t = -0.736$, $p = 0.463$).

However, BMI showed a statistically significant difference between the two groups ($t = 3.233$, $p = 0.002$). Urban patients had significantly higher BMI compared to rural patients.

Table 2 Independent Samples t-Test

| | | Statistic | df | p | Effect Size |
|---|---|---|---|---|---|
| Age<br>Student's t | Student's t | -0.7364 | 94.0 | 0.463 | -0.15085 |
| `BMI<br>Student's t | Student's t | 3.2335 | 94.0 | 0.002 | 0.66234 |
| HbA1c_%<br>Student's t | Student's t | 0.9109 | 94.0 | 0.365 | 0.18658 |
| Duration_DM_ Years<br>Student's t | Student's t | -0.0384 | 94.0 | 0.969 | -0.00786 |
| Systolic BP<br>Student's t | Student's t | -1.1563 | 94.0 | 0.250 | -0.23686 |
| Diastolic BP | Student's t | 0.1823 | 94.0 | 0.463 | 0.03734 |

Note. $H_a$ $\mu 1 \neq \mu 2$

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There was no significant difference in HbA1c levels between the groups (t = 0.911, p = 0.365).

Similarly, duration of diabetes mellitus did not differ significantly between urban and rural patients (t = −0.038, p = 0.969).

For blood pressure parameters:

- Systolic BP showed no significant difference (t = −1.156, p = 0.250)
- Diastolic BP also showed no significant difference (t = 0.182, p = 0.856)

Overall, BMI was the only variable that showed a statistically significant difference between urban and rural diabetic patients.

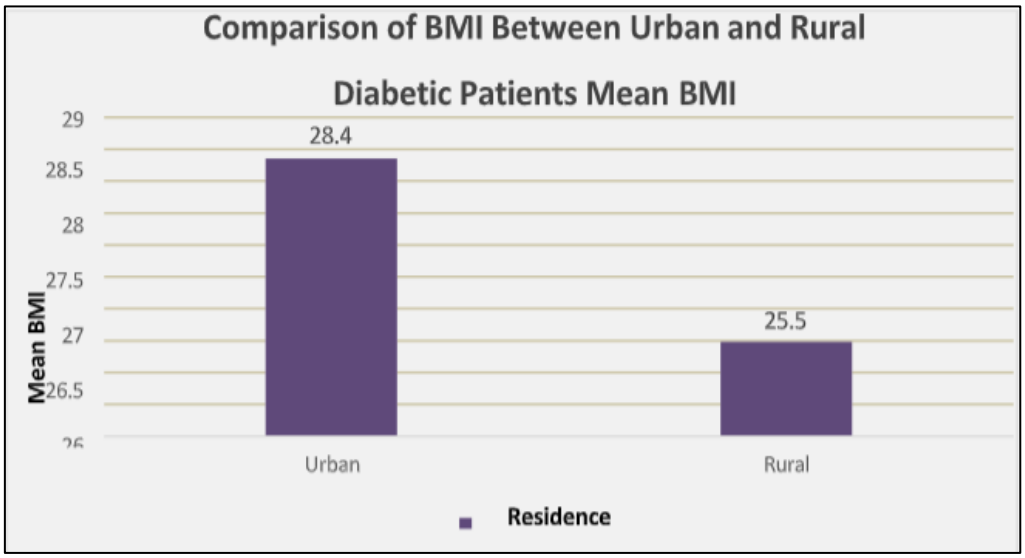


Fig 2 Comparison of BMI Between Urban and Rural Diabetic Patients

The above bar chart shows the comparison of mean BMI among urban and rural diabetic patients. The mean BMI of urban patients was 28.37 kg/m², whereas the mean BMI of rural patients was 25.45 kg/m². The graph indicates that urban diabetic patients had a higher mean BMI compared to rural diabetic patients.

Statistical analysis using the independent sample t-test showed that the difference in BMI between the two groups was statistically significant (p = 0.002). This suggests that higher BMI may be an important risk factor among urban diabetic patients compared to rural patients.

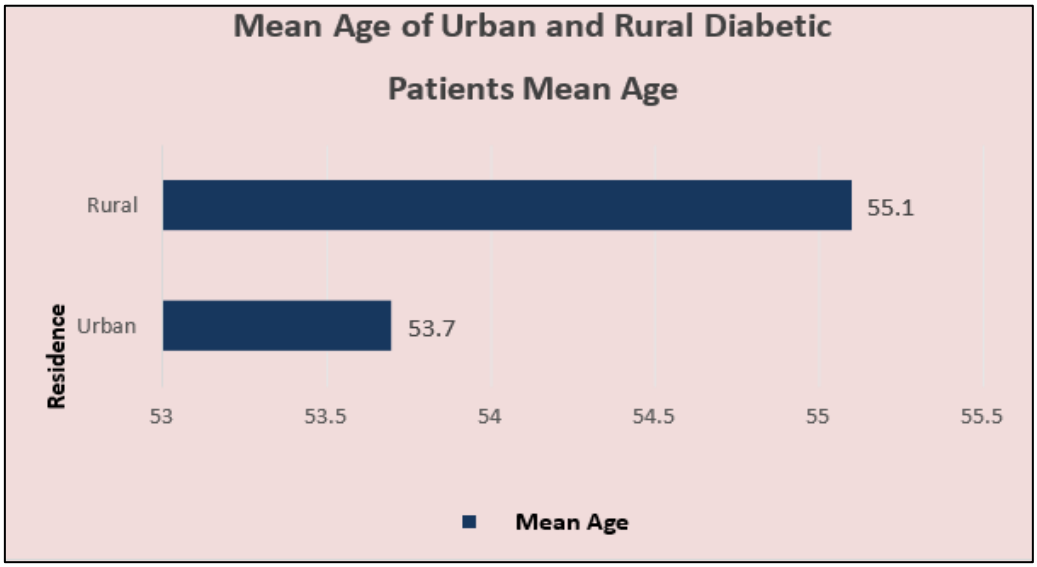


Fig 3 Comparison of Mean Age between Urban and Rural Diabetic Patients

The comparison of mean age between urban and rural diabetic patients is shown in Figure 3. The mean age of urban patients was 53.7 years, while the mean age of rural patients was 55.1 years. Rural patients had a slightly higher mean age compared to urban patients. However, the difference in age between the two groups was not statistically significant.

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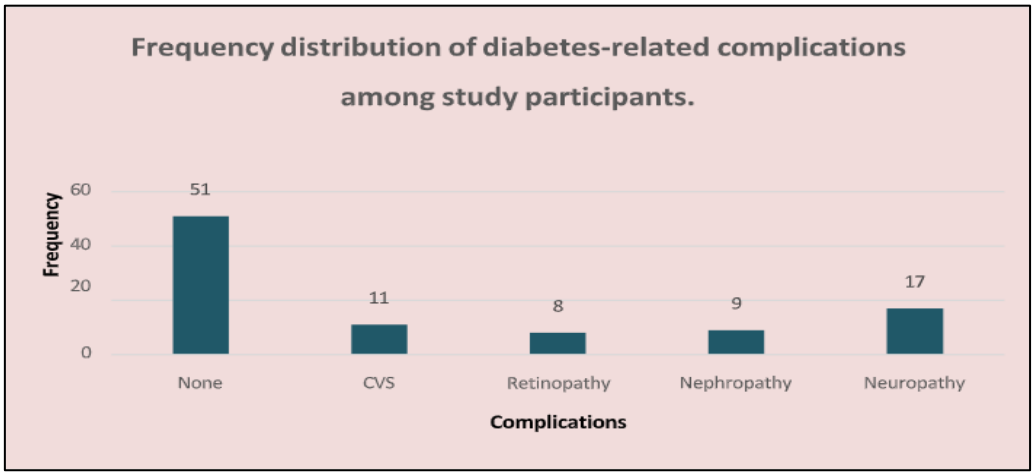


Fig 4 Distribution of Diabetes-Related Complications Among Study Participants.

The distribution of diabetes-related complications among the study participants is presented in Figure 4. Among the 96 patients analysed, 51 patients (53.1%) had no complications, while 45 patients (46.9%) had at least one complication. Neuropathy (17.7%) was the most common complication, followed by cardiovascular complications (11.5%), nephropathy (9.4%), and retinopathy (8.3%).

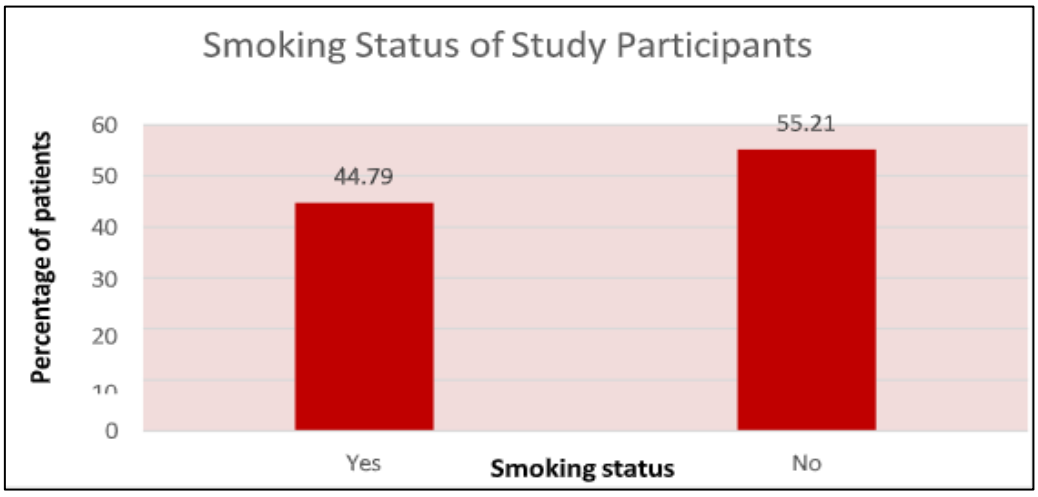


Fig 5 Distribution of Smoking Status Among Diabetes Patient

The distribution of smoking among the study participants is presented in Figure 5. Among the 96 patients included in the study,43patients (44.8%) were smokers, while 53 patients (55.2%) were non-smokers.

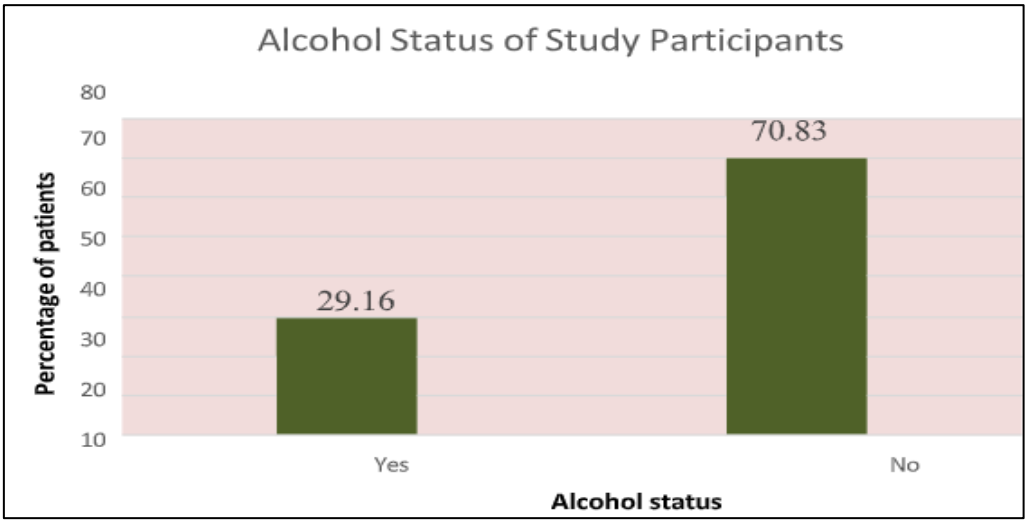


Fig 6 Distribution of Alcohol Consumption Among Diabetic Patients.

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The distribution of alcohol consumption among the study participants is shown in Figure 6. Among the 96 patients included in the study, 28 patients (29.2%) reported alcohol consumption, while 68 patients (70.8%) did not consume alcohol.

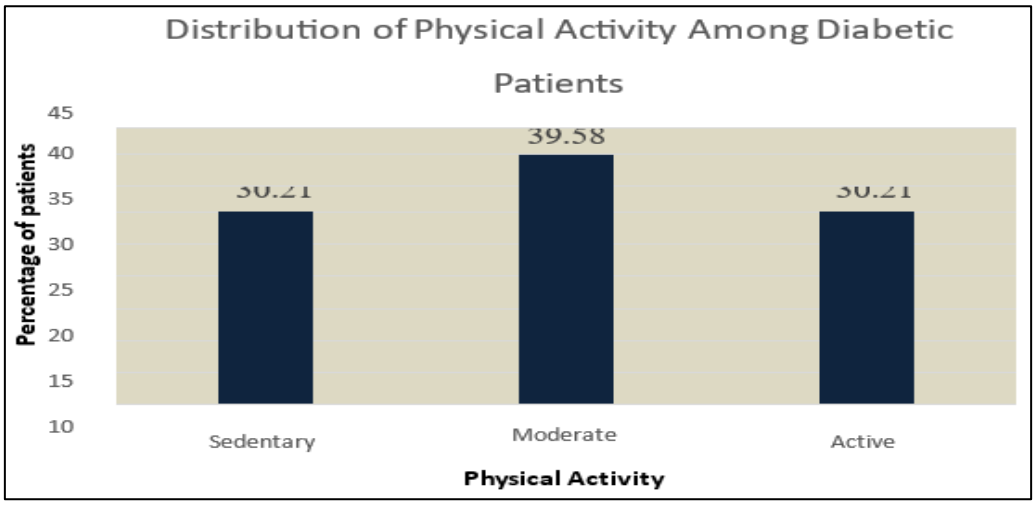


Fig 7 Distribution of Physical Activity Among Diabetic Patients

The distribution of physical activity among diabetic patients is shown in Figure 7. A higher proportion of patients were found to have moderate physical activity, followed by sedentary activity, while fewer patients were physically active. This indicates that lack of physical activity may be an important lifestyle risk factor among the study population.

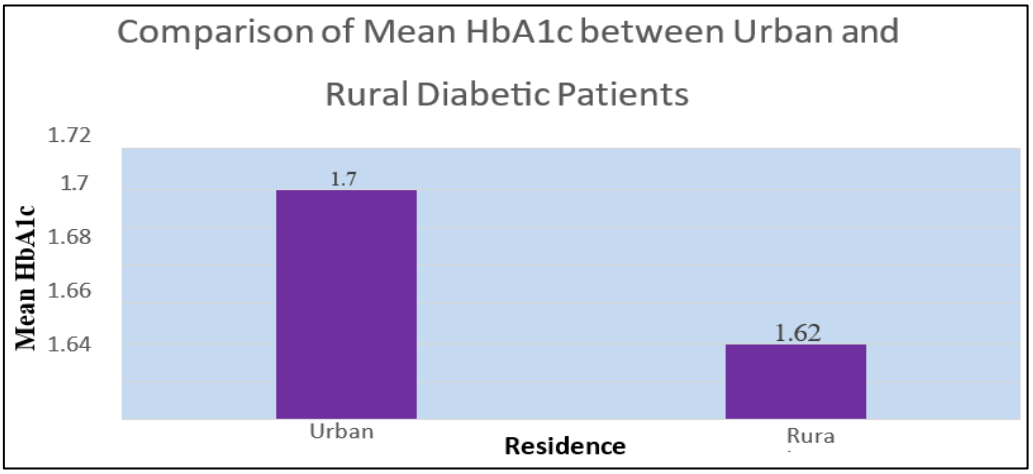


Fig 8 Comparison of Mean HbA1c Between Urban and Rural Diabetic Patients

The bar chart illustrates the comparison of mean HbA1c levels between urban and rural diabetic patients. The mean HbA1c value among urban patients was 1.70, whereas the mean HbA1c among rural patients was 1.62. Urban patients showed a slightly higher HbA1c level compared to rural patients.

However, the difference between the two groups was not statistically significant ($p = 0.365$) based on the independent samples t-test. This indicates that glycemic control was similar in both urban and rural diabetic patients.

➢ *Discussion:*

The present study evaluated and compared the risk factors associated with diabetes mellitus among rural and urban populations. A total of 96 diabetic patients were included, and the findings revealed important similarities and differences between the two groups.

In the present study, the mean age of rural patients (55.1 years) was slightly higher than that of urban patients (53.7 years), although the difference was not statistically significant ($p = 0.463$). This finding is consistent with previous epidemiological studies, which have reported that age is a common non-modifiable risk factor for diabetes in both rural and urban populations, without significant variation between the two groups.

A key finding of this study was the significantly higher BMI observed in urban patients ($28.37 \pm 5.96$ kg/m²) compared to rural patients ($25.45 \pm 2.41$ kg/m²) ($p = 0.002$). This indicates that obesity is more prevalent among urban

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diabetic patients. Similar findings have been reported in the Mohan et al. (WHO–ICMR NCD surveillance), which demonstrated that generalized and abdominal obesity were significantly higher in urban populations compared to rural populations, largely due to sedentary lifestyle and higher socioeconomic status.

Furthermore, Deepa M et.al. 2017 also identified urban residence, abdominal obesity, and physical inactivity as major contributors to diabetes risk. These findings strongly support the results of the present study. Gupta et al. (2018) observed that urban populations had a greater incidence of obesity and metabolic syndrome, which are key risk factors for diabetes mellitus.

The mean HbA1c levels were slightly higher in urban patients ($1.70 \pm 0.46$) compared to rural patients ($1.62 \pm 0.49$), but the difference was not statistically significant ($p = 0.365$). This suggests that glycemic control was similar in both groups. A recent Anjana et al. (2024) ICMR-INDIAB study analysis also reported that biochemical parameters between urban and rural populations often show non-significant differences despite variation in lifestyle risk factors, which aligns with the findings of this study.

The duration of diabetes mellitus was nearly identical in both groups and showed no statistically significant difference ($p = 0.969$), indicating similar disease progression. This observation is consistent with previous studies suggesting that disease duration does not significantly differ between rural and urban populations when access to treatment is comparable.

The study also assessed complications, where 46.9% of patients had at least one complication. Neuropathy (17.7%) was the most common complication, followed by cardiovascular complications, nephropathy, and retinopathy. These findings are in agreement with existing literature, which identifies diabetic neuropathy as one of the most frequent complications due to prolonged hyperglycemia and metabolic disturbances.

Lifestyle-related risk factors such as smoking (44.8%), alcohol consumption (29.2%), and low physical activity were also observed among study participants. These findings are consistent with national-level studies, Mohan et al. (WHO–ICMR NCD surveillance) which highlight that physical inactivity and unhealthy lifestyle behaviors are strongly associated with increased diabetes risk, particularly in urban populations. Additionally, recent studies emphasize that metabolic risk factors, including obesity and dyslipidemia, are increasingly prevalent in India due to lifestyle transitions. Unnikrishnan R, et.al. (ICMR-INDIAB-17). Overall, the findings of the present study are largely consistent with previous literature, demonstrating that urban populations are more affected by modifiable risk factors such as obesity and sedentary lifestyle, while clinical parameters such as HbA1c, age, and duration of diabetes remain similar between rural and urban groups.

## IV. CONCLUSION

The present study highlights important differences and similarities in risk factors associated with diabetes mellitus among rural and urban populations. The findings revealed that urban patients had a significantly higher body mass index (BMI), indicating that obesity and lifestyle-related factors play a major role in the development of diabetes in urban areas. In contrast, other clinical parameters such as age, duration of diabetes, glycemic control (HbA1c), and blood pressure were found to be comparable between rural and urban populations.

The study also identified a considerable burden of diabetes-related complications, with neuropathy being the most common, along with the presence of modifiable lifestyle risk factors such as smoking, alcohol consumption, and low physical activity in both groups.

Overall, the results suggest that while urban populations are more affected by obesity and sedentary lifestyle, rural populations are also at risk due to limited awareness and healthcare access. Therefore, there is a need for targeted preventive strategies, including lifestyle modification, early screening, and health education programs tailored to both rural and urban settings.

In conclusion, effective management of diabetes requires a comprehensive approach addressing both clinical and lifestyle risk factors to reduce the growing burden of the disease.

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