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Original Article

Prevalence of Type 2 Diabetes Mellitus and dyslipidemia in rural and urban patients from Faridabad, India

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Abstract

Type 2 Diabetes Mellitus (T2DM) is a chronic endocrine disease linked to elevated blood sugar levels and dyslipidemia. This study focused on the prevalence of type 2 diabetes mellitus (T2DM) and dyslipidemia in the urban-rural setting of Faridabad. A retrospective cross-sectional study was carried out at the Department of Laboratory Services, Metro Heart Institute, Faridabad, Haryana, India. Patient's data included their demography (urban *versus* rural), gender, blood analysis (fasting glucose level, HBA1C), and lipid profile-triglycerides (TG), high-density lipoprotein (HDL), low-density lipoprotein (LDL), and total cholesterol (TC). This study included 590 urban and 357 rural patients, with more than 60% males. The prevalence of T2DM (urban: 36.27%; rural: 6.16%) and dyslipidemia (urban: 90.85%; rural: 80.96%) was higher in urban than in rural patients. The prevalence of fasting blood glucose, HbA1c, TC, and TG was also high in rural patients. No gender differences were observed in HbA1c, TC, and fasting blood sugar levels. In both rural and urban patients, males had higher TG than females. Hypercholesterolemia and hypertriglyceridemia were more common in urban than rural patients. In urban (34.05%) areas, mixed dyslipidemia was more widespread than in rural (23.24%) areas. Lifestyle, economic status, and hormonal differences may lead to a higher prevalence of T2DM and dyslipidemia in the urban population compared to the rural population.

Keywords: Type 2 Diabetes Mellitus, endocrine, total cholesterol, low-density lipoprotein cholesterol (LDL), triglycerides, high-density lipoprotein (HDL)

Introduction

Diabetes mellitus is a non-communicable, chronic, epidemic disease [1]. Patients with Type II Diabetes Mellitus (T2DM) experience an increase in insulin resistance and a decrease in normal insulin production from the pancreas [1–3]. Type 2 diabetes mellitus (T2DM) is the primary etiology of 95% of diabetes patients [4, 5]. The most risk factors for T2DM are hyperglycemia, dyslipidemia, stroke, and cardiovascular illnesses, among many additional risks [6, 7]. An imbalance between insulin secretion and action leads to hyperglycemia. In low- and middle-income countries such as India, reports of T2DM and dyslipidemia occurrences and prevalence are most common [4, 5]. T2DM is the seventh most common cause of mortality worldwide, with comparable rates for men and women [4, 5].

Dyslipidemia, an abnormal lipid profile, is common in patients diagnosed with type 2 diabetes mellitus (T2DM) [8, 9]. Insulin resistance is associated with dyslipidemia through elevated fatty acid flux. Insulin resistance and metabolic syndrome cause the liver to create an excessive amount of free fatty acids. These fatty acids induce the overproduction of lipoproteins high in triglycerides, which raises LDL levels while lowering HDL [8, 9]. Lipid imbalances, including high triglycerides (TG), decreased HDL, elevated TC, and elevated LDL, are associated with the prevalence of dyslipidemia in patients with T2DM. Several investigations have demonstrated that insulin resistance plays a significant role in the onset of type 2 diabetes [10].

Pre-diabetic symptoms, such as impaired fasting glucose and/or impaired glucose tolerance, are present in the majority of patients. These symptoms appear before the full-blown diabetic symptoms. Pre-diabetes can be prevented from progressing further by altering one's lifestyle and controlling insulin levels [11]. The primary lifestyle factors associated with type 2 diabetes mellitus (T2DM) are obesity, inactivity, diet, stress, and urbanization [12–14]. Sugar-filled beverages are also believed to play a central role in the prevalence of T2DM. Moreover, monounsaturated and polyunsaturated lipids reduce the incidence of type II diabetes, while trans and saturated fats increase it [8, 9].

Diabetes mellitus is diagnosed through a test that measures blood glucose levels. The World Health Organization offers two standard tests for type 2 diabetes mellitus (T2DM) [15]. The first is the glycated hemoglobin level, which should be at least 6.5, and the second is the fasting plasma glucose level. People with impaired glucose tolerance had plasma levels between 140 and 200 mg/dL. Individuals with impaired fasting glucose are those whose blood glucose levels fall between 110 and 125 mg/dL. Compared to fasting glucose, the estimate of glycated hemoglobin is a more accurate method for predicting the risk of cardiovascular disease associated with T2DM [15].

Furthermore, as India becomes more urbanized, people's lifestyles change, which alters the country's disease prevalence [16–18]. This study aimed to assess the prevalence of dyslipidemia and type 2 diabetes mellitus among patients from Faridabad, Haryana, India, in both urban and rural areas. This study aimed to determine the prevalence of T2DM and dyslipidemia among genders in Faridabad, India, and to identify other risk factors associated with these conditions.

Material and methods

Research design

The Department of Laboratory Services, Metro Heart Institute, with multispecialty facilities in Faridabad (Haryana), was the site of this descriptive study. Data from patients visiting the diabetes clinic were collected in August and September 2023, with approval from the local Institutional Ethics Committee of Metro Heart Institute, Faridabad, Haryana, India.

Population under investigation

A total of 947 patients from urban and rural areas of Faridabad (Haryana, India) were included in the investigation to determine the prevalence of Type 2 Diabetes Mellitus (T2DM) and dyslipidemia in patients. Out of 947 patients, 590 were from an urban area and 357 from a rural area. The study comprised both males and females.

Procedure

The study incorporated patient data, including gender and demographic information (urban *versus* rural). The following measurements were included: The levels of fasting blood sugar (mg/dl), total cholesterol (mg/dl), triglycerides (mg/dl), high-density lipoprotein (mg/dl), low-density lipoprotein (mg/dl), and glycosylated hemoglobin-HbA1c (%). All patients were instructed to fast overnight for at least 12 hours, and 5 mL of venous blood was drawn before breakfast to assess fasting blood glucose and serum lipid profiles. After drawing blood from the patients, 3 mL was transferred into serum tubes for lipid analysis, and 2 mL was placed into sodium fluoride tubes for blood glucose measurement.

Materials

Patient data was collected from the Department of Laboratory Services, Metro Heart Institute with multispecialty Faridabad (Haryana). If the patient's fasting blood sugar was >126 mg/dL, they were diagnosed with type II diabetes mellitus (T2DM); if it was <100 mg/dL, they were classified as non-diabetic. If the value were between 100 and 125 mg/dL, the condition would be considered pre-diabetic for T2DM. If the patient had HBA1C >6.5% they were classified as diabetic; HBA1C between 5.7–6.4% considered pre-diabetic. While HBA1C <5.7% was indicative of controlled type 2 diabetes.

Dyslipidemia

Dyslipidemia was defined as the existence of one or more of the following lipid abnormalities: total cholesterol level >200 mg/dl, triglyceride level >150 mg/dl,

Table 1: Demographic (urban *versus* rural) distribution of patients for analyzing T2DM and dyslipidemia (n=947).

	Rural		Urban	
	Count	%	Count	%
Total patients	357	37.69%	590	62.30%
Gender				
Females	122	34.17%	231	39.15%
Males	235	65.82%	359	60.84%

low-density lipoprotein >100 mg/dl, or high-density lipoprotein <40 mg/dl in males or <50 mg/dl in females. Patients with HDL levels greater than 60 mg/dL were considered normal. A total cholesterol <200 mg/dL was regarded as normal, 200–239 mg/dL as borderline, and >240 mg/dL as high. Similarly, triglyceride levels <150 mg/dL were regarded as normal, those between 150–199 mg/dL as borderline, and those >200 mg/dL as high. A low-density lipoprotein level greater than 160–190 mg/dL was considered extremely high. Patients diagnosed with dyslipidemia were further divided into three categories: isolated single-parameter dyslipidemia, combined-parameter dyslipidemia (two abnormal lipid parameters), and mixed-parameter dyslipidemia (three abnormal lipid parameters).

Statistical analysis

Descriptive analysis including mean, percentage distribution, range and standard deviations was performed on fasting blood sugar (mg/dl), total cholesterol (mg/dl), triglyceride (mg/dl), high-density lipoprotein (mg/dl), low-density lipoprotein (mg/dl) and hemoglobin HBA1C (%) in both males and females as well as on rural *versus* urban patients. A P-value of <0.05 was considered statistically significant. The Statistical Package for the Social Sciences (SPSS version 14; IBM SPSS, Inc., Chicago, IL, USA) was used to analyze the collected data.

Results

Demographic distribution of patients

This study included 947 patients diagnosed with fasting blood sugar, glycosylated hemoglobin levels, total cholesterol, total triglyceride, high-density lipoprotein (HDL), and low-density lipoprotein (LDL) to examine Type II Diabetes mellitus (T2DM) and dyslipidemia from urban and rural populations (Table 1). Out of 947 studied patients, 590 belonged to the urban population and 357 to the rural population. The number of females who underwent diagnosis from both rural and urban populations was less than that of males. There were 231 (39.15%) and 122 (34.17%) females from urban and rural areas, respectively. In contrast, the study had significantly more males, with 235 (65.82%) from rural areas and 359 (60.84%) from urban areas (Table 1). HBA1C (%) analysis was performed on 69 females and

Table 2: Comparison of fasting blood sugar, glycosylated hemoglobin levels and lipid profile in rural *versus* urban patients for analyzing T2DM and dyslipidemia.

Variables	Rural		Urban		P-value
	Mean	SD	Mean	SD	
Fasting blood sugar (mg/dL)	98.64	25.64	124.24	47.70	<0.001
HBA1C	6.04	1.24	7.09	1.84	<0.001
Total cholesterol (mg/dL)	175.33	42.91	180.58	44.53	<0.05
Total triglyceride (mg/dL)	139.61	63.79	169.64	90.82	<0.001
High-density lipoprotein (mg/dL)	46.07	12.44	45.04	12.74	012 ^{ns}
Low-density lipoprotein (mg/dL)	101.34	35.34	100.84	36.91	0.23 ^{ns}

Note: ^{ns} – non-significant.

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85 males from an urban area and 9 females and 27 males from the rural population.

Comparison of urban *versus* rural patients

The mean values of diagnosis for fasting glucose level, glycosylated hemoglobin levels, and lipid profile from rural *versus* urban populations are illustrated in Table 2. Patients in the urban population had significantly (P-values: <0.001) higher fasting blood sugar (Urban: 124.24 mg/dL; Rural: 98.64 mg/dL), HBA1C (Urban: 7.09; Rural: 6.04), and total triglycerides (Urban: 169.64 mg/dL; Rural: 139.61 mg/dL) than patients in rural areas. Patients in urban areas had slightly higher total cholesterol than those in rural areas (P-values: <0.05). Nonetheless, patients in urban and rural areas had nearly identical and nonsignificant mean values for HDL (P=0.12, ns) and LDL (P=0.23, ns; Table 2).

Gender comparison

The gender-specific profiles of fasting glucose levels, glycosylated hemoglobin levels, and lipid profiles are shown in Table 3 and Figure 1. There was no difference between genders for fasting blood sugar levels of both urban (females: 125.79 mg/dL; males: 123.24 mg/dL; P-value: 0.40 ns) and rural patients (females: 99.37 mg/dL; males: 98.26 mg/dL; P-value: 0.35 ns). Likewise, HBA1C levels were similar for males and females from both urban and rural patients. There were no significant gender-specific differences in total cholesterol (mg/dL) between rural and urban patients (Table 3). Males' triglyceride levels were significantly higher (P-value <0.001) than females' in both rural (males: 146.02 mg/dL, females: 127.26 mg/dL) and urban patients (males: 183.45 mg/dL, females: 148.42 mg/dL). HDL levels were higher in females than in males in both rural (Males: 43.26 mg/dL, Females: 51.49 mg/dL) and urban patients (Males: 41.97 mg/dL, Females: 49.82 mg/dL). LDL was non-significant in males and females as well as urban and rural patients (Table 3, Figure 1).

Risk profile

T2DM diagnoses were more common in urban areas (36.27%) compared to rural areas (6.16%) (Table 4). Patients in both urban areas (24.40%) and rural areas (25.49%) had nearly identical pre-diabetic conditions. Additionally, the percentage of non-diabetic patients was higher in rural areas (68.34%) compared to urban areas (39.32%). HBA1C values ranged from 6.53–11.38% in the rural population and 6.57–14% in urban patients. Overall, patients with higher cholesterol levels were found in 6.16% of rural and 9.83% of urban patients (Table 4). Higher cholesterol levels ranged from 240 to 424 mg/dL in rural patients and from 240 to 367 mg/dL in urban patients. Patients with high triglycerides (>200 mg/dL) were higher in urban (27.11%) than rural (14.56%) areas. The percentage of patients with low HDL (<40 mg/dL in males and <50 mg/dL in females) was almost equal in rural (45.09%) and urban (49.50%) patients. Urban patients (6.77%) had a slightly higher percentage of high LDL (>160 mg/dL) than rural patients (5.04%) (Table 4).

Statistically significant differences were observed among diabetic and non-diabetic patients in both males and females from urban and rural populations (P-value<0.001; Table 5, Figure 2). A comparison of gender revealed that patients in urban areas (males, 78.88%; females, 84.05%) had a higher HbA1c risk profile than patients in rural areas (males, 48.17%; females,

Table 3: Comparison of genders (Mean±SD) for fasting blood sugar, glycosylated hemoglobin levels and lipid profile in rural *versus* urban patients for analyzing T2DM and dyslipidemia.

Variables	Rural			Urban		
	Females	Males	P-value	Female	Male	P-value
Fasting blood sugar (mg/dL)	99.37±25.14	98.26±25.94	0.35^{ns}	125.79±49.22	123.24±46.74	0.40^{ns}
HBA1C	6.12±0.98	6.01±1.33	0.81^{ns}	7.04±1.62	7.14±2.01	0.58^{ns}
Total cholesterol (mg/dL)	177.62±40.31	174.14±44.23	0.46^{ns}	180.17±43.77	180.85±45.07	0.86^{ns}
Triglyceride (mg/dL)	127.26±49.95	146.02±69.13	<0.001	148.42±69.57	183.45±100.01	<0.001
High-density lipoprotein (mg/dL)	51.49±11.76	43.26±11.86	<0.001	49.82±12.85	41.97±11.70	<0.001
Low-density lipoprotein (mg/dL)	100.67±34.19	101.67±35.99	0.82^{ns}	100.66±37.26	100.96±36.73	0.15^{ns}

Note: ^{ns} – non-significant.

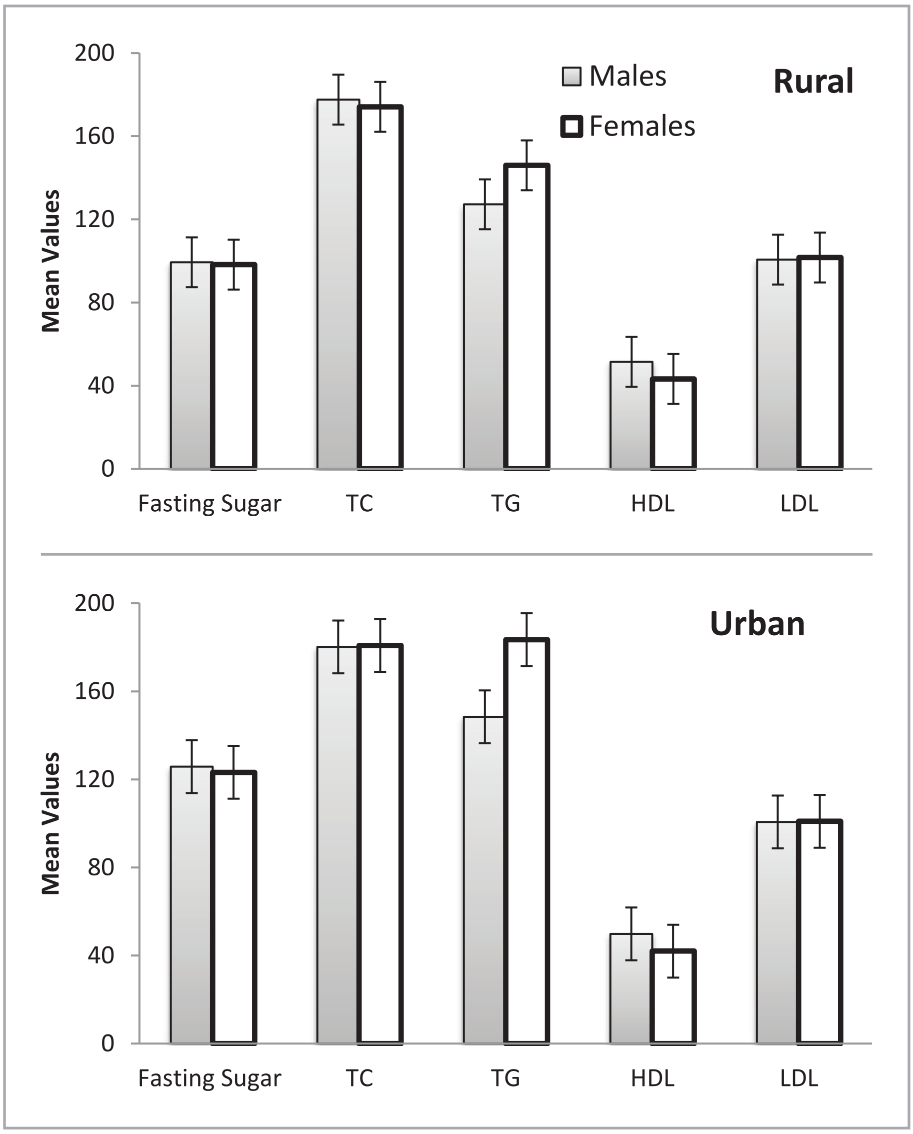

Figure 1: Comparison of fasting blood sugar and lipid profile amongst gender in rural *versus* urban patients. TC – total cholesterol; TG – triglycerides; HDL – high-density lipoprotein; LDL – low-density lipoprotein.

Table 4: Demographic profile of patients for fasting blood sugar, glycosylated hemoglobin levels and lipid profile to study dyslipidemia and T2DM (N=number of patients in%).

Variables		Rural				Urban			
		N (%)	Range	Mean	SD	N (%)	Range	Mean	SD
Fasting blood sugar (mg/dL)	Normal (<100 mg/dL)	68.34	45–99	88.88	8.01	39.32	66–99	88.71	6.40
	Prediabetic (100–125 mg/dL)	25.49		107.15	7.30	24.40		111.05	7.95
	Diabetes (>126 mg/dL)	6.16	126–349	171.86	55.91	36.27	129–526	171.63	49.57
HBA1C	Normal (<5.7%)	52.78	4.85–5.68	5.37	0.24	18.83	4.9–5.69	5.35	0.22
	Prediabetic (5.7–6.4%)	27.77		5.88	0.24	31.16		6.03	0.20
	Diabetes (>6.5%)	19.44	6.53–11.38	8.05	1.60	50.01	6.57–14	8.42	1.78

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Table 4: Continued.

Variables		Rural				Urban			
		N (%)	Range	Mean	SD	N (%)	Range	Mean	SD
Total cholesterol (mg/dL)	Normal (<200 mg/dL)	74.78	58–199	157.35	29.11	66.61	76–200	155.57	27.83
	Borderline (200–239 mg/dL)	19.04		216.48	11.19	23.55		217.44	11.61
	High (>240 mg/dL)	6.16	240–424	256.40	62.10	9.83	240–367	261.74	22.65
Triglyceride (mg/dL)	Normal (<150 mg/dL)	64.98	50–148	103.12	25.05	50.33	47–149	107.05	26.08
	Borderline (150–199 mg/dL)	20.44		171.69	15.09	21.86		170.78	14.46
	High (>200 mg/dL)	14.56	202–406	255.61	60.47	27.11	200–765	285.01	90.49
High-density lipoprotein (mg/dL)	Normal (>60 mg/dL)	14.56	60–91	67.75	7.98	12.71	60–95	68.89	8.34
	Low (<40 mg/dL/<50 mg/dL)*	45.09	15–49	36.37	6.63	49.50	15–50	36.18	6.96
Low-density lipoprotein (mg/dL)	Normal (<100 mg/dL)	47.33	16.2–99.8	72.63	19.14	48.30	9.4–100	70.87	19.77
	Borderline high (100 to 160 mg/dL)	47.61		121.48	16.02	44.91		123.90	16.47
	High (>160–190 mg/dL)	5.04	160.4–293.4	180.68	33.79	6.77	160–586	184.29	68.91

Note: * – Females <50 (mg/dL); Males <40 (mg/dL).

Table 5: Prevalence rates (% of patients) of studied characteristics in rural *versus* urban patients for analyzing T2DM and dyslipidemia.

Variables	Rural		Urban	
	Males (%)	Females (%)	Males (%)	Females (%)
Type-II diabetic mellitus				
No (<100 mg/dL)	67.65	69.67	38.44	40.69
Yes (>100 mg/dL)	32.34	30.32	61.55	59.30
P-value	<0.001	<0.001	<0.001	<0.001
HBA1C				
No (<5.7%)	51.85	55.55	21.17	15.94
Yes (>5.7%)	48.17	44.44	78.88	84.05
P-value	<0.05	<0.001	<0.001	<0.001
Hypercholesterolemia				
No (<200 mg/dL)	74.89	74.49	65.73	67.96
Yes (>200 mg/dL)	25.10	25.40	34.26	32.03
P-value	<0.001	<0.001	<0.001	<0.001

Table 5: Continued.

Variables	Rural		Urban	
	Males (%)	Females (%)	Males (%)	Females (%)
Hypertriglyceridemia				
No (<150 mg/dL)	60.42	73.77	44.56	59.30
Yes (>150 mg/dL)	39.57	26.22	54.31	40.69
P-value	<0.001	<0.001	<0.001	<0.001
Low HDL				
No (>60 mg/dL)	9.78	21.80	7.52	21.64
Yes (<60 mg/dL)	90.12	76.22	92.47	78.35
P-value	<0.001	<0.001	<0.001	<0.001
High LDL				
No (<100 mg/dL)	47.65	47.54	37.32	51.51
Yes (>100 mg/dL)	53.61	52.45	61.01	48.48
P-value	<0.001	<0.001	<0.001	<0.001

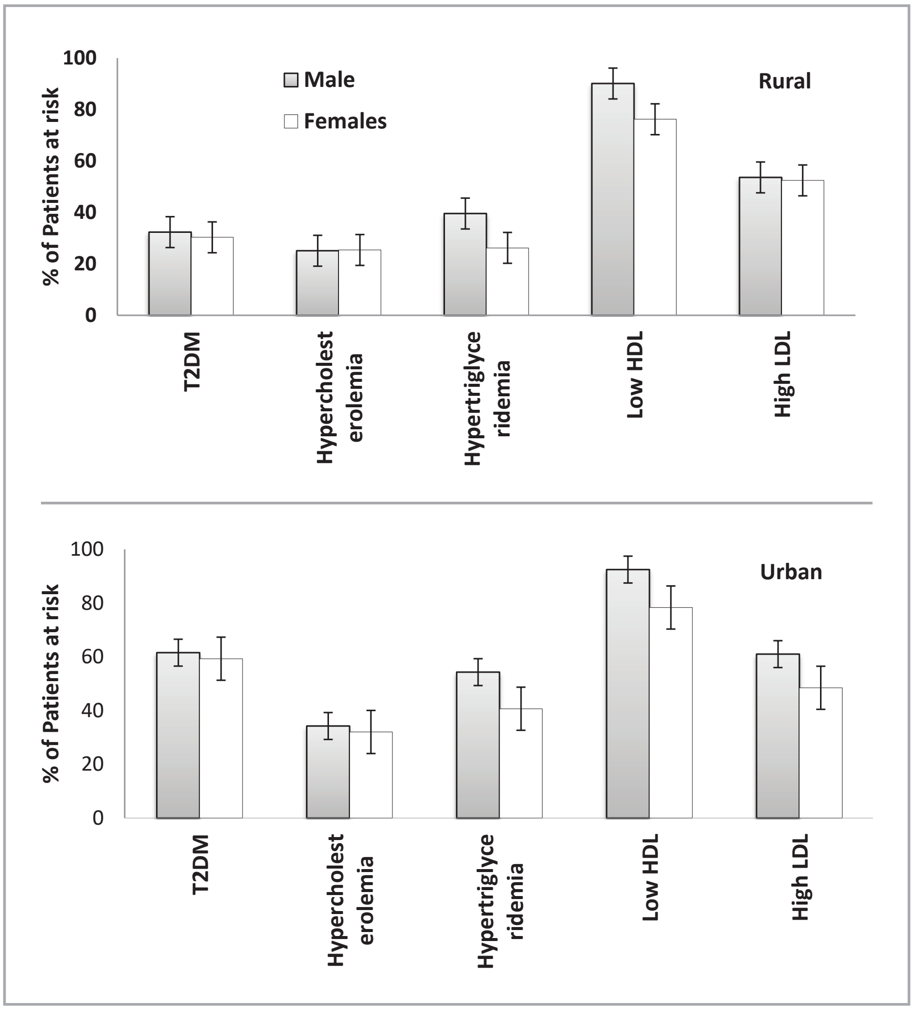

Figure 2: Comparison of genders based on risk profile (%) for fasting blood sugar, glycosylated hemoglobin levels and lipid profile in rural *versus* urban patients. T2DM – type-II Diabetic mellitus; HDL – high-density lipoprotein; LDL – low-density lipoprotein.

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44.44%). Hypercholesterolemia was more prevalent in urban areas (males: 34.26%; females: 32.03%) than in rural areas (males: 25.10%; females: 25.40%). Hypertriglyceridemia was also more common in urban (males, 54.31%; females, 40.69%) than in rural (males, 39.57%; females, 26.22%) patients. Males had more hypertriglyceridemia than females in both urban and rural areas. A high percentage of patients from both rural and urban areas (>75%) had low HDL values. Patients with LDL levels greater than 100 mg/dL were more common in urban males (61.01%) than in rural males (53.61%) and females (48.48% and 52.45%, respectively) (Table 5).

Prevalence of dyslipidemia

There were 19.04% patients in rural areas and 9.15% in urban areas without dyslipidaemia. The prevalence of dyslipidaemia (defined as having at least one abnormal lipid fraction) was 80.96% in rural patients and 90.85% in urban patients (Table 6). In 12.60% of rural and 5.08% of urban areas, high LDL dyslipidemia was the most prevalent form of isolated dyslipidemia. The percentage of patients with isolated dyslipidemia (characterized by high triglycerides, low high-density lipoprotein, and high low-density lipoprotein) was 29.13% in urban areas and 34.44% in rural areas. Patients with combined dyslipidemia (two abnormal lipid fractions) are more common in urban areas (26.7%) than in rural areas (23.24%). Patients with mixed dyslipidemia (three abnormal lipid fractions) were also more prevalent in urban (18.46%) than in rural (16.52%) populations (Table 6).

Discussion

Demographic distribution of patients

Urbanization affects the lifestyle and socio-economic status of people compared to those in rural areas.

Table 6: Demographic distribution of dyslipidemia amongst the studied patients.

	Rural			Urban		
	Females	Males	Total	Females	Males	Total
No dyslipidaemia	23 (18.85%)	45 (19.14%)	68 (19.04%)	4 (1.73%)	50 (13.92%)	54 (9.15%)
Isolated dyslipidaemia						
High TG (mg/dL)	1 (0.81%)	18 (7.65%)	19 (5.32%)	0	21 (5.84%)	21 (3.55%)
Low HDL (mg/dL)	24 (19.67%)	35 (14.89%)	59 (16.52%)	80 (34.63%)	41 (11.42%)	121 (20.50%)
High LDL (mg/dL)	16 (13.11%)	29 (12.34%)	45 (12.60%)	2 (0.87%)	28 (7.79%)	30 (5.08%)
Combined dyslipidaemia						
High LDL+Low HDL	13 (10.65%)	10 (4.25%)	23 (6.44%)	29 (12.55%)	19 (5.29%)	48 (8.13%)
High TG+Low HDL	6 (4.91%)	12 (5.10%)	18 (5.04%)	32 (13.85%)	52 (14.48%)	84 (14.23%)
High TG+High LDL	0	9 (3.82%)	9 (2.52%)	0	10 (2.78%)	10 (1.69%)
High TC+High LDL	12 (9.83%)	19 (8.08%)	31 (8.68%)	0	14 (3.89%)	14 (2.37%)
High TC+High TG	0	2 (0. 85%)	2 (0.56%)	0	0	0
High TC+ Low HDL	0	0	0	3 (1.29%)	4 (1.11%)	7 (1.18%)
Mixed dyslipidaemia						
High TG+Low HDL+High LDL	12 (9.83%)	18 (7.65%)	30 (8.40%)	15 (6.49%)	20 (5.57%)	35 (5.93%)
High TG+High TC+High LDL	6 (4.91%)	18 (7.65%)	24 (6.72%)	1 (0.43%)	38 (10.58%)	39 (6.61%)
High TC+High LDL+Low HDL	1 (0.81%)	1 (0.42%)	2 (0.56%)	19 (8.22%)	6 (167%)	25 (4.23%)
High TC+High TG+Low HDL	0	3 (1.27%)	3 (0.84%)	1 (0.43%)	9 (2.56%)	10 (1.69%)
High TG+Low HDL + High LDL+High TC	8 (6.55%)	16 (6.81%)	24 (6.72%)	45 (19.48%)	47 (13.09%)	92 (15.59%)

Note: TC – total cholesterol; TG – triglycerides; HDL – high-density lipoprotein; LDL – low-density lipoprotein.

Urbanization has several detrimental impacts, including increased consumption of sugar and fats, obesity, cardiovascular disease, and type 2 diabetes mellitus (T2DM) [14, 16–19]. Studies have indicated that individuals who relocate from rural to urban areas are typically less physically active than those who remain in rural areas [14, 16]. India's fast urbanization in recent years has led to a rise in the prevalence of many diseases in urban areas. Understanding the incidence of T2DM and dyslipidemia in India's rural and urban populations is therefore important. The current study examined the prevalence of pre-diabetes, diabetes, and dyslipidemia in patients from both urban and rural areas of Faridabad, India. The majority of patients diagnosed in this study came from urban areas (n=590) compared to rural areas (n=357).

Regarding gender, men from both urban and rural populations comprised the majority of diagnosed patients, compared to women (Table 1). T2DM diagnoses were significantly more common in the urban population (36.27%) than in the rural population (6.16%) (Table 4). Urban patients exhibited higher fasting blood sugar, HbA1c, total cholesterol, and triglyceride levels than rural patients (Table 2). The disparities in T2DM and dyslipidemia between patients in urban and rural areas can be attributed to a variety of factors, including living conditions, socioeconomic status, awareness, dietary habits, and lifestyle [20].

Gender comparison

Recent research indicates that men are diagnosed with T2DM at a higher rate than women [21]. Therefore, understanding gender differences in T2DM, pre-diabetes, and dyslipidemia prevalence is essential to understanding public health strategies. In this study, fewer than 40% of female participants in both urban and rural areas received a diagnosis, compared to more than 60% of male participants (Table 1). This could be the result of gender discrimination or a lack of knowledge about women's health and wellbeing. Interestingly, in patients from both urban and rural locations, changes in any of the following parameters—total cholesterol, LDL, HbA1c, or fasting blood sugar levels—were not influenced by gender. However, men's TG levels were significantly higher than those of women in individuals from both rural and urban areas (Table 3). In both rural and urban areas, the mean HDL was higher than that of males (Table 3). These differences can be explained by varying hormone effects and levels of physical exercise [16, 20, 21].

Risk profile

Adults living in urban areas were significantly more likely to have dyslipidemia and T2DM than those in rural areas [14, 16–19]. In comparison to their rural counterparts, urban patients had greater mean values for TC, TG, HBA1C, and fasting blood sugar (Table 4). Table 4 shows that a greater proportion of patients from urban areas had higher fasting blood sugar (Urban: 36.27%; Rural: 6.16%), HBA1C (Urban: 50.01%; Rural: 19.44%), triglycerides (Urban: 27.11%; Rural: 14.56%), and total cholesterol (Urban: 9.83%; Rural: 6.16%) than patients from rural population. In summary, patients in urban areas were more likely to develop dyslipidemia and T2DM than patients in rural areas.

Additionally, a comparison of genders showed that patients in urban areas had higher risk profiles than those in rural areas fasting blood glucose (Urban: males 61.55%; females 59.30%; males 32.34%; females 30.32%) and HBA1C (Urban: males 78.88%; females 84.05%; Rural: males 48.17%; females 44.44%) than rural population (Table 5).

Humans have two types of lipoproteins: HDL and LDL, whereas triglycerides are stored as excess fat in the body. Patients with elevated low-density lipoprotein (LDL) are at risk of atherosclerosis, myocardial infarction, and stroke. HDL, on the other hand, is regarded as healthy cholesterol and can help prevent heart attack and stroke to some extent. HDL carries LDL from the arteries back to the liver, where it is processed and eliminated from the body [6, 7]. Patients in urban areas were more likely than those in rural areas to have hypercholesterolemia (Urban: males: 34.26%; females: 32.03%; Rural: 25.10%; females: 25.40%) and hypertriglyceridemia (Urban: males: 54.31%; females: 40.69%; Rural: 39.57%; females: 26.22%; Table 5).

Dyslipidemia and other T2DM risk factors are produced when hypertriglyceridemia is paired with either high LDL or low HDL [6, 7]. Table 5 shows that most of the study's participants are from urban areas, have hypertriglyceridemia, low-HDL (>75%), and high-LDL (>50%) levels. Males had higher levels of hypertriglyceridemia than females, but there was no gender difference in hypercholesterolemia (Table 5). Low HDL (>75%) and high LDL (>50%) values were present in a large proportion of patients from both urban and rural areas (Table 5).

According to this study, dyslipidemia affected 90.85% of patients in the urban area and 80.96% of patients in the rural area (Table 6). In both males and females, the most prevalent patterns of dyslipidemia

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were (high LDL and low HDL) and (High TG and Low HDL). Isolated dyslipidemia, characterized by elevated LDL, was more prevalent in rural areas (Rural: 12.60%; Urban: 5.08%). Conversely, mixed dyslipidemia—defined as having three or more aberrant lipid fractions—was more prevalent in urban areas. 18.46% of patients in the urban population had three abnormal lipid fractions, while 15.59% had four or more abnormal lipid fractions. Table 6 shows that 16.52% of the rural population had three abnormal lipid fractions and 6.72% had four abnormal lipid fractions. Numerous earlier studies reported that the prevalence of dyslipidemia concurred with these findings. These differences in the prevalence and patterns of T2DM and dyslipidemia may be attributed to lifestyle, genetics, and socioeconomic development [6–8].

The study had several limitations, including not measuring variables like sleep period, depression, and dyslipidemia caused by secondary drugs. There were limited female and rural participants in the study due to a lack of awareness about disease progression. Furthermore, this study did not consider the proportion of diabetic patients who are migrants, which may have caused bias in the rural-urban diabetes prevalence.

Conclusions

According to this study, the prevalence of dyslipidemia and T2DM in adult Indians varied significantly between the urban and rural populations. The current study found an association between the prevalence of type II diabetes and dyslipidemia with urban *versus* rural lifestyles. According to these results, patients from the urban population may have greater levels of total cholesterol, total triglycerides, HBA1C, and fasting blood glucose.

The percentage of non-diabetic patients was higher in rural areas compared to urban areas. Findings of this study suggested that the large urban population of northern India may be at risk of progression of pre-diabetes to diabetes and dyslipidemia due to lifestyle changes. In India, there is an urgent need to increase understanding of the diagnosis and prevention of type 2 diabetes and dyslipidemia among rural populations and women.

Conflict of interest

The authors declare no conflict of interest.

Ethics approval

The approval for this study was obtained from the Ethics Committee of the Metro Heart Institute, Faridabad, Haryana, India (approval ID: 2022-672-1).

Consent to participate

Written informed consent was obtained from all the participants.

References

1. Saedi E, Gheini MR, Faiz F, Arami MA. Diabetes mellitus and cognitive impairments. World J Diabetes. 7: 412–422.2016. 10.1016/j.annepidem.2021.02.016
2. Tangvarasittichai S. Oxidative stress, insulin resistance, dyslipidemia, and type 2 diabetes mellitus. World J Diabetes. 6:456–80.2015. doi: 10.4239/wjd.v6.i3.456.
3. Hills AP, Arena R, Khunti K et al. Epidemiology and determinants of type 2 diabetes in South Asia.Lancet Diabetes Endocrinol. 6: 966-978.2018. https://doi.org/10.1016/S2213-8587(18)30204-3.
4. Lin X, Xu Y, Pan X et al. Global, regional, and national burden and trend of diabetes in 195 countries and territories: an analysis from 1990 to 2025. Sci Rep 10:14790.2020. https://doi.org/10.1038/s41598-020-71908-9.
5. Bommer C, Sagalova V, Heesemann E, et al. Global Economic Burden of Diabetes in Adults: Projections from 2015 to 2030. Diabetes Care. 41: 963–970.2018.
6. Udawat H, Goyal RK, Maheshwari S etal. Coronary risk and dyslipidemia in type 2 diabetic patients. J Assoc Physicians India. 49:970–973. 2001
7. Ghadeer A HA, Barqi AM, Almaqhawi A etal. Prevalence of Dyslipidemia in Patients with Type 2 Diabetes Mellitus: A Cross-Sectional Study. Cureus 13:1-7.e20222. 2021. DOI 10.7759/cureus.20222
8. Pitso L, Mofokeng TRP, Nel R. Dyslipidaemia pattern and prevalence among type 2 diabetes mellitus patients on lipid-lowering therapy at a tertiary hospital in central South Africa. BMC Endocrine Disorders 21:159.1-10.2021. https://doi.org/10.1186/s12902-021-00813-7.
9. Shahwan MJ, Jairoun AA, Farajallah A, Shanabli S: Prevalence of dyslipidemia and factors affecting lipid profile in patients with type 2 diabetes. Diabetes Metab Syndr 13:2387-92.2019. 10.1016/j.dsx.2019.06.009.
10. Warraich HJ, Rana JS. Dyslipidemia in diabetes mellitus and cardiovascular disease. Cardiovasc Endocrinol. 6:27–32.2017. https://doi.org/10.1097/XCE. 0000000000000120
11. Carris NW, Magness RR, Labovitz AJ. Prevention of Diabetes Mellitus in Patients with Prediabetes. The American Journal of Cardiology. 123: 507–512. 2019. doi:10.1016/j.amjcard.2018.10.032.
12. Chehade JM, Gladysz M, Mooradian AD. Dyslipidemia in type 2 diabetes: prevalence, pathophysiology, and management. Drugs 73:327–39.2013. doi: 10.1007/s40265-013-0023-5

13. Kenny HC, Abel ED. Heart failure in type 2 diabetes mellitus: impact of glucose-lowering agents, heart failure therapies, and novel therapeutic strategies. Circ Res. 124:121–41.2019. https://doi.org/10.1161/CIRCRESAHA.118.311371
14. Deepa M, Bhansali A, Anjana RM et al. Knowledge and awareness of diabetes in urban and rural India: The Indian Council of Medical Research India Diabetes Study (Phase I): Indian Council of Medical Research India Diabetes. Indian J Endocrinol Metab 18,3: 379–385.2014. 10.4103/2230-8210.131191
15. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care. 2010 33e57 doi: 10.2337/dc10-S062.
16. Ranasinghe P, Jayawardena R, Gamage N, Sivanandam N, Misra A. Prevalence and trends of the diabetes epidemic in urban and rural India: A pooled systematic review and meta-analysis of 1.7 million adults. Annals of Epidemiology. 58: 128-148. 2021. 10.1016/j.annepidem.2021.02.016
17. Anjana RM, Pradeepa R, Deepa M et al. Prevalence of diabetes and prediabetes (impaired fasting glucose and/or impaired glucose tolerance) in urban and rural India: Phase I results of the Indian Council of Medical Research-India Diabetes study. Diabetologia. 2011. 54:3022–7. 2011.
18. Velmurugan G, Mohanraj S, Dhivakar M et al. Differential risk factor profile of diabetes and atherosclerosis in rural, sub-urban, and urban regions of South India: The KMCH-Non-communicable disease studies. Diabet Med. 38(6):e14466.2021. doi: 10.1111/dme.14466.
19. Goryakin Y, Rocco L, Suhrcke M. The contribution of urbanization to non-communicable diseases: Evidence from 173 countries from 1980 to 2008. Econ Hum Biol. 26:151-63.2017. 10.1016/j.ehb.2017.03.004
20. Jialal I, Singh G. Management of diabetic dyslipidemia: an update. World J Diabetes. 10:280–90.2019. https://doi.org/10.4239/wjd.v10.i5.280.
21. Kautzky-Willer A, Harreiter J, Pacini G. Sex and gender differences in risk, pathophysiology and complications of type 2 diabetes mellitus. Endocr Rev 37: 278–316.2016. https://doi.org/10.1210/er.2015-1137

 https://doi.org/10.46389/rjd-2025-1524