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PREVALENCE AND PATTERN OF DYSLIPIDAEMIA AND ASSOCIATED FACTORS IN NAÏVE TYPE 2 DIABETES MELLITUS PATIENTS: A CROSS-SECTIONAL STUDY FROM WESTERN UTTAR PRADESH

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ABSTRACT

Objective: The present study was conducted with an objective to study prevalence and pattern of dyslipidemia in newly diagnosed type 2 diabetes mellitus patients.

Methods: From August 2021 to March 2022, 161 participants participated in the trial. After a night of fasting, skilled medical laboratory technicians drew 5 ml of blood from each study subject and performed anthropometric measurements on them.

Results: 110 patients, or 68.9% of the entire group, had dyslipidemia. About 3.7% (n=6) of the individuals had atherogenic dyslipidemia. Among 2.5% and 23.6% of the participants, high TC (total cholesterol) and low HDL (high-density lipoprotein), respectively, were found to be isolated dyslipidemias. Significantly more hypertensives (77.9%), people with abnormal fasting glucose levels (80.2%), those with elevated postprandial glucose levels (78.8%), and people with larger waist circumference had dyslipidemia (76.0%).

Conclusion: Our study showed that diabetic patients have a significant prevalence of dyslipidemia. The main public health issue in underdeveloped nations is dyslipidemia, which also serves as a standalone risk factor for developing cardiovascular disease (CVD). In addition, it complicates the progression of CVD in diabetic individuals and raises mortality when combined with other risk factors like high blood pressure.

Keywords: Diabetes mellitus, Dyslipidemia, Insulin resistance, Cardiovascular, Atherogenic.

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INTRODUCTION

In India, diabetes mellitus (DM) has emerged as a serious public health issue. It is a metabolic condition brought on either or both by inadequate insulin secretion. It is characterized by elevated blood sugar levels, decreased cellular glucose uptake and metabolism, and impaired lipid and protein metabolism [1]. Diabetes lowers quality of life in addition to increasing morbidity and mortality. In addition, sickness and its complications place a significant financial burden on those who are afflicted by them [2,3].

Diabetes is widespread worldwide and is becoming more common in both industrialized and developing nations. In India, there are currently 41 million diabetic patients, with a projected increase to 70 million by 2025, according to the International Diabetes Federation. The majority of these (more than 90%) are type 2 diabetic patients [4].

Diabetes complications include coronary heart disease, stroke, diabetic kidney disease, diabetic retinopathy, and neuropathy are all linked to persistent hyperglycemia of the condition. Major causes of macrovascular problems include impaired lipid metabolism and altered lipid levels [5].

The word "dyslipidemia" is frequently used to refer to the aberrant lipid profile. Dyslipidemia significantly raises a diabetic patient's risk of atherosclerosis and, ultimately, fatality. It frequently occurs before the onset of diabetes, especially type 2 DM, and it may continue even with adequate blood sugar control. 1 Elevated triglycerides (TG), low-density lipoproteins (LDL), and decreased high-density lipoprotein levels are the hallmarks of the normal diabetic dyslipidemia [6].

Insulin resistance in type 2 diabetics leads to uncontrolled lipolysis, which increases fatty acid flow in the liver and raises hepatic triglyceride production. In addition, endothelium insulin dependent lipoprotein lipase activity is lowered, which results in a reduction in triglyceride clearance. Affected processes also include those that involve apoprotein synthesis and cholesterol ester activity [7].

Compared to non-diabetics, patients with diabetic dyslipidemia have more atherogenic lipid particles [5]. It is important to identify and treat lipid abnormalities early due to the additional cardiovascular risk that hyperglycemia and hyperlipidemia pose. In view of this present study was conducted with objective to study prevalence and pattern of dyslipidemia in newly diagnosed type 2 diabetes mellitus patients.

METHODS

A tertiary care teaching hospital in western Uttar Pradesh's Departments of General Medicine and Community Medicine jointly planned and carried out the institution-based cross-sectional study. 161 participants took part in the trial, which ran from August 2021 to March 2022. Convenient sampling was utilized to choose study participants from the study population because random sample was challenging due to the variability in follow-up appointments for the study participants, some of whom might not show up on the scheduled day. In addition, compared to other sample approaches, it is simple and quick. Sociodemographic and clinical data were gathered using a standardized questionnaire delivered during an interview. Study participants who were pregnant, on lipid-lowering medication, and known to have a heart condition, chronic liver disease, or renal disease were excluded from the study.

Study strategy

After an overnight fast, trained professional nurses working at a diabetic clinic performed anthropometric measurements using a standardized technique. Each participant in the study had their height and weight determined using a digital analog scale, sans shoes. The

subjects were instructed to stand with their feet pointing outward, their legs straight and their knees together, their arms at their sides, their heads, shoulders, buttocks, and heels touching the measurement surface, their eyes straight ahead, and their shoulders relaxed. Weight over height squared was used to compute the body mass index (BMI), and the results were recorded.

A 1-cm-wide, stretch-resistant measuring tape that gives a consistent measurement was used to measure circumferences. Measurements of circumference were made with the patient upright and breathing normally.

The broadest part of the waist was measured, with the measuring tape parallel to the floor. The tape was wrapped snugly around the body for measuring the waist circumference but not too tightly as to be restricting. Two measurements were taken, and the average of those that were within 1 cm of one another was determined. The two measures were taken again if the difference between them exceeded 1 cm. Men's and women's normal WC ranges are 120 cm and 88 cm, respectively. A mercury sphygmomanometer was used to take three consecutive readings of the blood pressure. The initial measurement was made following at least a 10-min period of sitting, and subsequent measures were made every 5 min. The BP readings and the BP values used for analysis were the mean of the last two measurements.

Blood specimen collection technique and investigation

After an overnight fast, a certified medical laboratory technologist took 5 mL of blood from each study participant in accordance with the recommended standard operating procedure. For about 30 min, the obtained blood sample was held at room temperature to test for clot formation. After clot formation, the blood was spun using a fixed head rotor centrifuge at 2000 rpm for 10 min. The serum was then taken out of the blood and kept chilled until analysis. The study was then carried out in Delhi using the clinical chemistry analyzer model A25 from Biosystems (Costa Brava, Spain).

Definition of terms

Systolic blood pressure (SBP; 140 mmHg) and diastolic blood pressure (DBP; 90 mmHg) are the two measurements used to identify hypertension. Patients on antihypertensive medication have raised SBP and DBP.

The following anomalies in the lipid profile, either separately or together, are what are referred to as dyslipidemia. These include TG levels below 150 mg/dL, TC below 200 mg/dL, HDL below 40 mg/dL, and LDL below 100 mg/dL.

According to BMI data, study participants were divided into five categories: Underweight (BMI 18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (BMI 25–29.9 kg/m^2), obese (30–34.9 kg/m^2), severely obese (BMI 35–39.9 kg/m^2), and morbidly obese (BMI 40 kg/m^2).

The medical college's ethical review board provided its approval before any data collection could begin. The study's purpose was then fully communicated to the study subjects. Before any data were collected, each study participant provided a written agreement. Microsoft Office Excel for Windows 2008 and SPSS Version 20.0 were used to statistically analyze the data. The determining factors connected with the prevalence of dyslipidemia were found using the Chi-square test. Statistics were judged significant at p=0.05. Before data processing, all the survey responses were carefully reviewed for accuracy and consistency, as well as for completeness and clarity.

RESULTS AND OBSERVATIONS

The majority of the study subjects in the current study (49.7%) were between the ages of 45 and 59, making their mean age 52.4 9.7 years. Nearly equal percentages of men (49.7%) and women (50.3%) participated in our survey. According to BMI standards, 32.3% of the subjects were overweight, resulting in increased waist circumference in 62.1% of the subjects. In addition, hypertension was present in 64.6% of the participants (Table 1).

In our study, the individuals' mean postprandial glucose levels were 189.2 57.6 mg/dL and their mean fasting glucose levels were 136.8 52.2 mg/dL. In 50.9% of the individuals, elevated total cholesterol was found. In addition, 41.0% of the individuals had elevated triglycerides. A decreased level of high-density lipoprotein was seen in 35.4% of the individuals. About 54.0% of individuals had high levels of low-density lipoprotein, while 65.8% had high levels of non-high-density lipoprotein. The atherogenic index was high in 50.9% of participants based on HDL values (Table 2).

According to the study of the participants' lipid profiles, 68.9% of them had dyslipidemia. 3.7% of the individuals had atherogenic dyslipidemia. Among 2.5% and 23.6% of the participants, high TC (total cholesterol) and low HDL (high-density lipoprotein), respectively, were found to be isolated dyslipidemias. No patients had isolated high TG (Triglyceride) and high LDL dyslipidemias (Low-density lipoprotein). About 3.1%, 41.0%, and 2.5% of participants, respectively, had mixed dyslipidemias such as high triglyceride and low high-density lipoprotein, high triglyceride and high low-density lipoprotein, and high low-density lipoprotein, and high triglyceride (Table 3).

In the current investigation, ageing led to an increase in the prevalence of dyslipidemia. The frequency of dyslipidemia was approximately the same in males and females (70.0 %) (66.7%). In addition, as BMI grew, dyslipidemia prevalence also did so. Hypertensives (77.9%), people with abnormal fasting glucose levels (80.2%), people with abnormal postprandial glucose levels (78.8%), and people with increased waist circumference (76.0%) all had significantly higher prevalences of dyslipidemia (Table 4).

DISCUSSION

425 million people globally with diabetes, of which half are undiagnosed and 279 million live in metropolitan areas, according to the IDF Diabetes Atlas Update 2017 [4,8-10]. Cardiovascular, peripheral vascular, and cerebrovascular disease are the main causes of morbidity and mortality

Table 1: Demographic and anthropometric characteristics of study subjects (n=161)

Variables	Number/Mean	%/SD
Age (in years)	52.4	9.7
Age groups		
<45 years	31	19.2
45–59 years	80	49.7
60–74 years	46	28.6
≥75 years	4	2.5
Gender		
Male	80	49.7
Female	81	50.3
Residence		
Urban	98	60.9
Rural	63	39.1
Body mass index [BMI] (kg/m^2)	28.9	7.5
Grading of BMI (kg/m^2)		
18.5–24.9 (Normal)	56	34.7
25.0–29.9 (Overweight)	52	32.3
30.0–34.9 (Obese)	31	19.3
35.0–39.9 (Severely obese)	15	9.3
≥40.0 (Morbidly obesity)	7	4.4
Waist circumference (cm)	109.9	16.2
Waist circumference (cm)		
Normal [<88 (women), <120 (men)]	61	37.9
Increased [≥88 (women), ≥120 (men)]	100	62.1
Hypertension		
Yes	104	64.6
No	57	35.4

Table 2: Clinical and laboratory characteristics of study subjects (N=161)

Variables	Number/Mean	%/SD
Fasting blood glucose (mg/dL)	136.8	52.2
Fasting blood glucose (mg/dL)		
<130 (Normal)	80	49.7
≥130 (Raised)	81	50.3
Postprandial blood glucose (mg/dL)	189.2	57.6
Postprandial blood glucose (mg/dL)		
<180 (Normal)	71	44.1
≥180 (Raised)	90	55.9
Total cholesterol (mg/dL)	189.5	42.6
Total cholesterol (mg/dL)		
<200 (Normal)	79	49.1
≥200 (High)	82	50.9
Triglyceride (mg/dL)	132.9	62.1
Triglyceride (mg/dL)		
<150 (Normal)	95	59.0
≥150 (High)	66	41.0
High-density lipoprotein (mg/dL)	58.3	30.9
High-density lipoprotein (mg/dL)		
<50 [Low]	57	35.4
≥50 [Normal]	104	64.6
Low-density lipoprotein (mg/dL)	100.7	46.7
Low-density lipoprotein (mg/dL)		
<100 (Normal)	74	46.0
≥100 (High)	87	54.0
Non-High-density lipoprotein (mg/dL)	139.2	42.5
Non-High-density lipoprotein (mg/dL)		
<130 (Normal)	55	34.2
≥130 (High)	106	65.8
Atherogenic index	0.15	0.64
Atherogenic index		
<0.11 (Normal)	79	49.1
≥0.11 (High)	82	50.9

Table 3: Prevalence and pattern of dyslipidemia among study subjects (N=161)

Lipid profile	Number	%
Dyslipidemia*	110	68.9
Atherogenic dyslipidemia#	6	3.7
Isolated dyslipidemias		
High TC (Total Cholesterol)	4	2.5
High TG (Triglyceride)	0	0.0
High LDL (Low-density lipoprotein)	0	0.0
Low HDL (High-density lipoprotein)	38	23.6
Mixed dyslipidemias		
High TG (Triglyceride) and Low HDL (High-density lipoprotein)	5	3.1
High TG (Triglyceride) and High LDL (Low-density lipoprotein)	66	41.0
High LDL (Low-density lipoprotein) and Low HDL (High-density lipoprotein)	4	2.5

*High TC (Total Cholesterol); and/or High TG (Triglyceride); and/or High LDL (Low-density lipoprotein); and/or Low HDL (High-density lipoprotein). #High TC (Total Cholesterol); High LDL (Low-density lipoprotein); and Low HDL (High-density lipoprotein)

in this population, and patients with DM have a 2- to 4-fold greater risk of these conditions. Numerous Western epidemiological research have demonstrated a link between the prevalence of cardiovascular disease and diabetic dyslipidemia, which is characterized by hypertriglyceridemia, low HDL cholesterol, postprandial lipemia, and tiny, and dense LDL cholesterol particles [9-11].

According to the "Chennai Urban Population Study," the prevalence of CAD is now 11%, which is 10 times more than it was in 1970. Hyperglycemia, central obesity, dyslipidemia, and hypertension (HTN) tend to cluster as

Table 4: Association of dyslipidemia with demographic, anthropometric, clinical, and laboratory characteristics of study subjects (n=161)

Variables	Number	%	p value
	Dyslipidemia (n=110)	Normal (n=51)	
Age groups			
<45 years (n=31)	19 (61.3)	12 (38.7)	0.790
45–59 years (n=80)	55 (68.7)	25 (31.3)	
60–74 years (n=46)	33 (71.7)	13 (28.3)	
≥75 years (n=4)	3 (75.00)	1 (25.0)	
Gender			
Male (n=80)	56 (70.0)	24 (30.0)	0.649
Female (n=81)	54 (66.7)	27 (33.3)	
Residence			
Urban (n=98)	71 (72.4)	27 (27.6)	0.160
Rural (n=63)	39 (61.9)	24 (38.1)	
Grading of BMI			
Normal (n=56)	37 (66.1)	19 (33.9)	0.859
Overweight (n=52)	35 (67.3)	17 (32.7)	
Obese (n=31)	21 (67.7)	10 (32.3)	
Severely obese (n=15)	11 (73.3)	4 (26.7)	
Morbidly obesity (n=7)	6 (85.7)	1 (14.3)	
Waist circumference			
Normal (n=61)	34 (55.7)	27 (44.3)	0.007
Increased (n=100)	76 (76.0)	24 (24.0)	
H/o hypertension			
Yes (n=104)	81 (77.9)	23 (28.3)	0.0004
No (n=57)	29 (50.9)	28 (49.1)	
Fasting blood glucose			
Normal (n=80)	45 (56.2)	35 (43.8)	0.001
Raised (n=81)	65 (80.2)	16 (19.8)	
Postprandial blood glucose			
Normal (n=71)	39 (54.9)	32 (45.1)	0.395
Raised (n=90)	71 (78.8)	19 (21.2)	0.001

CAD risk factors. The interaction of these risk factors may account for the increased risk of CAD in Indians. Other contributing variables include a probable hereditary predisposition and low-grade inflammation [12].

Our study revealed a high prevalence of dyslipidemia among the 161 patients recruited, with a frequency of 68.9%. The prevalence of dyslipidemia was practically equal across males and females (70.0%) (66.7%). In our study, dyslipidemia was more common in the urban population than in the rural population, with 72.4% of newly diagnosed diabetics having the condition compared to 61.9% of rural diabetics. In the four regions examined by the ICMR study, dyslipidemia was prevalent in 79% of the population and there was no difference between urban and rural areas [13].

The majority of the study participants exhibited mixed patterns of dyslipidemia, with high TG (triglyceride) and high LDL (low-density lipoprotein) being the most frequently seen in 41.0% of participants. On study of individual indicators, 50.9% of individuals had excessive total cholesterol. In addition, 41.0% of the individuals had elevated triglycerides. A decreased level of high-density lipoprotein was seen in 35.4% of the individuals. About 54.0% of individuals had high levels of low-density lipoprotein, while 65.8% had high levels of non-high-density lipoprotein. Therefore, elevated non-HDL levels were the most prevalent lipid abnormality, highlighting the significance of using non-HDL cholesterol as a co-primary target for therapeutic interventions in addition to primary LDL targets, particularly in patients with TGs in the 200–500 range, as recommended by Lipid Association of India guidelines [14]. According to the findings of the Dixit *et al*. investigation, hypertriglyceridemia was the most often identified abnormality [15]. According to Abbate *et al*'s. findings, the decline in adipose tissue and muscle lipoprotein lipase activity was associated with the rise in triglycerides in individuals with poorly managed diabetes [16].

Increased TC was reported in 13.9% of cases, increased TG in 29.5%, low HDL was the most prevalent abnormality at 72.3%, and high LDL was reported in 11.8% of cases by ICMR-INDIAB. 4.8% of patients had all four lipid abnormalities, high TC, high TG, high LDL, and low HDL, respectively. In our study, the prevalence of the four lipid abnormalities listed above was substantially greater, at 26.1%. In our study, the majority of diabetes patients (46.6%) had mixed dyslipidemia, or more than one aberrant lipid profile. The most prevalent combined abnormality found was hypertriglyceridemia and high LDL levels (41.0%), which contrasted with western studies where a different pattern was seen [17,18] but was similar to a study conducted by Pandya *et al*. among the Gujarati population that showed that the most common mixed abnormality was hypertriglyceridemia and high LDL levels.

In our investigation, the prevalence of atherogenic diabetic dyslipidemia (ADD) was 3.7%, which was lower than the prevalence of 36.1% in the study by Parikh *et al*. Among participants with abnormal fasting (80.2%) and postprandial glucose readings, dyslipidemia was more common (78.8%). Therefore, managing diabetes is crucial since it can lower the prevalence of atherogenic diabetic dyslipidemia.

Since numerous studies have shown that non-HDL-C levels are a stronger predictor of CVD risk than LDL-C, recent attention has shifted to lowering non-HDL-C (all atherogenic lipoproteins). The burden of atherogenic, cholesterol-carrying lipoproteins may be underestimated by LDL-C. In our study, non-high-density lipoprotein levels were greater in 65.8% of participants.

CONCLUSION

Our study showed that diabetic patients have a significant prevalence of dyslipidemia. The significance of a type of dyslipidemia known as atherogenic diabetic dyslipidemia, which is demonstrated to have a lower prevalence in our study, is also highlighted. The risk factors linked to the prevalence of dyslipidemia were gender, ageing, a higher BMI, high blood pressure, and abnormal blood sugar levels. The main public health issue in underdeveloped nations is dyslipidemia, which also serves as a standalone risk factor for developing cardiovascular disease (CVD). In addition, it complicates the progression of CVD in diabetic individuals and raises mortality when combined with other risk factors like high blood pressure. Therefore, it is essential to diagnose, manage, and inform diabetic patients about dyslipidemia and the risk factors connected to it.

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AUTHORS CONTRIBUTION

All the authors made equal contribution.

CONFLICTS OF INTERESTS

None to declare.

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