Patterns of Dyslipidemia Among Patients with Diabetes Mellitus

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Abstract

Background:
Diabetes mellitus presents a prevalent endocrine and metabolic challenge globally. Type-2 diabetic patients exhibit a heightened incidence of dyslipidemia, characterized by elevated low-density lipoprotein (LDL), diminished high-density lipoprotein (HDL), or increased triglycerides (TG) levels. This phenomenon poses a significant public health concern both internationally and within our nation.

Objective:
This study aimed to assess the patterns of dyslipidemia among diabetes patients.

Methods:
This cross-sectional observational study was conducted at the Outpatient Department (OPD) of Shaheed Ziaur Rahman Medical College Hospital, Bogura, from July 2018 to June 2019. Both male and female patients with Type2 diabetes were considered as the study population. A total of 90 patients were selected as study subjects through purposive sampling.The study included 45 diabetic patients on therapy, divided into male (A1, n=19) and female (A2, n=26) subgroups. Additionally, 45 newly diagnosed diabetic patients were categorized into male (B1, n=15) and female (B2, n=30) subgroups.Analysis was performed by using SPSS (Statistical Package for Social Science) version 22.0.

Results:
The study found similar ages and BMI among groups. Elevated serum TC was noted in 31.6%, 19.2%, 26.7%, and 30% of subjects in A1, A2, B1, and B2 respectively. High serum TG levels were observed in 36.8%, 38.5%, 40%, and 66.7% of subjects in the respective groups. Dyslipidemia prevalence varied, with A1 at 57.9%, A2 at 53.8%, B1 at 46.7%, and B2 at 76.7%. High HbA1C was prevalent in B1 and B2 (100%).

Conclusion:
Dyslipidemia patterns among diabetes patients exhibit significant variability, with elevated serum total cholesterol, triglycerides, and low-density lipoprotein levels, alongside reduced high-density lipoprotein levels, commonly observed. These findings underscore the importance of tailored lipid management strategies in mitigating cardiovascular risk in this high-risk population.

Keywords: Dyslipidemia, Diabetes mellitus, Lipid profile, Glycemic control

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Introduction:

Dyslipidemia, characterized by abnormal levels of lipids in the bloodstream, is a significant comorbidity among patients with diabetes mellitus.The global burden of diabetes has reached unprecedented levels, with an estimated 463 million adults affected worldwide, and this number is projected to escalate to 700 million by 2045.[1] Among individuals with diabetes, dyslipidemia is prevalent, affecting up to 80% of patients.[2] Such a high prevalence underscores the importance of understanding the intricate relationship between dyslipidemia and diabetes and its implications for clinical management. Insulin resistance, a hallmark of type-2 diabetes mellitus (T2DM), plays a central role in dyslipidemia development. Insulin resistance impedes the suppression of lipolysis in adipose tissue, leading to increased free fatty acid release into circulation, which subsequently stimulates hepatic synthesis of triglycerides and secretion of verylow-density lipoprotein (VLDL) particles.[3]

Furthermore, insulin resistance hampers the activity of lipoprotein lipase, an enzyme responsible for the hydrolysis of triglycerides in circulating lipoproteins, resulting in elevated TG levels.[4] In addition to insulin resistance, genetic predisposition and lifestyle factors such as diet and physical activity contribute to dyslipidemia in diabetes. Polymorphisms in genes encoding key proteins involved in lipid metabolism, such as apolipoproteins and lipoprotein receptors, can influence lipid profiles and susceptibility to dyslipidemia.[5] Moreover, diets rich in saturated fats and refined carbohydrates exacerbate dyslipidemia by promoting hepatic lipogenesis and impairing lipid clearance mechanisms.[6] Sedentary behaviour further compounds the dyslipidemic phenotype by exacerbating insulin resistance and promoting weight gain, which in turn aggravates dyslipidemia.[7] Understanding the specific dyslipidemia patterns among diabetes patients is crucial for risk stratification and tailored therapeutic interventions. While elevated LDL-C levels are a well-established risk factor for atherosclerotic cardiovascular disease (ASCVD) in the general population, their significance in diabetes-associated dyslipidemia is nuanced. Recent evidence suggests that LDL-C particles in diabetes patients may be smaller and denser, rendering them more atherogenic compared to larger, buoyant LDL-C particles typically observed in non-diabetic individuals.[8] Consequently, traditional LDL-C targets may underestimate ASCVD risk in diabetes patients, necessitating a more comprehensive lipid profiling approach that incorporates particle size and composition analyses. Furthermore, dyslipidemia in diabetes is often characterized by a concomitant reduction in HDL-C levels, impairing reverse cholesterol transport and exacerbating atherogenesis.[9] HDL-C functionality, rather than absolute levels, maybe a more pertinent determinant of cardiovascular risk in diabetes patients. Dysfunctionality of HDL particles, manifested by impaired cholesterol efflux capacity and anti-inflammatory properties, has been implicated in the pathogenesis of ASCVD in diabetes.[10] Moreover, elevated TG levels, a common feature of dyslipidemia in diabetes, have emerged as an independent predictor of cardiovascular events, particularly in patients with concomitant insulin resistance and central obesity.[11] Hypertriglyceridemia contributes to atherogenesis through multiple mechanisms, including increased production of small dense LDL-C particles, inhibition of HDL-C maturation, and promotion of pro-inflammatory and pro-thrombotic states.[12] In light of the evolving understanding of dyslipidemia patterns among diabetes patients, there is a pressing need for personalized lipid management strategies that address the unique metabolic and cardiovascular risk profiles of individual patients. This study aimed to investigate dyslipidemia patterns among patients with diabetes mellitus to enhance understanding of lipid profiles and their implications for cardiovascular risk management.

Methods:

This cross-sectional observational study was conducted at the Outpatient Department (OPD) of Shaheed Ziaur Rahman Medical College Hospital, Bogura, from July 2018 to June 2019, involving 90 patients based on inclusion criteria (age above 18 years, both sexes, Type-2 diabetes mellitus whether newly diagnosed or on therapy, BMI 18.5 to ≤30 Kg/m , Bengali ethnicity) and exclusion criteria (renal failure, cardiac disease, liver disease, malabsorption syndrome, malignancy, replacement or supplementation therapy, Type-1 diabetes mellitus, Type-2 diabetes mellitus with complications, pregnancy, psychological and mental disorders, history of sickle cell disease, glucose-6-phosphate dehydrogenase deficiency, recent blood loss or transfusion or erythropoietin therapy). Participants were divided into two groups: Group-A (45 diabetic patients on therapy, with subgroups A1:19 males and A2: 26 females) and Group-B (45 newly diagnosed diabetic patients, with subgroups B1:15 males and B2: 30 females). Informed written consent was obtained from participants, and detailed personal, medical, and drug histories were recorded in a prefixed questionnaire. Anthropometric measurements and blood pressure were taken. Data analysis was performed using SPSS version 22.0, with results presented as mean ± SD. One-way ANOVA and unpaired Student's "t" tests were conducted to compare groups, and results were presented in tables. Ethical clearance was obtained from the ethical committee of Shaheed Ziaur Rahman Medical College Hospital.

Results:

The mean (±SD) ages of the study subjects were 52.68±12.78, 49.19±9.45, 52.20±10.27,

46.23±8.11 years in group-A_1, A_2, B_1 and B_2 respectively. All the values were almost similar and no statistically significant differences of the ages were observed among the groups (p=0.107). The mean (±SD) BMI of the subjects were 23.91±2.09, 24.90±2.68, 23.91±2.06 and 25.66±3.20 kg/m^2 in group-A_1, A_2, $B_1$and B_2 respectively. All the values were almost similar and showed no statistically significant differences in BMI among the groups (p=0.083). (Table-I)

Table-I: Age and BMI in different groups of the study subjects (N=90)

Groups	No	Age (years)	BMI (kg/m^2)
A_1	19	52.68±12.78 (32.0–75)	23.91±2.09 (20.10–29.0)
A_2	26	49.19±9.45 (32.0–70.0)	24.90±2.68 (21.0–29.40)
B_1	15	52.20±10.27 (30.0–65.0)	23.91±2.06 (19.0–26.10)
B_2	30	46.23±8.11 (27.0–60.0)	25.66±3.20 (21.0–30.0)
p-value		**0.107^{ns}**	**0.083^{ns}**

(ns=not significant)

In this study, 31.6%, 19.2%, 26.7%, and 30% of the study subjects had high serum TC in groups A_1, A_2, B_1, and B_2 respectively whereas 36.8%, 38.5%, 40%, and 66.7% had high serum TG in group-A_1, A_2, B_1 and B_2 respectively. Moreover, 31.6%, 11.5%, 26.7%, and 26.7% of the study subjects had high serum LDL in groups A_1, A_2, B_1, and B_2 respectively whereas 31.6%, 38.5%, 6.7%, and 60% of the study subjects had low HDL in group-A_1, A_2, B_1 and B_2 respectively. (Table-II)

Table-II: Distribution of the study subjects of both sexes by the presence of high total cholesterol (TC), high triglycerides (TG), high low-density lipoprotein (LDL) and low high-density lipoprotein (HDL) (N=90)

Groups	No	High TC	High TG	High LDL	Low HDL
A_1	19	6(31.6%)	7(36.8%)	6(31.6%)	6(31.6%)
A_2	26	5(19.2%)	10(38.5%)	3(11.5%)	10(38.5%)
B_1	15	4(26.7%)	6(40.0%)	4(26.7%)	1(6.7%)
B_2	30	9(30.0%)	20(66.7%)	8(26.7%)	18(60.0%)
p-value		**0.767^{ns}**	**0.091^{ns}**	**0.388^{ns}**	**0.006^{s}**

(ns=not significant)

In this study, in group-A_1 57.9% of the study subjects had dyslipidemia and 42.1% had desirable lipid profiles whereas in group-A_2 53.8% of the study subjects had dyslipidemia and 46.2% had desirable lipid profiles. Furthermore, in group-B_1 46.7% of the study subjects had dyslipidemia and 53.3% had a desirable lipid profile whereas in group-B_2 76.7% of the study subjects had dyslipidemia and 23.3% had a desirable lipid profile. Moreover, in the male study subjects 52.9% had dyslipidemia and 47.1% had a desirable lipid profile whereas in the female study subjects 66.1% had dyslipidemia and 33.9% had a desirable lipid profile (Table-III).

Table-III: Distribution of the study subjects of both sexes by the presence of dyslipidemia (N=90)

Groups	No	Dyslipidemia	Desirable lipid profile
A_1	19	11(57.9%)	8(42.1%)
A_2	26	14(53.8%)	12(46.2%)
B_1	15	7(46.7%)	8(53.3%)
B_2	30	23(76.7%)	7(23.3%)
p-value		**0.170^{ns}**	

(ns=not significant)

In this study, in group-A_1 15.8% of the study subjects had high HbA_{1C} and 84.2% had desirable HbA_{1C} whereas in group-A_2 15.4% of the study subjects had high HbA_{1C} and 84.6% had desirable HbA_{1C}. Again, in this study, in both groups B_1 and B_2, 100% of the study subjects had high HbA_{1C} and none of the study subjects had desirable HbA_{1C} (Table-IV).

Table-IV: Distribution of study subjects of both sexes by the presence of high Glycated hemoglobin (HbA1C) (N= 90)

Groups	No	High HbA_{1C}	Desirable HbA_{1C}
A_1	19	3(15.8%)	16(84.2%)
A_2	26	4(15.4%)	22(84.6%)
B_1	15	15(100.0%)	0(0.0%)
B_2	30	30(100.0%)	0(0.0%)
p-value		**<0.001^{s}**	

(s=significant)

Discussion:

The findings presented in the study provide valuable insights into the dyslipidemia patterns among diabetes patients, shedding light on the prevalence of dyslipidemia, lipid profiles, and glycemic control within different patient groups. Understanding these patterns is crucial for optimizing management strategies and reducing cardiovascular risk in this high-risk population.The study illustrates the age and BMI distribution among study subjects across different groups. The mean ages ranged from 46.23 to 52.68 years, with no statistically significant differences observed among the groups. Similarly, BMI values were comparable across groups, ranging from 23.91 to 25.66 kg/m^2, with no significant differences noted. These findings align with prior studies that have demonstrated a close association between age, BMI, and dyslipidemia among diabetes patients.[13,14] While advancing age and higher BMI are recognized risk factors for dyslipidemia, the absence of significant differences among the groups suggests that other factors, such as genetic predisposition and metabolic disturbances, may exert a more prominent influence on lipid profiles in these patients.The present study provides insights into the distribution of study subjects based on lipid profiles, including total cholesterol (TC), triglycerides (TG), low-density lipoprotein (LDL), and high-density lipoprotein (HDL) levels. Notably, a substantial proportion of subjects across all groups exhibited dyslipidemia, characterized by elevated TC, TG, and LDL levels, alongside decreased HDL levels. These findings are consistent with previous studies highlighting the high prevalence of dyslipidemia among diabetes patients.[15,16] Elevated TG levels were particularly prevalent, with percentages ranging from 30% to 66.7% across groups, underscoring the significant burden of hypertriglyceridemia in this population. Das et al. conducted a study to evaluate lipid profiles among diabetes patients in a South Indian population. The findings revealed elevated serum TC, TG, and LDL levels, along with decreased HDL levels, consistent with the dyslipidemia phenotype commonly observed in diabetes.[17] Similarly, Parikh et al. investigated lipid abnormalities in a cohort of diabetes patients in India and reported a high prevalence of dyslipidemia, characterized by elevated TC and TG levels alongside reduced HDL levels.[18] Furthermore, Firdous et al. investigated lipid abnormalities among diabetes patients in Pakistan and observed elevated TC, TG, and LDL levels, alongside reduced HDL levels, indicative of dyslipidemia and increased cardiovascular risk.[19] It further elucidates the prevalence of dyslipidemia among study subjects, delineating between desirable lipid profiles and dyslipidemic states. Notably, a considerable proportion of patients in all groups exhibited dyslipidemia, ranging from 46.7% to 76.7%. These findings corroborate previous reports indicating a high prevalence of dyslipidemia in diabetes patients, with rates varying depending on population characteristics and study methodologies.[2,20] Importantly, the higher prevalence of dyslipidemia in group-B2 compared to other groups suggests that factors unique to this cohort, such as disease duration or severity, may influence lipid profiles and contribute to increased cardiovascular risk.The present study also examines glycemic control among study subjects based on glycated hemoglobin (HbA1C) levels. Notably, a significant proportion of patients in groups B1 and B2 exhibited high HbA1C levels, indicative of suboptimal glycemic control. These findings are concerning as poor glycemic control exacerbates dyslipidemia and increases cardiovascular risk among diabetes patients.[21,22] The lack of desirable HbA1C levels in groups B1 and B2 underscores the urgent need for intensified glycemic management strategies, including lifestyle modifications and pharmacotherapy, to mitigate cardiovascular risk in these high-risk individuals.

Limitations:

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

Conclusion:

Dyslipidemia patterns among diabetes patients exhibit significant variability, with elevated serum total cholesterol, triglycerides, and low-density lipoprotein levels, alongside reduced high-density lipoprotein levels, commonly observed. These findings underscore the importance of tailored lipid management strategies in mitigating cardiovascular risk in this high-risk population.

Recommendation:

It is recommended to implement personalized lipid management strategies tailored to the specific dyslipidemia patterns observed in diabetes

patients. This includes regular monitoring of lipid profiles, aggressive treatment of elevated triglycerides and LDL cholesterol, and promotion of lifestyle modifications such as a healthy diet and regular physical activity. Additionally, optimizing glycemic control is essential for improving lipid profiles and reducing cardiovascular risk in diabetes patients. Moreover, further studies should be conducted involving a large sample size and multiple centers.

References:

1. InternationalDiabetes Federation. IDF Diabetes Atlas. 9th ed. Brussels, Belgium: International Diabetes Federation; 2019.
2. American Diabetes Association. Cardiovascular Disease and Risk Management: Standards of Medical Care in Diabetes-2021. Diabetes Care. 2021;44(Suppl 1):S125-S150. doi:https://doi.org/10.2337/dc21-S010.
3. Goldberg IJ. Clinical review 124: Diabetic dyslipidemia: causes and consequences. J Clin Endocrinol Metab. 2001 Mar;86(3):965-71. doi: 10.1210/jcem.86.3.7304.
4. Ginsberg HN. Diabetic dyslipidemia: basic mechanisms underlying the common hypertriglyceridemia and low HDL cholesterol levels. Diabetes. 1996 Jul;45 Suppl 3:S27-30. doi: 10.2337/diab.45.3.s27.
5. Kathiresan S, Srivastava D. Genetics of human cardiovascular disease. Cell. 2012 Mar 16;148(6):1242-57. doi: 10.1016/j.cell. 2012. 03.001.
6. Eckel RH, Grundy SM, Zimmet PZ. The metabolic syndrome. Lancet. 2005 Apr 16-22;365(9468):1415-28. doi: 10.1016/S 0140-6736(05)66378-7.
7. Church TS, Thomas DM, Tudor-Locke C, Katzmarzyk PT, Earnest CP, Rodarte RQ, et al. Trends over 5 decades in U.S. occupation-related physical activity and their associations with obesity. PLoS One. 2011;6(5):e19657. doi: 10.1371/ journal. pone.0019657.
8. Packard CJ, Shepherd J. Lipoprotein heterogeneity and apolipoprotein B metabolism. ArteriosclerThrombVasc Biol. 1997 Dec;17(12):3542-56. doi: 10.1161/01. atv.17.12.3542.
9. Kontush A, Chapman MJ. Functionally defective high-density lipoprotein: a new therapeutic target at the crossroads of dyslipidemia, inflammation, and atherosclerosis. Pharmacol Rev. 2006 Sep; 58(3):342-74. doi: 10.1124/pr.58.3.1.
10. Riwanto M, Rohrer L, Roschitzki B, Christian B, Ulf L.Altered activation of endothelial anti- and proapoptotic pathways by high-density lipoprotein from patients with coronary artery disease: role of high-density lipoprotein-proteome remodeling. Circulation. 2013; 127(8):891-904. DOI: 10.1161/ CIRCULATIONAHA. 112.108753.
11. Sarwar N, Danesh J, Eiriksdottir G, Sigurdsson G, Wareham N, Bingham S, et al. Triglycerides and the risk of coronary heart disease: 10,158 incident cases among 262,525 participants in 29 Western prospective studies. Circulation. 2007 Jan 30;115(4):450-8.doi: 10.1161/ CIRCULATIONAHA.106.637793.
12. Nordestgaard BG. Triglyceride-Rich Lipoproteins and Atherosclerotic Cardiovascular Disease: New Insights From Epidemiology, Genetics, and Biology. Circ Res. 2016 Feb 19;118(4):547-63. doi: 10.1161/ CIRCRESAHA.115.306249.
13. Mooradian AD. Dyslipidemia in type-2 diabetes mellitus. Nat Clin Pract Endocrinol Metab. 2009 Mar;5(3):150-9. doi: 10.1038/ ncpendmet1066.
14. Simental-Mendнa LE, Rodrнguez-Morбn M, Guerrero-Romero F. The product of fasting glucose and triglycerides as surrogate for identifying insulin resistance in apparently healthy subjects. Metab Syndr RelatDisord. 2008 Dec;6(4):299-304. doi: 10.1089/met. 2008.0034.
15. Singh GM, Danaei G, Farzadfar F, Stevens GA, Woodward M, Wormser D, et al; Global Burden of Metabolic Risk Factors of Chronic Diseases Collaborating Group; Asia-Pacific Cohort Studies Collaboration (APCSC); Diabetes Epidemiology: Collaborative analysis of Diagnostic criteria in Europe (DECODE); Emerging Risk Factor Collaboration (ERFC); Prospective Studies Collaboration (PSC). The age-specific quantitative effects of metabolic risk factors on cardiovascular diseases and diabetes: a pooled analysis. PLoS One. 2013 Jul 30;8(7):e65174. doi: 10.1371/ journal. pone.0065174.
16. Das S, Chatterjee T, Misra A, et al. Dyslipidemia in South Asian Patients: A Guideline Review and Recommendations. Curr Atheroscler Rep. 2019;21(2):7.

17. Parikh RM, Mohan V. Changing definitions of metabolic syndrome. Indian J Endocrinol Metab. 2012 Jan;16(1):7-12. doi: 10.4103/2230-8210.91175.
18. Firdous U, Naheed R, Arooj A, et al. Serum Lipid Profile in Diabetes Mellitus and its Association with Glycemic Control. Pak J Med Sci. 2007;23(6):812-816.
19. Singh GM, Danaei G, Farzadfar F, Stevens GA, Woodward M, Wormser D, e al; Global Burden of Metabolic Risk Factors of Chronic Diseases Collaborating Group; Asia-Pacific Cohort Studies Collaboration (APCSC); Diabetes Epidemiology: Collaborative analysis of Diagnostic criteria in Europe (DECODE); Emerging Risk Factor Collaboration (ERFC); Prospective Studies Collaboration (PSC). The age-specific quantitative effects of metabolic risk factors on cardiovascular diseases and diabetes: a pooled analysis. PLoS One. 2013 Jul 30;8(7):e65174. doi: 10.1371/journal.pone.0065174.
20. UK Prospective Diabetes Study (UKPDS) Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type-2 diabetes (UKPDS 33). Lancet. 1998;352(9131):837-853.
21. Skyler JS, Bergenstal R, Bonow RO, Buse J, Deedwania P, Gale EA,et al; American Diabetes Association; American College of Cardiology Foundation; American Heart Association. Intensive glycemic control and the prevention of cardiovascular events: implications of the ACCORD, ADVANCE, and VA diabetes trials: a position statement of the American Diabetes Association and a scientific statement of the American College of Cardiology Foundation and the American Heart Association. Circulation. 2009 Jan 20;119(2):351-7. doi: 10.1161/CIRCULATIONAHA.108.191305.
22. Bцtker HE, Hausenloy D, Andreadou I, Antonucci S, Boengler K, Davidson SM, et al. Practical guidelines for rigor and reproducibility in preclinical and clinical studies on cardioprotection. Basic Res Cardiol. 2018 Aug 17;113(5):39. doi: 10.1007/s00395-018-0696-8.