

Prevalence of Diabetes and Dyslipidemia Patterns amongst Hypertensive Patients in a Tertiary Cardiac Centre in Kathmandu, Nepal

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Abstract

Background: Dyslipidemia and hypertension are independent cardiovascular risk factors that are linked by insulin resistance and they require follow-up and more aggressive therapeutic strategies. Hence, the present study was done to study the prevalence of Diabetes and Dyslipidemia patterns in hypertensive patients. **Methods:** A cross-sectional observational study was done on patients with hypertension for duration of one year, *i.e.* from Feb 2022 to January 2023. A total of 726 hypertensive Patients were included. All calculations and statistical analyses were processed by SPSS 25.0. **Results:** A Total of 726 patients with a history of hypertension were included; the average age was 55, with 24.2% of patients belonging to the age group 51 - 60; 55.8% were males and 44.2% were females. In the present study, the prevalence of diabetes was 29.06% and 35.5% of patients in the prediabetic stage. The most frequent dyslipidaemic form was reduced HDL, seen in 96.1% and 94% of new and old respectively; followed by elevated LDL, 86% and 48.2% in new and old respectively. It was followed by elevated TG level and Total cholesterol levels. **Conclusion:** There was a high prevalence of diabetes, pre-diabetes as well as dyslipidemia in hypertensive patients.

Keywords

Hypertension, Diabetes, Dyslipidemia

1. Introduction

Metabolic syndrome (syndrome X, insulin resistance) is a multifactorial disease with multiple risk factors, which arises from insulin resistance accompanying abnormal adipose deposition and function. [1] [2] Dyslipidemia and hyperten-

sion are independent cardiovascular risk factors that are linked by insulin resistance and commonly coexist with other cardiovascular risk factors such as dysglycaemia and truncal obesity. Previous human studies had reported common patterns of dyslipidemia in hypertension including; increased total plasma cholesterol, triglyceride and low-density lipoprotein (LDL-C) cholesterol, decreased high-density lipoprotein (HDL-C) cholesterol, changes in the composition of LDL-cholesterol viz, small dense LDL-cholesterol, and increased electronegativity of LDL-cholesterol. [3] [4] Consequently, there is an increased cardiovascular disease risk, a leading cause of morbidity and mortality. [5] In a recent, large, prospective cohort study, the development of type II diabetes was almost 2.5 times more likely in persons with hypertension than in their normotensive counterparts. [6] Recent studies in Korea also suggested that dyslipidemia; diabetes and hypertension may be developing at even younger ages. [7]

The consequences of dyslipidaemic patterns have been largely reported in previous studies. [8] [9] [10] Elevated total cholesterol is known to play key roles in both initiation and progression of atherosclerosis with long-term clinical consequences. Low levels of HDL-C and high triglycerides have been consistently reported in cardiovascular disease states. [10] Plasma lipid levels vary significantly in various populations, depending on differences in geographical locations, cultural, economic and social conditions, dietary habits, genetic makeup and coexisting disease states such as hypertension. Nepal is characterized by an affluent lifestyle with atherogenic dietary patterns, which may impact the cardiovascular disease profile of its inhabitants. Data on lipid patterns amongst hypertensive patients in Nepal is very scanty or limited to total plasma cholesterol. Information on plasma lipid patterns and prevalence of dyslipidemia among patients with hypertension in Nepal is important. The objective of this study, therefore, is to determine the prevalence of diabetes and pattern of dyslipidemic forms among hypertensive patients in Kathmandu, with a view to providing data that may be useful in cardiovascular disease interventions and prevention.

2. Methods

Ethical clearance was obtained from the Institutional Review Board of the Research Department of the Hospital. This cross-sectional study was undertaken to analyze the prevalence of diabetes and dyslipidemia in hypertensive patients who attended the Out Patient Department (OPD) and In-patient Department (IPD) of a tertiary care hospital from February 2022 to January 2023. The consecutive Sampling method was used. Both inpatients and outpatients who gave consent to the study were included in the study. Their blood pressure was measured using a mercury sphygmomanometer with appropriate cuff size in standard method. The blood pressure was measured two times on the upper arm in a sitting position at the interval of 30 minutes. The average blood pressure was taken for the study. Hypertension was defined as systolic blood pressure \geq 140 mmHg and/or

diastolic blood pressure ≥ 90 mmHg. Those who were diagnosed previously and taking antihypertensive medication were also defined as hypertensive. The diagnosis and classification of hypertension was done according to the Seventh Joint National Committee on the Detection, Elevation, and Treatment of High Blood Pressure (JNC-7) report. [11]

Similarly, the Fasting Lipid Profile and Fasting Blood Glucose were measured in all hypertensive patients after 12 hours of fasting. The diagnosis of Diabetes is classified as Fasting Blood Sugar (FBS) > 126 mg/dl & Impaired Fasting glucose as $126 \geq \text{FBS} \geq 100$ mg/dl. The diagnosis of Diabetes & Impaired blood glucose was done according to American Diabetic Association (ADA) 2018 guidelines. [12] The diagnosis and classification of dyslipidemia were done according to National Institute of Health (NIH) guidelines, 2012. [13] The Triglyceride Level was classified as Normal (<150 mg/dl), Borderline High (150 - 199 mg/dl), High (200 - 499 mg/dl) and Very High (>500 mg/dl). The Total Cholesterol level was classified as Normal (<200 mg/dl), Borderline High (200 - 239 mg/dl) and High (>240 mg/dl). The LDL cholesterol level was classified as Normal (<100 mg/dl), Near Optimal (100 - 130 mg/dl), Borderline High (130 - 159 mg/dl), High (160 - 189 mg/dl) and Very High (>190 mg/dl). The HDL Cholesterol was classified as Low (<40 mg/dl), Normal (40 - 60 mg/dl) and High >60 mg/dl. The outcome variable was dyslipidemia which was defined as the presence of any of high total cholesterol (TC) (>200 mg/dl), raised low-density lipoprotein cholesterol (LDL-C) (>100 mg/dl) or reduced high-density lipoprotein cholesterol (HDL-C) (<40 mg/dl) based on the Adult Treatment Panel III (ATP III) guidelines.

A clinical performa was used to collect the data. The demographic characteristics of patients including age, gender, years of hypertension, Lipid Profile including Triglycerides, Total cholesterol, Low-Density Lipoprotein (LDL) and High-Density Lipoprotein (HDL) and Fasting Blood Glucose were taken into consideration and the prevalence of Dyslipidemia and Diabetes were analyzed from the data collected. The collected data was entered using a data validation tool (MS-Excel worksheet 2010). Statistical analyses were performed with statistical software (IBM SPSS[®] Statistics 25 for Windows). The normality of the data was assessed by the Shapiro-Wilk test.

Descriptive statistics were used to describe the data. Mean \pm SD/Median (IQR) as appropriate was used to present for Age. For DM/Dyslipidemia/Hypertension Smoking status, frequencies and percentages were reported. Effect modifiers and confounders were eliminated through logistic regression analysis. Univariate analysis was done keeping the significance level at 0.25 and multivariate analysis was done keeping the significance level at 0.05.

3. Results

Seven Hundred and Twenty-Six, (726) cases were enrolled for this study, 447 (61.6%) olds and 279 (38.4%) new as shown in **Table 1**. There were 405 (55.8%) males and 321 (44.2%) females. The average age was 55 with 24.2% of patients belonging to the age group 51 - 60.

Amongst the previously diagnosed patients, most of the patients 249 (55.7%) had hypertension for a maximum of 5 years as displayed in **Table 2** and **Figure 1**. The new group had higher frequencies for all the dyslipidemias. The most frequent dyslipidaemic form was reduced HDL, seen in 96.1% and 94% of new and old respectively; followed by elevated LDL, 86% and 48.2% in new and old respectively.

Among the 726 hypertensive patients, 211 patients *i.e.* 29.06% already had been diagnosed with diabetes mellitus as shown in **Table 3**.

However, among the 515 non-diabetic hypertensive patients, 183(35.5%) patients had Fasting Blood Glucose of more than 100 with 121 (23.5%) patients having Fasting Blood Glucose between 101 - 126, *i.e.* Impaired Blood Glucose and 62 (12%) of patients having Fasting Blood Glucose more than 126.

Only 24 percent had a normal level of triglycerie while 37.2% had elevated levels of triglyceride. As compared to 29% in the previously diagnosed group, only 21% had a normal level of triglyceride probably due to the level of consciousness and taking of medications. 41% of the newly diagnosed had elevated level of triglyceride as compared to 31% in the previously diagnosed group. (**Figure 2** & **Table 4**)

Table 5 represents the level of HDL in the total study population. Only 32.7 percent had normal (30.2%) and above (2.5%) levels of HDL while 67.4% had low levels of HDL. Both the newly diagnosed and previously diagnosed group had similar levels of HDL as shown in **Table 6** and **Figure 3**.

Table 7 represents the level of total cholesterol in the total study population. 68.7% percent had a normal level of total cholesterol while 9.9% had a high level of total cholesterol. Both the newly diagnosed and previously diagnosed group had similar levels of total cholesterol levels as shown in **Table 8** and **Figure 4**.

Table 9 represents the LDL levels in the total study population. 20.2% percent had a normal level of LDL, 49.6% had a near-optimal level of LDL levels while

Table 1. Table showing patients on the basis of diagnosis.

	Frequency	Percent
Newly Diagnosed	279	38.4
Previously Diagnosed	447	61.6
Total	726	100.0

Table 2. Table showing patients on the basis of duration of hypertension.

Duration of Hypertension		
	Frequency	Percent
Less Than 5 Years	249	55.7
5 - 10 Years	117	26.2
More Than 10 Years	81	18.1
Total	447	100.0

Table 3. Prevalence of Diabetes in study population by age group.

		Age * Diabetes Crosstabulation		
		Yes	No	Total
Age	Less Than 20	0	5	5
	21 - 30	1	52	53
	31 - 40	10	97	107
	41 - 50	31	106	137
	51 - 60	69	107	176
	61 - 70	42	89	131
	71 - 80	38	47	85
	81 and above	20	12	32
Total	211	515	726	

Table 4. Table showing comparison of Triglyceride levels in new and previously diagnosed patients.

	Newly_Diagnosed * Triglyceride Crosstabulation				Total
	Triglyceride Levels mg/dl				
	Normal (<150)	Borderline High (150 - 199)	High (200 - 499)	Very High (>500)	
Newly Diagnosed	81 (29%)	111 (40%)	87 (31%)		279
Previously Diagnosed	93 (21%)	171 (38%)	177(40%)	6 (1%)	447
Total	174	282	264	6	726

Table 5. Table showing level of HDL.

Level	HDL	
	Frequency	Percent
Low (<40 mg/dl)	489	67.4
Normal (40 - 60 mg/dl)	219	30.2
High (>60 mg/dl)	18	2.5
Total	726	100.0

Table 6. Table showing comparison of HDL levels in new and previously diagnosed patients.

	Newly_Diagnosed * HDL Crosstabulation			Total
	HDL Levels (mg/dl)			
	Low (<40)	Normal (40 - 60)	High (>60)	
Newly Diagnosed	186 (66.6%)	87 (31.2%)	6 (2.1%)	279
Previously Diagnosed	303 (67.8%)	132 (29.5%)	12 (2.6%)	447
Total	489	219	18	726

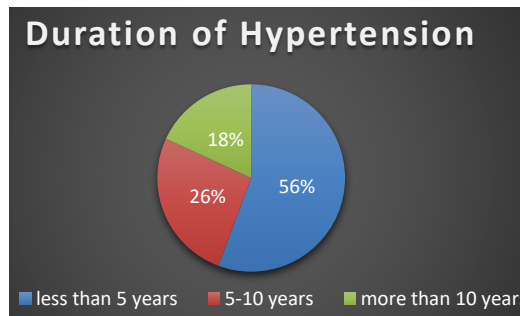


Figure 1. Pie chart showing patients on the basis of duration of hypertension.

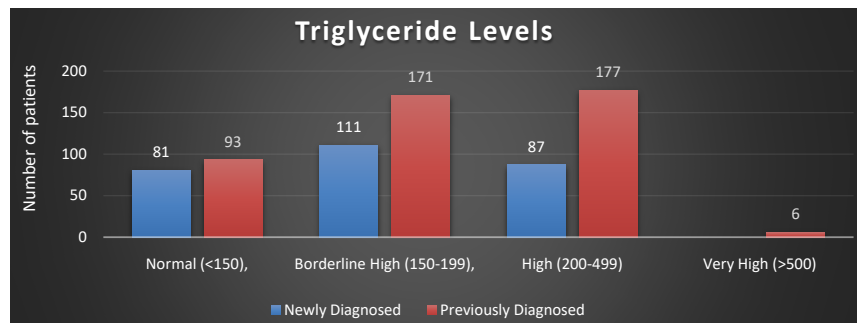


Figure 2. Figure showing comparison of triglyceride levels in new and previously diagnosed patients.

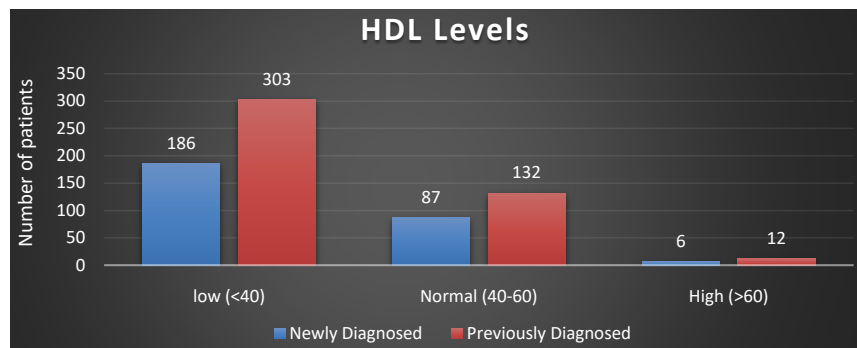


Figure 3. Figure showing comparison of HDL levels in new and previously diagnosed patients.

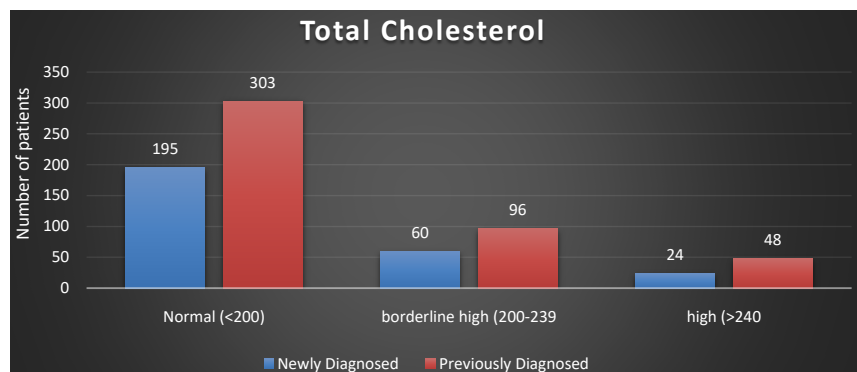


Figure 4. Bar Diagram showing comparison of total cholesterol levels in new and previously diagnosed patients.

Table 7. Table showing level of total cholesterol.

	Cholesterol	
	Frequency	Percent
Normal (<200 mg/dl)	498	68.6
Borderline High (200 - 239 mg/dl)	156	21.5
High (>240 mg/dl)	72	9.9
Total	726	100.0

Table 8. Table showing comparison of total cholesterol levels in new and previously diagnosed patients.

	Newly_Diagnosed * Cholesterol Crosstabulation				Total
	Cholesterol Levels (mg/dl)				
	Normal (<200)	Borderline High (200 - 239)	High (>240)		
Newly Diagnosed	195 (70%)	60 (21.5%)	24 (8.5%)	279	
Previously Diagnosed	303 (68%)	96 (21.5%)	48 (10.5%)	447	
Total	498	156	72	726	

Table 9. Table showing level of LDL levels.

	LDL		
	Levels (mg/dl)	Frequency	Percent
Normal (<100)		147	20.2
Near Optimal (100 - 130),		360	49.6
Borderline High (130 - 159)		105	14.5
High (160 - 189)		66	9.1
Very High (>190)		48	6.6
Total		726	100.0

Table 10. Table showing comparison of LDL levels in new and previously diagnosed patients.

	Newly_Diagnosed * LDL Crosstabulation					Total
	LDL Levels (mg/dl)					
	Normal (<100)	Near Optimal (100 - 130),	Borderline High (130 - 159)	High (160 - 189)	Very High (>190)	
Newly Diagnosed	66 (23.6%)	135 (48.4%)	45 (16.1%)	21 (7.5%)	12 (4.3%)	279
Previously Diagnosed	81 (18.1%)	225 (50.3%)	60 (13.4%)	45 (10.1%)	36 (8.1%)	447
Total	147	360	105	66	48	726

9.1% and 6.6% had a high and very high level of LDL respectively. The previously diagnosed group had similar levels of LDL levels as compared to the newly diagnosed group as shown in **Table 10** and **Figure 5**.

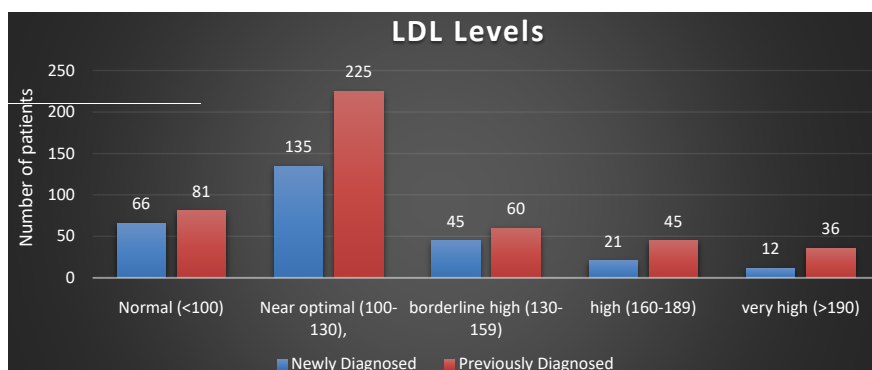


Figure 5. Showing comparison of LDL levels in new and previously diagnosed patients.

4. Discussion

211 patients *i.e.* 29.06% already had concomitant Diabetes mellitus whereas 121 (23.5%) patients had Impaired Blood Glucose and 62 (12%) patients had Fasting Blood Glucose of more than 126.

The most frequent dyslipidaemic form was reduced HDL, seen in 96.1% and 94% of new and old respectively; followed by elevated LDL, 86% and 48.2% in new and old respectively. It was followed by elevated TG level and Total cholesterol levels. This is consistent with earlier reports.

Onyegbutulem, H. C. *et al.* reported the commonest dyslipidaemic type to be reduced High-density lipoprotein, HDL (96.1%), followed by elevated low-density lipoprotein, LDL (78.6%), then, elevated total cholesterol, (62.3%) TCHOL and elevated triglycerides, TG 43.5%. [14]

Pokharel, D.R. *et al.* reported most prevalent single lipid disorder was increased non-HDL-C (75.5%) while the least prevalent was hypercholesterolemia (43.7%). The prevalence of mixed dyslipidemia was 88.1% in that study. [15]

Ayoade *et al.* reported 60.0% of the hypertensive patients to have dyslipidemia, with 43.4% having high TC, 30.3% high LDL-C, 20.8% elevated TG, and 12.9% low HDL-C, respectively. [16]

Similarly, Mohammed O. *et al.* reported majority (93.2%) of patients have at least one atherogenic dyslipidemia. The prevalence of elevated total cholesterol (TC), elevated triglyceride (TG), raised low-density lipoprotein cholesterol (LDL-c), and reduced high-density lipoprotein cholesterol (HDL-c) were 47.7%, 50.3%, 44.3%, and 59.6%, respectively. [17]

Kifle ZD *et al.* reported the overall prevalence of dyslipidemia to be 48.4%. Similarly, the prevalence of TC, TG, LDL-c, and HDL-c was 73 (19.6%), 91 (24.5%), 60 (16.1%), and 115 (30.9%), respectively in that study. [18]

Katundu KGH *et al.*, reported a prevalence of dyslipidemia in 58%, 55%, and 70% of participants with diabetes mellitus, hypertension, and both conditions. Low-density lipoprotein cholesterol (LDL-C) dyslipidaemia was the most common in all participant groups. Participants with both diabetes and hypertension had 2.4 times (95% CI 1.2 - 4.6) increased risk of LDL-C dyslipidaemia than those with diabetes alone ($p < 0.02$). [19]

Kotiso KS *et al.*, identified obesity, sedentary activity, stress score, the interaction of diabetes duration with insulin use, serum creatinine level, age, occupation, and family history of hypertension as independent determinants of hypertension among people with Type 2 Diabetes Mellitus. [20]

As compared to the new hypertensive patients, the long duration of hypertension probably has increased risk factors. Our study also showed elevated LDL levels in old patients at 86% as compared to the newer ones at 48.2%. This result is similar to the result from a large cross-sectional study from China which included 62,957 Chinese Adult Males based on the data from the DATADRYAD database which reported that total cholesterol (TC), low-density cholesterol (LDL-c), and non-high-density lipoprotein cholesterol (non-HDL-c) were higher in the hypertensive population ($p < 0.001$). The study concluded that Elevated TC, LDL-c, and non-HDL-c were related to the incidence of hypertension in Chinese adult males, whereas triglycerides (TG) were not significantly associated. [21]

5. Limitation of the Study

This study was a single Centre study. It was done in a tertiary cardiac Centre, so the patients visiting are very chronic patients and those referred from the primary Centre are probably in the malignant form. Similarly, the study was a cross-sectional study with a consecutive sampling method. Randomization could have some effects on the data results.

6. Conclusion

This study revealed that a high prevalence of concomitant diabetes and dyslipidemia in hypertensive patients. Thus, to prevent dyslipidemia and its other consequences, it is high time to create routine lipid profile testing and commence awareness and prevention strategies for risk reduction.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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