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Research Article

A comparative study of lipid profile among controlled and uncontrolled type 2 diabetic patients in Lahore, Punjab, Pakistan

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Abstract
Diabetes Mellitus is a metabolic disease that is characterized by chronic hyperglycemia. Due to impaired insulin secretion, insulin action, or both, leads to carbohydrate, fat, and protein metabolism disorders. Dyslipidemia is a group of biochemical disorders, which is frequently seen in diabetic individuals and plays an important role in the development of arteriosclerosis and cardiovascular complications. This Cross-Sectional study was carried out between January 2021, to April 2021 at Minhaj University Lahore, Pakistan to compare the lipid profile abnormalities in controlled and uncontrolled type 2 diabetic patients. Diagnosed patients with type 2 diabetes of both genders and ages from 25 to 75 years were included in the study. A total of 300 subjects were included in the study consisting of two equal groups of 150 controlled diabetic groups and 150 uncontrolled diabetes patients. The laboratory tests including HbA1c level and lipid profile (Serum Total Cholesterol, HDL, LDL, and VLDL, Triglycerides) were measured. The serum total cholesterol, triglycerides, and VLDL levels were found significantly raised in patients with uncontrolled DM (p-value = 0.009, 0.001, and 0.001) respectively. The HDL and LDH cholesterol level was significantly (p-value = 0.941, 0.198) lower in uncontrolled DM patients. There was a low correlation found between HbA1c and triglyceride and VLDL. The patient's glycemic control has a profound effect on blood lipid levels. Patients should be educated to monitor and control blood lipids and blood glucose levels on a regular basis.

Keywords: Dyslipidemia; Glycemic control; HbA1c; Hyperglycemia; Lipid Profile

Introduction

Diabetes mellitus (DM) is an inherited chronic endocrine and metabolic disease accompanied by a variety of complications **[1]**. Diabetes mellitus (DM) is characterized by chronic high blood glucose levels (hyperglycemia) and alteration of carbohydrate, lipid, and protein metabolisms resulting from defects in insulin secretion and/or action or both **[2]**. The major symptoms of diabetes comprise increased urination, obscured vision, increased thirst, fatigue, weight loss, and increased hunger **[3]**.

The long-term complexity of diabetes mellitus includes dysfunction, and damage to numerous organs, particularly the heart, eyes, nerves kidneys, and blood vessels, and are liable for most of the morbidity and mortality related to the disease. Globally diabetes mellitus got one of the significant health issues and is endemic with quickly increasing prevalence in both developed and developing countries [4]. Diabetes occurs worldwide and the incidences of both type 1 and type 2 diabetes are rising; Recent reports showed that, in the year 2000, 171 million people had diabetes, and by 2030 this incidence is expected to increase to 366 million [5]. Diabetes mellitus is more extreme in South Asian countries and it is being indicated from recent studies and estimates that Pakistan will face the uppermost increase in diabetes mellitus. According to different studies from Pakistan, the prevalence has been reported quite excessive with few variations ranging from 7% to 11% [6].

Atherosclerosis is one of the most common complications of diabetes. There may be many reasons for the metabolic disorders associated with diabetes. These abnormalities include changes in lipoprotein metabolism, especially triglyceride lipoproteins [7].

Dyslipidemia is known to be an important risk factor for macrovascular complications in patients with type 2 diabetes (T2DM) [8]. Macrovascular complications encompass cardiovascular disease (CVD), including stroke, which occurs in diabetic patients because of chronic uncontrolled hyperglycemia, which is the cause of death in 50% of diabetic patients. When diabetes is associated with dyslipidemia, the cardiovascular risk of diabetes increases even further [5, 9].

Dyslipidemia is a group of biochemical diseases common in diabetic patients [10]. The lipid profile related to plasma lipids clinically includes triglycerides (TG), total cholesterol (TC), high-density lipoprotein (HDL), and low-density lipoprotein (LDL) [11]. Insulin dysfunction and relative insulin deficiency in diabetes can cause complex changes in plasma lipids leading to raised plasma low-density lipoprotein cholesterol (LDL-C) levels and decreased high-density lipoprotein cholesterol (HDL-C) levels, or elevated triglyceride (TG) levels [4]. The most common lipoprotein change is hypertriglyceridemia (TG), which is caused by elevated very low-density lipoprotein (VLDL) levels [12]. Additionally, data from the UK Prospective Diabetes Study showed that both a decrease in HDL-C and an increase in LDL-C predict cardiovascular diabetes [13].

The biggest differences in blood lipid levels between diabetic and non-diabetic patients are high-density lipoprotein cholesterol (HDL-C) and triglycerides: diabetic patients usually have significantly higher triglycerides, while HDL is moderately low, compared with non-diabetic patients [14, 15]. High cholesterol, triglycerides, low-density lipoprotein cholesterol, and low-density lipoprotein cholesterol may be caused by obesity, increased caloric intake, and insufficient muscle activity in diabetic patients [16].

Some possible reasons for higher serum cholesterol levels in diabetic patients may be due to reduced muscle pressure or suppression of cholesterol catabolism [17]. Although low-density lipoprotein cholesterol levels are normal, many patients still develop these diseases is also a sign of insulin resistance syndrome (also known as metabolic syndrome), which is the basis of many cases of type 2 diabetes [18].

Glycated hemoglobin (HbA1c) is a commonly used marker for long-term blood sugar control. In cases such as uncontrolled diabetes, the proportion of glycosylated hemoglobin increases significantly. The HbA1c level reflects the blood sugar control level in the past 120 days, so it can also be

used to diagnose and monitor diabetes control. HbA1c is not only an indicator of average blood sugar but also can predict the risk of diabetic complications in diabetic patients **[12]**.

Due to the high prevalence of diabetes and the limited understanding of related diseases such as dyslipidemia, the complications of diabetes have increased because patients with type 2 diabetes are at high risk for cardiovascular events. Early detection and treatment of dyslipidemia are very important to reduce the risk of cardiovascular complications. The aim of the present study is to find the correlation between blood glucose control and dyslipidemia in the control group and uncontrolled diabetic patients. It is hypothesized that early detection and treatment of lipid abnormalities can effectively reduce the risk of atherosclerotic cardiovascular disease and cerebrovascular accidents (stroke) in patients with type 2 diabetes.

Materials and Methods

This cross-sectional study was done including 300 subjects aged between 25 to 75 of either sex who visited different hospitals in Lahore Punjab Pakistan, for a duration of 4 months from January 2021 to April 2021 after obtaining permission from the Institutional Ethical Committee.

Diabetic patients were classified into 2 groups with 150 subjects in each group. Group 1 was controlled diabetic patients (HbA1c≤7.5%) and Group 2 was uncontrolled diabetic patients (HbA1c>7.5%). Venous blood samples were collected from all the subjects after at least 8 hours of fasting. Blood specimens were collected into in Serum Separator Tube for lipid profile and EDTA tubes for HbA1c measurement. The serum was later used for analyzing, HbA1c, lipid profile- serum total cholesterol (TC), triglycerides (TG), HDL-cholesterol, LDL-cholesterol, VLDL-cholesterol.

All the parameters were assessed in both groups and were compared. All the values were expressed as mean standard deviation of the mean. All values of different parameters were expressed using conventional units. An independent sample t-test was applied to compare the mean values of lipid profile parameters between controlled and uncontrolled diabetic patients. P-value <0.05 was considered significant. The results were analyzed using an independent samples t-test (2-tailed), and Pearson's correlation test was done to evaluate correlations of HbA1c with all other parameters.

Results

Data collection

The study sample of this study consisted of 300 patients with diabetes mellitus, among which 150 patients had controlled and 150 had uncontrolled diabetic Mellitus patients on the basis of HbA1c. The age range of the patients in the study was 25 to 75 years, with a mean value of 48.54±14years in the controlled group and 51.46±10.78 years in the uncontrolled group. The age was no significant (p-value =0.012) difference between both groups on the basis of age table 1.

The patients were divided into controlled and uncontrolled groups on the basis of HbA1c.The HbA1c range of the patients with a mean value of 7.15±0.36 in the controlled group and 9.42±1.76 in the uncontrolled group described in table 2 and figure 1.

Table 1. Mean age of study participants

Study population	Mean± S.D ages (year)
Controlled group	48.54±14 (range 25-75)
Uncontrolled DM	51.46±10.78 (range 28-75)
p-value	0.012*

Table 2. HbA1c status in controlled and uncontrolled DM Patients

	Number of cases	HbA1c% (Mean)	Standard Deviation (SD)
Controlled group	150	7.15	0.36
Uncontrolled DM	150	9.42	1.76

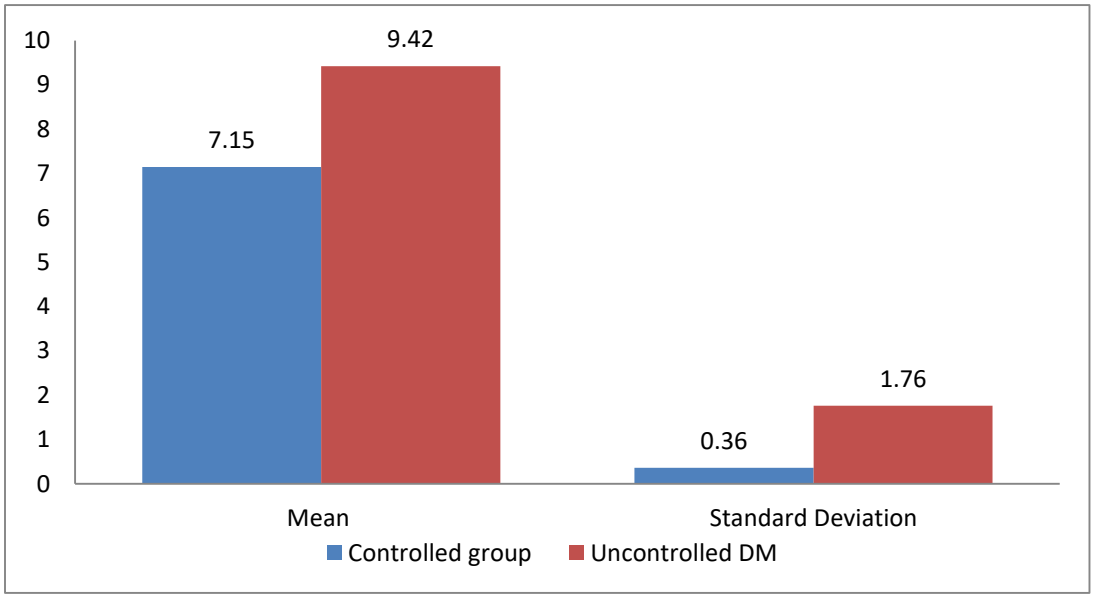

Figure 1. HbA1c status in controlled and uncontrolled DM Patients

The table 3 demonstrates total cholesterol levels in the controlled were 184.54±30.44 mg/dl and 204.4±46.61 mg/dl in an uncontrolled group with a p-value of 0.009 which is highly significant. The same was seen in cholesterol and triglyceride 151.86±56.84 mg/dl and 30.32±11.36 mg/dl respectively and 220.16±132.01 mg/dl and 42.74±24.66 mg/dl in the uncontrolled group with a p-value of 0.001 in both which significant. In contrast, HDL levels in the controlled group were 43.68±9.83 mg/dl and 43.54±7.56mg/dl in the uncontrolled group with a non-significant p-value of 0.941. Similarly, LDL levels in controlled and uncontrolled diabetics were 109.28±22.76 mg/dl and 117.36±40.46 mg/dl respectively with a non-significant p-value of 0.198 mentioned in figure 2.

HbA1c was positively correlated with all components of the lipid profile except total cholesterol and HDL-C which showed a negative correlation. Triglycerides and VLDL showed a low positive correlation with HbA1c described in table. 4 and figure. 3.

Table 3. Comparison of lipid profiles among controlled and uncontrolled diabetics

	Controlled group HbA1c<7	Uncontrolled DM HbA1c>7	P-value
Total cholesterol (mg/dl)	184.54±30.44	204.4±46.61	0.009*
Triglyceride (mg/dl)	151.86±56.84	220.16±132.01	0.001*
HDL (mg/dl)	43.68±9.83	43.54±7.56	0.941*
LDL (mg/dl)	109.28±22.76	117.36±40.46	0.198*
VLDL (mg/dl)	30.32±11.36	42.74±24.66	0.001*

*Significant as 0.05 level of significance

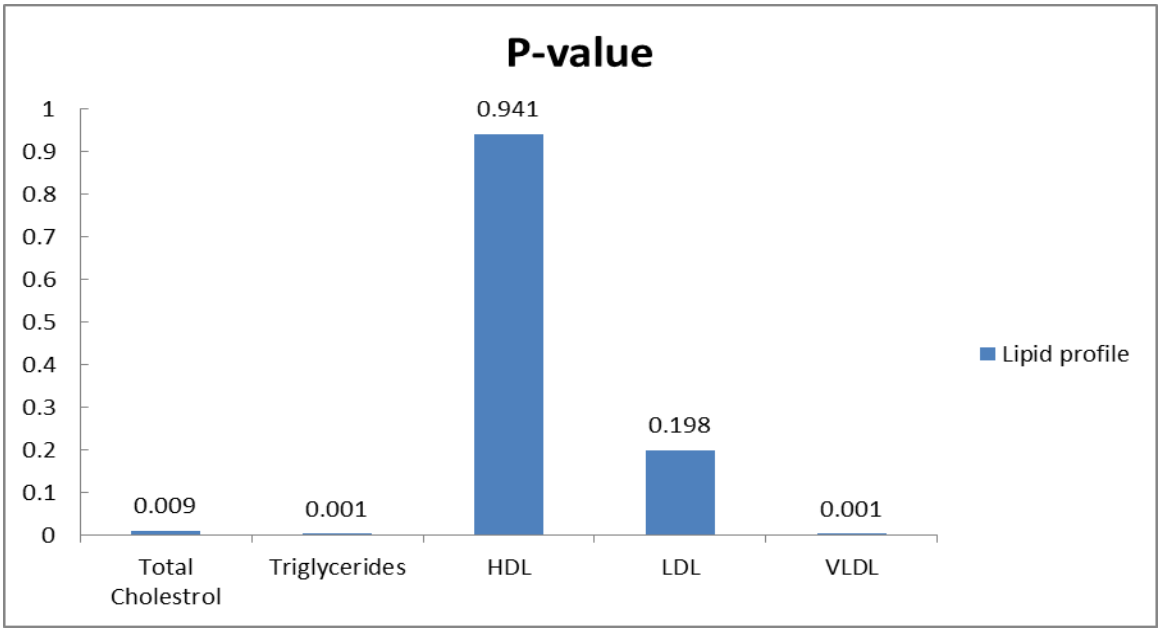

Figure 2. P-value of lipid profiles

Table 4. Correlation between HbA1c values and lipid profile

Correlation between HbA1c and lipid profile	Correlation coefficient(r)
Total cholesterol	-0.154
Triglyceride	0.317
HDL	-0.036
LDL	0.156
VLDL	0.339

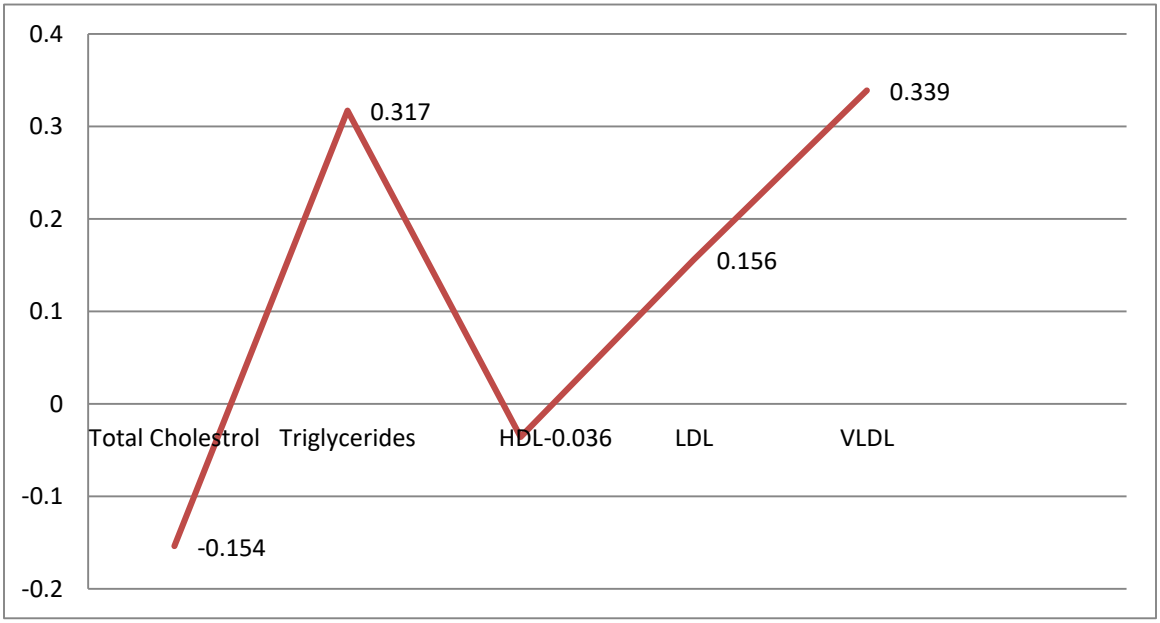

Figure 3. Correlation between HbA1c values and lipid profile

Discussion

Type 2 diabetes mellitus is a major risk factor for dyslipidemia. Chronic hyperglycemia adversely affects health through a variety of mechanisms: dyslipidemia, changes in endothelial metabolism, and platelet activation [19]. Lipid profile and diabetes are both important predictors of metabolic abnormalities such as dyslipidemia, hypertension, and cardiovascular disease. Lipids play an important role in diabetic pathogenesis [11].

The main cause of dyslipidemia in diabetes is elevated free fatty acid levels due to insulin resistance, leading to poor glucose utilization, hyperglycemia, and mobilization of fatty acids from adipose tissue [20]. Diabetes has emerged as a major health problem in the world. In South Asia, the prevalence of diabetes and its adverse health effects are increasing faster than in any other major region in the world [21].

We conducted this study to find out the lipid levels of diabetic patients and compare the lipid levels of control and uncontrolled diabetic patients. According to the results of this study, diabetic patients with poor blood glycemic control (HbA1c> 7.5%) had statistically significant (p-value <0.05) different levels of lipid profile such as high values of Total Cholesterol, Triglycerides, VLDL levels when compared with normal glycemic control. Similar results were seen in other studies like studies done by Gupta *et al*. [22] such as total Cholesterol levels with a p-value of 0.0005 which is highly significant, the same was seen in triglyceride and VLDL levels.

Previous studies have reported that the total cholesterol, triglycerides, and low-density lipoprotein cholesterol of diabetic patients with uncontrolled glycemic index increase, while the decrease of plasma high-density lipoprotein cholesterol is due to changes in lipid metabolism [23]. Azad *et al*. [6] study also show different results from this present study as the level of serum total cholesterol and triglycerides was found significantly high. The level of serum HDL cholesterol was significantly (p-value = 0.013) but LDL cholesterol level was found significantly (p-value = 0.042) raised.

So the results of the present study show that laboratory tests of lipid profiles and glycosylated hemoglobin in diabetic patients indicate early medical intervention. Good glycemic control and maintenance of blood lipid profile within normal levels through medical intervention should be part of the comprehensive treatment of diabetes. Lifestyle changes, including increased physical exercise, weight management strategies, and dietary changes are important management milestones. It is expected that these efforts will also lead to a reduction in dyslipidemia [24]. Our research clearly shows that the lipid distribution of diabetic patients is impaired. Considering the possibility of developing cardiovascular and cerebrovascular diseases, it is very important for diabetic patients to deal with dyslipidemia.

Conclusion

Early screening and early intervention for dyslipidemia in diabetic patients are essential to minimize the risk of death from cardiovascular disease in the future. This study shows that hypercholesterolemia, hypertriglyceridemia, and elevated VLDL cholesterol are common lipid abnormalities in diabetic dyslipidemia. Patients should be educated about lifestyle changes, healthy eating habits, and exercise. In order to avoid a sedentary lifestyle, take appropriate medications, regularly monitor blood lipid status, and observe by a doctor. It is very effective to monitor blood sugar and blood lipid levels to reduce the risk of coronary artery disease.

Authors' contributions

Conceived and designed the experiments: H Kashif & S Yahya, Performed the

experiments: S Yahya & H Kashif, Analysed the data: H Kashif & S Yahya, Contributed materials/ analysis/ tools: MMA Qadri, Wrote the paper: S Yahya, H Kashif & MMA Qadri.

References

1. Iweka FK, Okogun GR, Dic-Ijiewere EO, Dada LF, Akhuemokhan IK, Obodo BN & Onoyovwi OA (2020). Assessment of Thyroid Profile of Type 1 and Type 2 Diabetes Mellitus Patients and Patients with Diabetic Complications. *Recent Adv Biol Med* 6(2): 12728.
2. World Health Organization (1999). Definition, diagnosis and classification of diabetes mellitus and its complications: report of a WHO consultation. Part 1, Diagnosis and classification of diabetes mellitus (No. WHO/NCD/NCS/99.2). World Health Organization. 2 p.
3. Hasona N & Elasbali A (2016). Evaluation of Electrolytes Imbalance and Dyslipidemia in Diabetic Patients. *Med Sci* 4(2): 7.
4. Gangadhar M & Narasimhamurthy K & Muthahanumaiah (2020). Lipid profile among controlled and uncontrolled type-2 diabetic patients in a rural tertiary care center: a comparative study. *Inter J of Basic & Clin Pharmacol* 9(4): 562-565.
5. Ahmad M, Ijaz I, Rasheed N, Saeed M, Ghaznavi S, Mohsan S & Bokhari R (2017). Correlation between Glycated Hemoglobin and Dyslipidemia in Type-2 Diabetes Mellitus. *J of Isl Med & Dental College* 20165(4): 161–164.
6. Azad AH, Khan HR, Nasir GM & Afzal M (2017). Lipid Profile Abnormalities in Controlled and Uncontrolled Diabetic Patients: A Comparative Study. *Ann Pak Ann Pak Inst Med Sci* 13(2): 208-212.
7. Steiner G (1997). Diabetes and atherosclerosis-a lipoprotein perspective. Diabetic Medicine: *A J of the British Diab Assoc* 14(3): S38-44.
8. Chandra KS, Bansal M, Nair T, Iyengar SS, Gupta R, Manchanda SC, Mohanan PP, Rao VD, Manjunath CN, Sawhney JPS, Sinha N, Pancholia AK, Mishra S, Kasliwal RR, Kumar S, Krishnan U, Kalra S, Misra A, Shrivastava U & Gulati S (2014). Consensus statement on management of dyslipidemia in Indian subjects. *Indian Heart J* 66(S3): S1–S51.
9. Ismail KH (2014). Lipid profile of controlled and uncontrolled diabetics in Erbil, Iraq. *Iraqi J Comm Med* 1: 10-13.
10. Gupta S, Mangal R & Grover A (2020). Lipid profile pattern in controlled and uncontrolled diabetic patients in a tertiary care centre. *Inter J of Res in Med Sci* 8(4): 1528.
11. Wang S, Ji X, Zhang Z & Xue F (2020). Relationship between lipid profiles and glycemic control among patients with type 2 diabetes in Qingdao, China. *Inter J of Environ Res and Pub Health* 17(15): 1–11.
12. Parveen A, Chimkode SM, Kumaran SD & Shivanna R (2015). Correlation of hemoglobin A1C levels with serum lipid profile in patients with type 2 diabetes mellitus. *Res J of Pharm, Biol and Chem Sci* 6(3): 703–706.
13. Achille ME, Michel N, Fonkeng SL, Elvis Chongsi W, Patrice PA, Maurice M, Njikam Rene M & Bonglavnyuy TC (2018). Pattern of Lipid Profile of Type 2 Diabetes Patients in Tertiary Hospital South-West Region of Cameroon. *J of Diab & Metabol* 9(5).
14. Windler E (2005). What is the consequence of an abnormal lipid profile in patients with type 2 diabetes or the metabolic syndrome. *Atherosclerosis Suppl* 6(3): 11–14.
15. Vijayaraghavan K (2010). Treatment of dyslipidemia in patients with type 2 diabetes. *Lip in Health and Dis* 9: 144.
16. Suryawanshi NP, Bhutey AK, Nagdeote AN, Jadhav AA & Manoorkar GS (2006).

Study of lipid peroxide and lipid profile in diabetes mellitus. *Indian J of Clin Biochem* 21(1): 126–130.
17. Yagi K (1987). Lipid peroxides and human diseases. *Chem and Phy of Lipids* 45(2–4): 337–351.
18. Haffner SM, Mykkänen L, Festa A, Burke JP & Stern MP (2000). Insulin-resistant prediabetic subjects have more atherogenic risk factors than insulin-sensitive prediabetic subjects: Implications for preventing coronary heart disease during the prediabetic state. *Circulation* 101(9): 975–980.
19. Colwell JA & Nesto RW (2003). The platelet in diabetes: focus on prevention of ischemic events. *Diab Care* 26(7): 2181–2188.
20. Berry C, Tardif JC & Bourassa MG (2007). Coronary Heart Disease in Patients with Diabetes. Part I: Recent Advances in Prevention and Noninvasive Management. *J of the Ame College of Cardiol* 49(6): 631–642.
21. Begum A & Irfan SR (2019). Lipid Profile Abnormalities in Bangladeshi Type 2 Diabetic Patients Attending a Tertiary Care Hospital: A Cross-Sectional Study. *Bangl Crit Care J* 7(1): 44–47.
22. Gupta S, Mangal R & Grover A (2020). Lipid profile pattern in controlled and uncontrolled diabetic patients in a tertiary care centre. *Inter J of Res in Med Sci* 8(4): 1528.
23. Krauss RM (2004). Lipids and lipoproteins in patients with type 2 diabetes. *Diab Care* 27(6): 1496–1504.
24. Ozder A (2014). Lipid profile abnormalities seen in T2DM patients in primary healthcare in Turkey: A cross-sectional study. *Lipids in Health and Dis* 13(1): 1–6.