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Original article

Study of Lipid Profile in Diabetes Mellitus with and without Hypertension

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Keywords:
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Abstract: Introduction Alterations in the lipid metabolism have been reported in the subject of diabetes mellitus. They may be influenced by the presence of hypertension. **Aims** The present study was undertaken to estimate the serum lipids profiles of diabetics with and without hypertension. **Study design** The study design is experimental with comparative study method, **Methodology** The sample size taken is 80 which is divided into four groups as A group of 20 healthy individuals of age 20-70 years, other B group of 20 diabetic patients without Hypertension, other C group of 20 hypertensive patients without diabetes and the rest 20 diabetic patients along with hypertension of age 20-70 years of D group. They were matched with respect to various lipid parameters such as total cholesterol, Triglycerides, β: α lipoprotein ratio etc. with control group A. **Place and duration of study: t**he study took place at Santosh group of institutions between August 2013 to August 2016. **Result** The serum cholesterol levels were significantly higher in hypertensives without diabetics and in diabetics with hypertension as compared to normal controls. No significant difference in the serum triglyceride level was observed among various groups in this study. The β: α lipoprotein ratio was found to be affected in all the groups as compared to controls with maximum ratio in diabetics without hypertension and in hypertension without diabetes. Patients who were suffering from diabetes and hypertension were at a maximum risk of developing atherosclerosis and its complications such as coronary artery disease. Diabetics with hypertension had significant higher levels of cholesterol as compared to that of without hypertension. The diabetics with hypertension had lipid abnormalities because of diabetic element in them rather than the hypertension. All the groups studied except the controls were found to be increasingly susceptible to the risk of atherosclerosis and its complications. This risk was found to be maximum in diabetics with hypertension rather than diabetics or hypertensive's alone. **Conclusion** The need for right balanced diet, regular exercise and a stress free life is essential for prevention and management of diabetes and hypertension.

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INTRODUCTION

The term "diabetes" refers to a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. Several pathogenic processes are involved in the development of diabetes (Farooqui, Akhlaq A 2018). These range from autoimmune destruction of the beta cells of the pancreas in Type 1 diabetes with complete insulin deficiency, to abnormalities that result in resistance to insulin action as in Type 2 diabetes (Althunibat et al., 2010; American Diabetes Association al.el. 2018). The chronic hyperglycemia associated with diabetes is associated with long-term damage, dysfunction, and failure of various organs, especially the eyes, kidneys, nerves, heart, and blood vessels (Rohmetra A, Tandon R 2018). In diabetes, the deficient action of insulin on the target tissues causes the dysfunction of carbohydrate, fat, and protein metabolism (American Diabetes Association al.el.1998). Diabetic patients with dyslipidemia are targets of cardiovascular deaths. Patients with type 2 diabetes often exhibit an atherogenic lipid profile, which greatly increases their risk for cardiovascular disease compared with people without diabetes (Haffner SM, Lehto S,1998). The combination of hyperglycemia, diabetic dyslipidemia, insulin resistance and hypertension produces an enhanced atherogenic environment within the circulation (Gotto AM Jr.2007)]. Severe hyperlipidemia in diabetes may also lead to lipid infiltration into the retina, causing macular edema and retinal hard exudates and blindness (Miljanovic B, Glynn RJ, 2004 Hu D, Hannah J 2000). The association between lipid profile and body fat distribution has been much discussed during the past decades (Bertoli A, Di Daniele N, 2003. Both lipid profile and body fat mass have been shown to be the important predictors for metabolic disturbances and serious

medical conditions, including dyslipidemia, hypertension, diabetes, cardiovascular diseases, among other. Hyperglycemia and atherosclerosis are related in type-2 diabetes (Devrajani, B.R. 2010). Hence this association of hypertension with diabetes deserves an in-depth study at the biochemical level in order to unravel any existing etiological relationship between these two disease entities (Sachidananda G1, Manjunath M.L 2012).Serum lipid profile in diabetes mellitus has been extensively studied, and it has been sufficiently evidenced that there is a clear cut and well defined hyperlipidemia (Keen, 1976, Suryawanshi K.2015]. However, although few serum lipid studies have been carried out on hypertensive without diabetes,(Lorenzo Gordon, Dalip Ragoobirsingh,2010) very little study has been done on the lipid metabolism in diabetic patients with hypertension (Sachidananda G1, Manjunath M.L 2012).There are few studies to establish the relationship between hypertension and hyperlipidaemia, but very few studies showing this association from India and there are no such studies from central India (Raksha Goyal & Nandini Sarwate 2014). Diabetes and hypertension frequently occur together. There is substantial overlap between diabetes and hypertension in etiology and disease mechanisms. Obesity, inflammation, oxidative stress, and insulin resistance are thought to be the common pathways. Recent advances in the understanding of these pathways have provided new insights and perspectives. Physical activity plays an important protective role in the two diseases. Knowing the common causes and disease mechanisms allows a more effective and proactive approach in their prevention and treatment. This study might unravel any possible etiological relationship between these two apparently separate disease entities.

MATERIALS AND METHODS

The study design is experimental with comparative study method. The sample size taken is 80 which is divided into four groups as A group of 20 healthy individuals of age 20-70 years, other B group of 20 diabetic patients without Hypertension, other C group of 20 hypertensive patients without diabetes and the rest 20 diabetic patients along with hypertension of age 20-70 years of D group. They were matched with respect to various lipid parameters such as total cholesterol, Triglycerides, β: α lipoprotein ratio etc. with control group A. The study took place at Santosh group of institutions between August 2013 to August 2016. Ethical approval was taken from Institutional Ethical Committee, Santosh Medical College, Ghaziabad (NCR). The various parameters taken like blood sugar, lipid profile, and blood pressure (BP) [Systolic BP and Diastolic BP]. The estimation of blood glucose was done by Asatoor and King method (Asatoor, A. M., and King 1954), estimation of total serum cholesterol was done by Sackett's method (Sackett 1925), estimation of serum triglycerides was done by acetyl-acetone, estimation of serum lipoproteins was done by paper electrophoresis, estimation of blood urea by colorimetric method and estimation of serum uric acid by Caraway's method (Caraway WT 1955). Estimation of serum free fatty acid by enzymatic kit method (Kızıltunç 2005).

Data is presented as mean ± standard deviation (SD), using SPSS software version-21. A compare mean value by paired-variables Sample T-test was applied to see the difference in various group. P value < 0.05 was taken significant. The p value comparisons which have been reported in the Tables1-7 are comparisons of normal healthy controls and the groups.

RESULTS

Serum lipid profile in different groups: - Serum triglycerides (TG) total cholesterol, free fatty acids (FFA) and beta: alpha lipoprotein ratio were estimated in each group. The results obtained are presented below.

Serum lipid profile in Diabetes without Hypertension: - In the present study we observed 11.5% increase in mean TG levels when compared with controls. On comparison with controls we observed 30% and 73.5% increase in the levels of cholesterol and FFA respectively.

There was a significant rise in FFA levels and beta: alpha lipoprotein ratio as compared to those in the controls. The total serum cholesterol level also showed a rising trend in this group, but this narrowly failed to achieve any statistical significance. (**Table-1**)

Table 1:- Serum lipid profile in Diabetes without Hypertension:-

Serum Lipids	Controls Mean±S.D.	Diabetes without hypertension Mean±S.D.	P value
Triglycerides [mg%]	105.25±30.16	117.20±28.20	> 0.05
Total cholesterol [mg%]	172.40± 24.87	224.28±66.51	< 0.05
Free Fatty Acid µ moles/L	503.80±92.93	874.21±325.48	< 0.05
β: α lipoprotein ratio	2.8±1.10	2.8±1.10	> 0.05

Table 2:- Serum lipid profiles in Hypertension without Diabetes:-

Serum lipids	Controls Mean±S.D.	Hypertension without Diabetes Mean±S.D.	P Value
Triglycerides [mg%]	105.25±30.16	111.45±38.20	>0.05
Total cholesterol [mg%]	172.40± 24.87	293.33±106.72	<0.05
β: α lipoprotein ratio	2.8±1.10	2.88±1.05	<0.05
Free Fatty Acid µ moles/L	503.80±92.93	464.06±134.51	>0.05

Table 3: Serum lipid profiles in Diabetes with Hypertension

Serum lipids	Controls Mean±S.D.	Diabetes with Hypertension Mean±S.D.	P Value
Triglycerides [mg%]	105.25±30.16	111.25±37.75	>0.05
Total cholesterol [mg%]	172.40± 24.87	288.10±59.46	<0.05
β: α lipoprotein ratio	2.8±1.10	3.47±1.03	<0.05
Free Fatty Acid µ moles/L	503.80±92.93	948.25±415.40	<0.05

Table 4: Serum blood sugar levels in Diabetes without Hypertension

Blood sugar	Controls Mean±S.D.	Diabetes without hypertension Mean±S.D.	P Value
Fasting sugar [mg%]	92.35±9.21	279.55±162.84	<0.05
Post Prandial blood sugar [mg%]	_	409.40±82.45	_

Table 5: Serum blood sugar levels in Diabetes with Hypertension

Blood sugar	Controls Mean±S.D.	Diabetes with Hypertension Mean±S.D.	P Value
Fasting sugar [mg%]	92.35±9.21	153.75±55.86	<0.05
Post Prandial blood sugar [mg%]	_	247.30±74.64	_

Table 6: Blood Pressure levels in Hypertension without Diabetes

Blood Pressure	Controls Mean±S.D.	Hypertension without Mean±S.D.	P Value
Systolic blood pressure [mmHg]	121.45±9.62	165.65±25.69	<0.05
Diastolic blood pressure [mmHg]	79.80±4.77	113.65±33.53	<0.05

Table 7: Blood Pressure Levels in Diabetes with Hypertension

Blood pressure	Controls Mean±S.D.	Diabetes with Hypertension Mean±S.D.	P Value
Systolic blood pressure [mmHg]	121.45±9.62	164.50±19.25	<0.05
Diastolic blood pressure [mmHg]	79.80±4.77	107.75±9.10	<0.05

Serum lipid profile in hypertension without diabetes: - We observed 5.8%, 70.1% and 2.8% increase in this group the mean TG, total cholesterol beta: alpha lipoprotein ratio levels and 7.8% decrease FFA level comparison with control.

This group showed a statistical significant rise in total cholesterol level. Beta: alpha lipoprotein ratio was raised as compared to controls p value <0.05 (**Table-2**).

Serum lipid profile in diabetes with hypertension: - In this group we observed 5.7%, 67.1%, 88.2% and 21.4% increase in mean TG total cholesterol, FFA and beta: alpha lipoprotein ratio levels when compared with controls. This group showed a significant rise in total cholesterol, FFA and beta: alpha lipoprotein ratio (**Table-3**).

Blood pressure (BP) levels in "diabetes with hypertension" in more statistically significant at p<0.05 as compared to healthy controls (**Table 7**).

The Systolic BP and Diastolic BP of patients with "hypertension but without diabetes" is statistically significant at p<0.05 as compared to healthy controls (**Table-6**).

The Blood sugar level of both "hypertension with diabetes" and "hypertension without diabetes" is statistically significant as compared to healthy control at p <0.05 **(Table 4, 5)**.

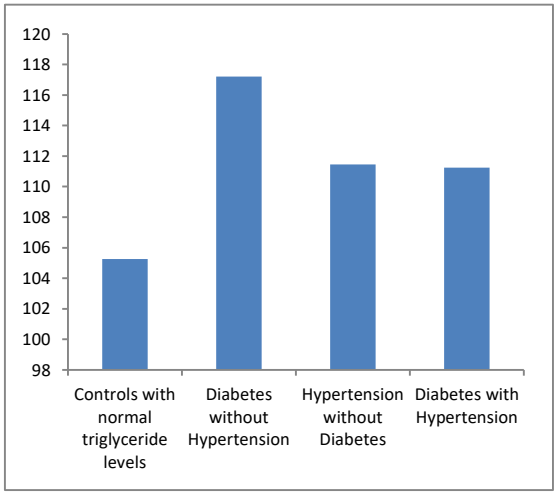

Figure 1: Comparison of Serum Triglycerides

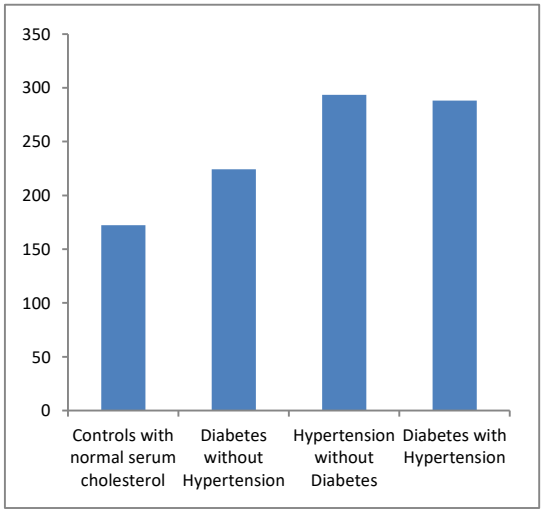

Figure 2: Comparison of Serum Cholesterol

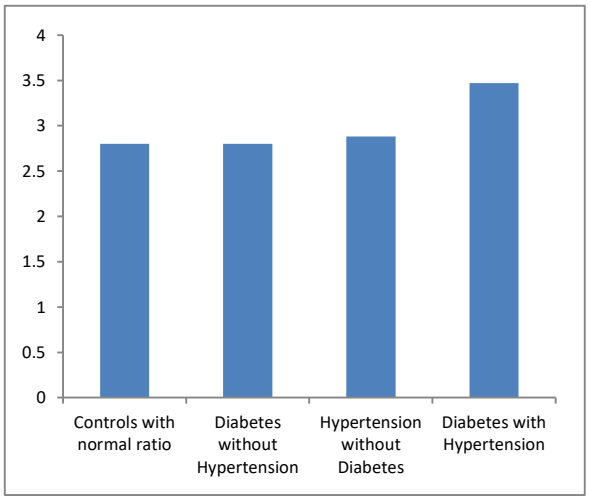

Figure 3: Comparison of serum β:α Lipoprotein Ratio

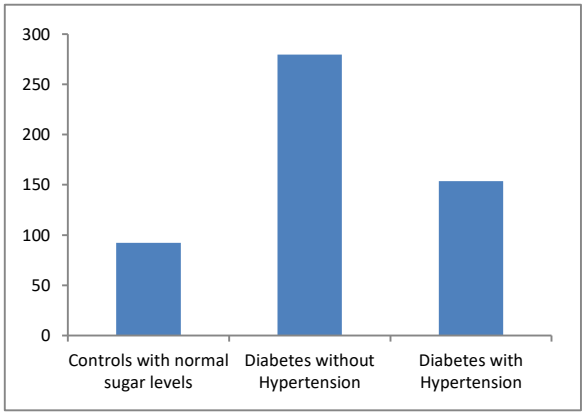

Figure 4: Comparison of Fasting Blood sugar levels

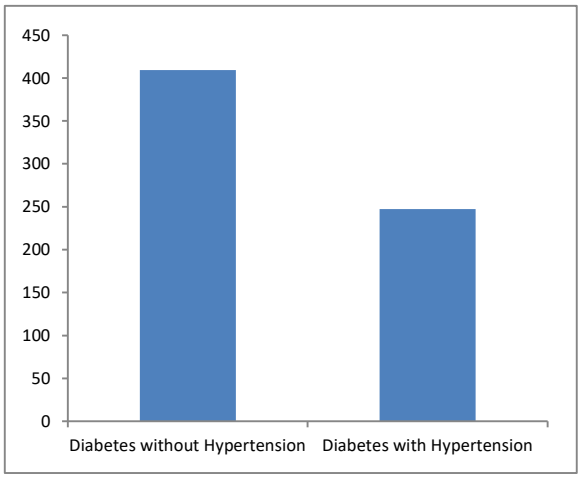

Figure 5: Comparison of post prandial blood sugar levels

DISCUSSION

The whole study group was divided into different 4 groups in this study, including the controls, diabetic and hypertensive patients. The various parameters were taken, compared and analyzed with results like on comparing serum lipid profile, it was observed that in the patients of diabetics without hypertension, there was a highly significant rise in Free Fatty Acids (FFA) levels and beta: alpha lipoprotein ratio as compared to those in the controls.

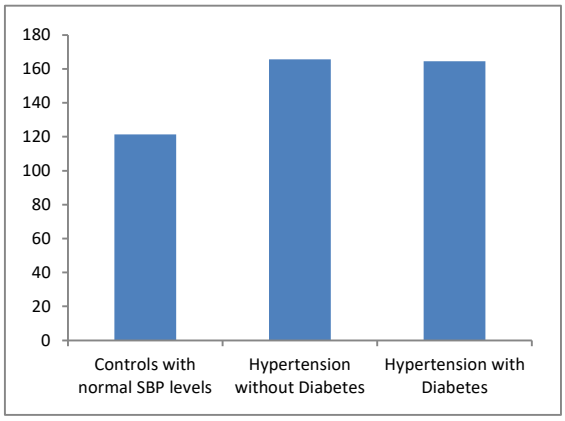

Figure 6: Comparison of Systolic blood pressure levels

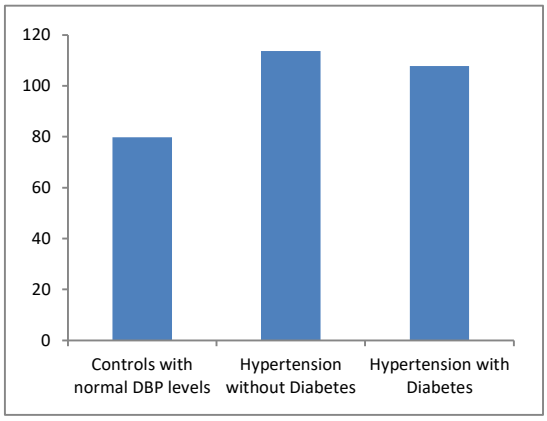

Figure 7: Comparison of Diastolic blood pressure levels

The total serum cholesterol level also showed a rising trend in this group, but this narrowly failed to achieve any statistical significance; the patients of essential Hypertension without diabetes showed a statistical significant rise in total cholesterol. Beta: alpha lipoprotein ratio was raised as compared to controls. Compared to controls, the diabetic patients with hypertension showed a significant rise in total cholesterol and beta: alpha lipoprotein ratio. But there was no change in the serum triglycerides levels between these patients and controls. It is thus, clear from the various Indian reports, including the results of this present study that the serum lipid fraction in Indians is lower than those of western population (Paththinige C, Sirisena N 2017). The most likely explanation for this variation is the difference in the dietary habits of the two populations. The diet in the developed western countries is usually rich in saturated fatty acids, fats, proteins and refined carbohydrates while the diet in developing countries, such as India, is mainly comprised of carbohydrates and unsaturated fatty acids (Togha M, Gheini MR, 2011)**.**The serum cholesterol level in the diabetic in this study showed a higher mean level as compared to that of the controls. However, the reports in the

literature show an elevation of serum cholesterol level in diabetics especially in those with ketoacidosis and other complications (DeFronzo RA 2009). The findings go well which has been reported in the literature of hypercholesterolemia in essential hypertensives (Bertoli A, 2003 Lorenzo Gordon, 2010). Hypertension is correlated with the incidence of atherosclerosis (Kones R 2013 and Nwanjo HU 2005). Previous clinical and epidemiological studies have defined plasma lipoprotein levels such as reduced high density lipoprotein-cholesterol (HDL-C), increased total cholesterol (TC) and low density lipoprotein-cholesterol (LDL-C) etc. as strong predictors of atherosclerosis and hypertension (Tenenbaum A, 2014) Furthermore, increased renal tubular reabsorption and increased arterial pressure lead to higher values of glomerular capillary wall stress, activation of neurohumoral systems, increased serum lipid level, and glucose intolerance (Hall JE 2000). High β: α lipoprotein ratio along with high cholesterol level pointing to an increased LDL or β lipoprotein ratio along with high cholesterol. It can be conjectured that in the diabetic patients with hypertension, the hypertension probably does not have much to contribute to their lipid abnormalities. Diabetes on the other hand seems to be the main factor responsible for their deranged lipid metabolism, as such abnormalities are well documented in diabetes mellitus. Though multiple variation analysis could not be done due to lack of facilities, still on the basis of comparison done and as described above, it seem possible to suggest that the lipid abnormalities encountered by accelerating the commencement and /or progression of atherosclerosis, have a direct contribution in the development of hypertension and this hardly needs to be mentioned that hypertension is an important risk factor for cardiovascular and cerebrovascular diseases which cause increased morbidity and mortality. Diabetes and hypertension share common pathways such as oxidative stress and insulin resistance. These pathways interact and influence each other and may even cause a vicious cycle. Hypertension and diabetes are both end results of the metabolic syndrome. They may, therefore, develop one after the other in the same individual. Central obesity is the cause of the metabolic syndrome. Therefore, optimization of lifestyle remains the cornerstone in the prevention and treatment of diabetes and hypertension. The need for right balanced diet, regular exercise and a stress free life is essential for prevention and management of diabetes and hypertension (Sri Sri Paramhansa Yogananda. 2015).

CONCLUSION AND SUMMARY

Alterations in the lipid metabolism have been reported in the subject of diabetes mellitus. They may be influenced by the presence of hypertension. The present study was undertaken to estimate the serum lipids profiles of diabetics with and without hypertension. The serum cholesterol levels were significantly higher in hypertensives without diabetics and in diabetics with hypertension as compared to normal controls. No significant difference in the serum triglyceride level was observed among various groups in this study. The β: α lipoprotein ratio was found to be affected in all the groups as compared to controls
with maximum ratio in diabetics without hypertension and in hypertension without diabetes. Thus the group of diabetics with hypertension was at a maximum risk of developing atherosclerosis and its complications such as coronary artery disease. Diabetics with hypertension had significant higher levels of cholesterol as compared to that of without hypertension. Thus in conclusion it said that the lipid abnormalities occurred in the all the groups compared to controls. The diabetics with hypertension had lipid abnormalities because of diabetic element in them rather than the hypertension. All the groups studied except the controls were found to be increasingly susceptible to the risk of atherosclerosis and its complications. But this risk was found to be maximum in diabetics with hypertension rather either the diabetics or the hypertensives alone. The need for right balanced diet, regular exercise and a stress free life is essential for prevention and management of diabetes and hypertension.

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REFERENCES:

Ahmet Kızıltunç / Fatih Akçay (2005) An Enzymatic Method for the Determination of Free Fatty Acids in Serum/Plasma Published Online:06 01| DOI: https://doi.org/10.1515/CCLM.1998.015

Althunibat, O. Y., Al-Mustafa, A. H., Tarawneh, K., Khleifat, K. M., Ridzwan, B. H., & Qaralleh, H. N. (2010). Protective role of Punica granatum L. peel extract against oxidative damage in experimental diabetic rats. Process Biochemistry, 45(4), 581-585.

American Diabetes Association. (2018)"2. Classification and diagnosis of diabetes: standards of medical care in diabetes." Diabetes Care 41.Supplement 1: S13-S27.

American Diabetes Association. Diabetes Care; 21 January (1998) (Suppl. 1): S23-S31,

Haffner SM, Lehto S, Ronnemaa T, Pyorala K, Laakso M. Mortality from coronary heart disease in subjects with type 2 diabetes and in nondiabetic subjects with and without

prior myocardial infarction. N Engl J Med; 339:229-234.

Asatoor, A. M., and King, E. J. Estimation of Blood Glucose levels (1954). Biochem. J., 56, 44P.

Bertoli A, Di Daniele N, Ceccobelli M, Ficara A, Girasoli C, De Lorenzo A.(2003). Lipid profile, BMI, body fat distribution, and aerobic fitness in men with metabolic syndrome. Acta Diabetol. 40: 30-133,

Caraway WT.(1955) Determination of uric acid in serum by a carbonate method. Am J Clin Pathol. Jul;25 (7):840–845.

DeFronzo RA.(2009) Insulin resistance, lipotoxicity, type 2 diabetes and atherosclerosis: the missing links. The Claude Bernard Lecture. Diabetologia. 2010;53(7):1270-1287. doi:10.1007/s00125-010-1684-1.

Devrajani, B.R., S.Z. Shah, A.A. Soomro and T. Devrajani, (2010) Type 2 diabetes mellitus: A risk factor for Helicobacter pylori infection: A hospital based case-control study. Int J Diabetes Dev Ctries,30 (1): 22-6.

Farooqui, Akhlaq A., and Tahira Farooqui. (2018) "Contribution of Diabetes and Metabolic Syndrome in the Pathogenesis of Alzheimer's Disease." *Role of the Mediterranean Diet in the Brain and Neurodegenerative Diseases*. 301-316.

Gotto AM Jr. (2007) Cardiologist's role in improving glucose control and global cardiovascular risk in patients with type 2 diabetes mellitus. Am J Cardiol.99:3–5.

Hall JE.(2000). Pathophysiology of obesity hypertension. Current hypertension reports.;2 (2):139-47.

Hu D, Hannah J, Gray RS, Jablonski KA, Henderson JA, Robbins DC, et al (2000); Effects of obesity and body fat distribution on lipids and lipoproteins in nondiabetic American Indians: The Strong Heart Study. Obes Res. 8: 411-421.

Keen, H. (1976) Glucose intolerance in diabetes mellitus and atherosclerosis – Prospects for prevention. Post Grad Med J,9: 52: 445.

Kones R.(2013) Molecular sources of residual cardiovascular risk, clinical signals, and innovative solutions: relationship with subclinical disease, undertreatment, and poor adherence: implications of new evidence upon optimizing cardiovascular patient outcomes. Vascular Health and Risk Management.;9:617-670. doi:10.2147/VHRM.S37119.

Lorenzo Gordon, Dalip Ragoobirsingh, Errol Y St A Morrison, Eric Choo-Kang, Donovan McGrowder, E Martorell. (2010) Lipid Profile of Type 2 Diabetic and Hypertensive Patients in the Jamaican Population. Journal of Laboratory Physicians Jan-Jun Vol-2 / Issue-1/25-30/.

Miljanovic B, Glynn RJ, Nathan DM, Manson JE, Schaumberg DA.(2004) A prospective study of serum lipids and risk of diabetic macular edema in type 1 diabetes. Diabetes; 53:2883–2892.

Nwanjo HU.(2005) Efficacy of aqueous extract of Vernonia amydalina in plasma lipoprotein and oxidative status in diabetic rats. Nig JPhysiol Sci; 20(1-2): 39-42.

Paththinige C, Sirisena N, Dissanayake V. (2017) Genetic determinants of inherited susceptibility to hypercholesterolemia – a comprehensive literature review. Lipids in Health and Disease;16:103. doi:10.1186/s12944-017-0488-4.

Raksha Goyal & Nandini Sarwate. (2014) A correlative study of hypertension with lipid profile. IMPACT: IJRANSS ISSN (E): 2321-8851; ISSN (P): 2347-4580 Feb Vol. 2, Issue 2, 143-150.

Rohmetra A, Tandon R, Jaiswal A, Rai R, Srivastava RK. . (2018) Orthodontic plight: Diabetes mellitus. International Journal of Oral Health Sciences.Jan 1;8(1):13.

Sachidananda G1, Manjunath M.L, Naveen S. Kotur. (2012) Blood pressure, lipid profile and lipid peroxidation in Diabetic hypertensive patients. IJBAR;03(04) 244-247.

Sackett, 0. E.,Estimation of Serum Cholesterol. J Bwl Chein (1925) 64, 203.

Sri Sri Paramhansa Yogananda (2015). Scientific Healing Affirmations, Pg-47.

Suryawanshi K. S, Jagtap. P. E., Belwalkar. G. J., Dhonde. S. P., Mane.V.P, More. S. J. (*2015)* To study serum uric acid, serum lipid profile in type-2 diabetes mellitus, *SSRG International Journal of Medical Science (SSRG-IJMS) Issue 5 – volume 2*

Tenenbaum A, Klempfner R, Fisman EZ. (2014) Hypertriglyceridemia: a too long unfairly neglected major cardiovascular risk factor. *Cardiovascular Diabetology*;13:159. doi:10.1186/s12933-014-0159-y.

Togha M, Gheini MR, Ahmadi B, Khashaiar P, Razeghi S. (2011) Lipid profile in cerebrovascular accidents. *Iranian Journal of Neurology*;10(1-2):1-4.