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Original Research

To evaluate the atherogenic index of plasma, non-HDL cholesterol, and other cardiac indices as potential risk factors for cardiovascular disease in individuals with type II diabetes

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ABSTRACT:

Aim: The aim of this study is to evaluate the atherogenic index of plasma, non-HDL cholesterol, and other cardiac indices as potential risk factors for cardiovascular disease in individuals with type II diabetes. **Materials and Methods:** A total of 280 individuals of both sex groups were included for this investigation. A total of 280 people participated in this research, with 140 being diagnosed with diabetes and the other 140 serving as healthy non-diabetic controls. **Results:** There was a substantial increase seen in the mean values of weight, body mass index (BMI), systolic blood pressure, and diastolic blood pressure among diabetes patients when compared to the control group. The study observed a substantial rise in the mean values of FBS, HbA1c, TC, TG, LDL-cholesterol, Non HDL-cholesterol, CRR, AC, and AIP in diabetic patients as compared to persons without diabetes. **Conclusion:** In the context of Diabetes, there is a disruption in the metabolism of lipids and lipoproteins, which may lead to the occurrence of atherogenic dyslipidemia. This dyslipidemia is recognised as a prevalent risk factor in the pathogenesis of atherosclerosis. The marker of cardiovascular risk in diabetes is mostly low density lipoprotein cholesterol.

Keywords: FBS, HbA1c, Non HDL-cholesterol, AIP

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INTRODUCTION

Diabetes mellitus (DM) is a prevalent worldwide condition that is characterised by chronic hyperglycemia resulting from either an insufficient production of insulin or a diminished response to its effects. Dyslipidemia represents a significant and potentially paramount association between diabetes and cardiovascular disease. The connection between glucose and lipid metabolism has been a central topic of investigation, with particular emphasis on diabetic dyslipidemia [1]. The incidence of cardiovascular (CV) mortality in persons diagnosed with type 2 diabetes (T2DM) is two to four times higher compared to those without diabetes [2]. The Indian population has a hereditary predisposition towards the onset of cardiovascular disease, which may be attributed to dyslipidemia and reduced levels of high density lipoproteins [3]. Several studies have shown that non-HDL-C could serve as a more effective biomarker for predicting cardiovascular disease when compared to low density lipoprotein-cholesterol alone [4]. This finding suggests that a significant proportion of individuals with diabetes are unable to achieve desired targets for non-HDL-C levels. Despite achieving their desired LDL cholesterol target, individuals nevertheless have problems associated with atherosclerotic vascular disease and endure cardiovascular events. The remedial aim at such amount of triglycerides is designated as non-HDL cholesterol. Non-HDL cholesterol may be regarded as an indicator for the prediction of cardiovascular disease (CVD), and its calculation involves the subtraction of HDL cholesterol from total cholesterol. The use of non-HDL-C and other lipid ratios for calculations may out to be more efficacious compared to the assessment of all lipoproteins [4]. Lipid ratios

have been identified as indicators of atherogenic risk and are considered to be superior predictors of cardiovascular illnesses compared to lipids in isolation. Instead of cholesterol characteristics, it has been shown that increasing lipoprotein ratios have a stronger statistical correlation with the severity and frequency of Coronary Artery Disease (CAD) [5]. There are several variables that contribute to the heightened risk of cardiovascular disease in individuals with diabetes, with lipid abnormalities playing a significant role in this association. The heightened cardiovascular risk among those with diabetes is well recognised. The timely evaluation and management of cardiovascular risk factors in individuals diagnosed with type 2 diabetes mellitus (T2DM) provide favourable outcomes by mitigating the likelihood of CVD and mortality, as well as enhancing patient prognosis.In recent times, scholars have directed their attention on a novel lipid index known as the atherogenic index of plasma (AIP). This index has the potential to provide a thorough assessment of the equilibrium between atherogenic and anti-atherogenic elements. Numerous researchers have shown in their respective studies that AIP serves as a superior marker for accurately predicting the risk of CAD [6,7]. A research study done in Iran revealed a favourable correlation between AIP, waist circumference, and body mass index (BMI), while also indicating a negative correlation with physical activity [8]. The AIP is derived from the logarithm of the ratio between triglycerides (TG) and high-density lipoprotein cholesterol (HDL-C). This index has been identified as a potential indicator of atherosclerosis and a substitute for assessing the size of tiny low-density lipoprotein particles [9]. Therefore, the primary objective of this research was to evaluate the Atherogenic coefficient and Atherogenic index of plasma, together with other cardiac indices, as a means of determining the risk of Cardiovascular disease in individuals with Diabetes. The aforementioned fractions are computed values that may be used in the clinical laboratory to evaluate the likelihood of cardiovascular disease, extending beyond the lipid profile typically conducted.

MATERIALS AND METHODS

The present investigation was conducted inside the academic setting of the Department of Biochemistry. A total of 280 participants were included in the present investigation. Prior to the commencement of the study, ethical approval was obtained from the relevant committee, and informed permission was obtained from all participants included in the research. All of the studies were conducted inside the Biochemistry Department. A total of 280 individuals of both sex groups were included for this investigation. A total of 280 people participated in this research, with 140 being diagnosed with diabetes and the other 140 serving as healthy non-diabetic controls. The research excluded those who had hepatic disease, cardiovascular disease, any chronic or acute inflammatory sickness, all forms of malignancy, pulmonary TB, addiction to alcohol, those who smoke, and individuals with extended illness.

METHODOLOGY

About 5 ml of blood was drawn after an overnight fast under aseptic precautions from clinically diagnosed type 2 DM patients and controls. Fasting plasma glucose level and lipid parameters were done by enzymatic method by using automated analyzer**.** Cardiac Risk ratio, Atherogenic Index of Plasma, non-HDL cholesterol and **Atherogenic Coefficient were calculated as follows:**

1. CRR (Cardiac Risk Ratio) = Total Cholesterol / HDL-Cholesterol
2. AC (Atherogenic Coefficient) = (Total Cholesterol- HDL cholesterol) / HDL-cholesterol
3. AIP = Log Triglyceride / HDL-cholesterol (mmol/l)
4. Non-HDL-cholesterol = Total Cholesterol – HDL- cholesterol

STATISTICAL ANALYSIS

SPSS version 25.0 was used for Statistical analysis and a $p<0.05$ was considered as statistically significant. The statistical differences between the groups were determined by student independent sample t-test.

RESULTS

A total of 280 participants were included in the research, including 140 persons diagnosed with diabetes and 140 individuals classified as normal and healthy, representing both sexes. Table 1 displays the demographic variables among those diagnosed with diabetes and those who are considered to be in a normal state of health. There was a substantial increase seen in the mean values of weight, body mass index (BMI), systolic blood pressure, and diastolic blood pressure among diabetes patients when compared to the control group. The table 2 displays the biochemical parameters of normal and diabetic individuals. The study observed a substantial rise in the mean values of FBS, HbA1c, TC, TG, LDL-cholesterol, Non HDL-cholesterol, CRR, AC, and AIP in diabetic patients as compared to persons without diabetes.

Table 1: Demographic profile of the participants

Parameter	Diabetics	Healthy Controls	p-Value
Age (years)	39.11 ± 5.25	37.17 ± 10.12	0.34
Weight (Kg)	60.52 ± 3.96	76.17 ± 8.19	**0.001**

Height (Meter)	1.60 ± 0.021	1.68 ± 0.05	**0.001**
BMI (Kg/Meter2)	23.74 ± 1.22	28.02 ± 2.89	**0.001**
Systolic Blood pressure (mm of Hg)	120.11± 5.63	130.25 ± 6.38	**0.001**
Diastolic Blood Pressure (mm of Hg)	79.02 ± 4.33	85.06± 84	**0.001**

Table 2: Biochemical parameters and cardiac indices in diabetic and normal healthy individual

Variables	Diabetics	Healthy Controls	p-Value
Fasting Blood Glucose (mg/dL)	178.03 ± 12.58	97.36 ± 4.63	0.001
HbA1c	8.31 ± 1.11	5.21 ± 0.85	0.001
Total Cholesterol	239.98 ± 15.63	181.11 ±12.63	0.001
Triglyceride (mmol/L)	2.31 ±0.14	1.57 ± 0.13	0.001
HDL-cholesterol (mmol/L)	1.03 ± 0.21	1.15 ± 0.12	0.001
LDL-cholesterol (mg/dL)	160.25 ± 8.96	101.22 ± 7.96	0.001
VLDL-cholesterol	39.89 ± 3.34	28.02 ± 3.64	0.001
Non-HDL-cholesterol (mg/dL)	199.98 ± 11.36	130.37 ± 8.64	0.001
Cardiac Risk Ratio	5.14 ± 0.78	3.11 ± 0.67	0.001
Atherogenic Index of Plasma	0.72 ± 0.05	0.136± 0.07	0.001
Atherogenic Coefficient	6.16 ± 0.65	4.11 ± 0.74	0.001

DISCUSSION

The incidence of diabetes mellitus has a persistent upward trend, making it a frequently seen ailment. A significant correlation was seen between diabetes and cardiovascular disease, which stands as the primary contributor to morbidity and death among individuals with diabetes. Cardiovascular risk factors, including hypertension, obesity, and dyslipidemia, are prevalent in individuals with diabetes and contribute to an increased susceptibility to cardiac events. In their study, the researcher stated that there was a threefold increase in the incidence of cardiovascular disease (CVD) among diabetic patients. Furthermore, CVD has emerged as the primary risk factor for morbidity and death associated with diabetes [10]. In the present study, the AIP is found to be increased in diabetic patients as compared to healthy individual and it was statistically significant. Our results are in accordance with the many researchers[11-14]. AIP is a simple relationship between TG and HDL cholesterol and can be considered as good predictor of atherosclerosis [15]. The cardiac risk ratio and atherogenic coefficient were found to be increased significantly in diabetic patients as compared to normal healthy individual. Our results are in agreement with many researchers[16, 17]. Risk factors for more aggregation in patients with T2DM include insulin resistance, central obesity, elevated blood pressure, and elevated triglycerides. It may be due to increased oxidative stress, increased inflammation, or endothelial cell dysfunction in association with low HDL cholesterol[18]. The risk factors associated with increased AIP are closely related to those for CVD and cerebrovascular disease in patients with Diabetes. In the present study we have observed significant increased level of non HDL cholesterol in diabetic patient as compared to normal healthy individual. Many researchers were obtained same results[19-21]. Many Studies have shown that the non-HDL-c being analogous to Apo-B in assessing atherogenic cholesterol and lipoprotein burden[22]. Although apo B can be measured directly but the measurement of non HDL cholesterol is more practical, reliable and inexpensive and is accepted as a surrogate marker for apoB in routine clinical practice [23]. In diabetic patients it may be Insulin deficiency that causes increased metabolization of free fatty acid that may lead to disorder in lipid metabolism and stimulates protein kinase-C pathway. All these impair the vasodilatory response and hence predict the cardiovascular disease. The increase in triacylglycerol level may be due to the accumulation of triacylglycerol, increased lipogenesis and decreased fatty acid oxidation. Insulin resistance causes more catabolism of HDL particles and formation of LDL particles, this may lead to increase in LDL and decrease in HDL levels in type 2 diabetes[24]. Lipid ratios and AIP have been reported to indicate atherogenic dyslipidemia. Various lipid and lipoprotein fractions were shown to be associated in diabetes with and without complications. Researchers in their study observed that the atherogenic index and TC/HDL-c levels were significantly higher in diabetic patients than in controls and both these were found to be lowered in patients on treatment with insulin[25]. These findings suggest the role of lipid ratios in identifying the CV risk rather than the individual lipids alone.

CONCLUSION

In the context of Diabetes, there is a disruption in the metabolism of lipids and lipoproteins, which may lead to the occurrence of atherogenic dyslipidemia. This dyslipidemia is recognised as a prevalent risk factor in the pathogenesis of atherosclerosis. The marker of cardiovascular risk in diabetes is mostly low density lipoprotein cholesterol. The use of lipid ratios, atherogenic coefficient, and atherogenic index of plasma has been identified as a means to assess the likelihood of atherosclerosis development, surpassing

the predictive capabilities of lipids in isolation, so serving as superior indicators of cardiovascular risk. Therefore, it is advisable to include all of these data into a standard cardiac profile as indicators of atherosclerotic injury.

REFERENCES

1. Bayındır Çevik A, Karaaslan MM, Koçan S, Pekmezci H, Ba ydur S, Şahin S, Kırbaş A, Ayaz T. Prevalence and screening for risk factors of type 2 diabetes in Rize, Nourtheast Turkey: findings from a population-based study. *Prim Care Diabetes* 2016;10:10–8.
2. Artha IMJR, Bhargah A, Dharmawan NK, Pande UW, Triyana KA, Mahariski PA, et al. High level of individual lipid profile and lipid ratio as a predictive marker of poor glycemic control in type-2 diabetes mellitus. *Vasc Health Risk Manag*. 2019;15:149–57.
3. Acay A, Ulu MS, Ahsen A, Ozkececi G, Demir K, Ozuguz U, et al. Atherogenic index as a predictor of atherosclerosis in subjects with familial mediterranean fever. Medicina. 2014;50(6):329- 33.
4. Critchley JA, Carey IM, Harris T, DeWilde S, Cook DG. Variability in glycated hemoglobin and risk of poor outcomes among people with type 2 diabetes in a large primary care cohort study. *Diabetes Care* 2019;42:2237–46.
5. Onat A, Can G, Kaya H, Hergenc G. Atherogenic index of plasma" (log10 triglyceride/high-density lipoprotein cholesterol) predicts high blood pressure, diabetes, and vascular events. J Clin Lipidol 2010;4(2):89–98.
6. Zhan Y, Xu T, Tan X. Two parameters reflect lipid-driven inflammatory state in acute coronary syndrome: atherogenic index of plasma, neutrophil-lymphocyte ratio. BMC Cardiovasc Disord 2016;16(1):96.
7. Dobiasova M. AIP--atherogenic index of plasma as a significant predictor of cardiovascular risk: from research to practice. Vnitr Lek 2006;52:64- 71.
8. Dobiasova M, Frohlich J, Sedova M, Cheung MC, Brown BG. Cholesterol esterification and atherogenic index of plasma correlate with lipoprotein size and findings on coronary angi-ography. J Lipid Res 2011;52(3):566-71.
9. Singh PS, Sharma H, Zafar KS, Singh PK, Yadav SK, Gautam RK, et al. Prevalence of type 2 diabetes mellitus in rural population of India-astudy from Western Uttar Pradesh. Int J Res Med Sci 2017;5(4):1363-7.
10. Vinik AI, Erbas T, Casellini CM. Diabetic cardiac autonomic neuropathy, inflammation and cardiovascular disease. J Diabetes Investig 2013;4(1):4-18.
11. Palem SP, Abraham P. Atherogenic Index of Plasma an Indicator for Predicting Cardiovascular Risk in Addition to Endothelial Dysfunction in Type 2 Diabetic Subjects. Journal Clin Diag Res 2018;12(6):BC21-BC24.
12. Trimbake SB, Prachi S. Chikhalikar, Pratinidhi SA. Comparative analysis of atherogenic index of plasma and body mass index in type II diabetes mellitus patients. EJBPS 2018;5(8):256-61.
13. Muralidhara KCS, Hemantha KDS, Vishwanath HL. Role of non- HDL cholesterol in type II diabetes mellitus. Int J Clin Biochem Res 2018; 5(4):642-5.
14. Butt M, Ali AM, Bakry MM. Lipid profile patterns and association between glycated haemoglobin (HbA1C) and atherogenic index of plasma (AIP) in diabetes patients at a tertiary care hospital in Malaysia. Int J Pharm Pharm Sci 2017;9(6):150-4.
15. Nwagha UI, Ikekpeazu EJ, Ejezie FE, Neboh EE, Maduka IC. Atherogenic index of plasma as useful predictor of cardiovascular risk among postmenopausal women in Enugu, Nigeria," African Health Sciences 2010;10(3):248–52.
16. Du EM, Ukwamedu HA, Oghagbon ES. Assessment of Cardiovascular Risk indices in Type 2 Diabetes Mellitus. Trop Med Surg 2015; 3(2):1-4.
17. Nimmanapalli HD, Kasi AD, Devapatla PK, Nuttakki V. Lipid ratios, atherogenic coefficient and atherogenic index of plasma as parameters in assessing cardiovascular risk in type 2 diabetes mellitus. Int J Res Med Sci 2016;4(7):2863-9.
18. Ormazabal V, Nair S, Elfeky O, Aguayo C, Salomon C, Felipe A. Association between insulin resistance and the development of cardiovascular disease. Cardiovasc Diabetol 2018;17:122.
19. Safo AS. Correlation between non-high-density lipoprotein-cholesterol and the degree of glycemic control in type 2 diabetes mellitus. Med J Babylon 2018;15(2):169-73.
20. Kumpatla S, Soni A, Narasingan SN, Viswanathan V. Presence of elevated non-HDL among patients with T2DM with CV events despite of optimal LDL-C – A report from South India. Indian heart Journal 2016;68(3):378-9.
21. Zabeen S, Rahman MR, Mustafa TG, Eusufzai NH, S Shermin S. Non-HDL Cholesterol and Type 2 Diabetes Mellitus. AKMMCJ 2012;3(2):15-8.
22. Hermans MP, Sacks FM, Ahn SA, Rousseau MF. Non-HDL-cholesterol as valid surrogate to apolipoprotein B100 measurement in diabetes: Discriminant Ratio and unbiased equivalence. Cardiovasc Diabetol 2011;28(10):20.
23. Anie LP. Clinical Relevance of Non-HDL Cholesterol in Patients with Diabetes. Clinical Diabetes 2008;261):3-7.
24. Trimbake SB, Chikhalikar PS, Pratinidhi SA. Comparative analysis of atherogenic index of plasma and body mass index in type ii diabetes mellitus patients. EJBPS 2018;5(8):256-61.
25. Siddiqui IA, Mariya LB , Rao JR. Lipid indices in type II diabetes mellitus and their association with macro and micro vascular complications. Int J Med J Res Health Sci 2013;2(1):87-92