ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26apr2137

Assessment of Cardiovascular Disease Biomarkers in Type 2 Diabetic Patients Attending Primary Health Centres in Osogbo, Osun State, Nigeria

Rasaq Olugbenga Fafioye[1, 3]; Ebenezer Idowu Olatubosun Ajayi[1]; Bamidele Stephen Ajilore[2]; Omolola Yinka Adeagbo[3]; Yusuff Adewale Akeem[4]

[1]Metabolic Complications and Infectious Disease-Related Movement Disorders Research Group, Computational Membrane Biochemistry and Nanobiotechnology Unit, Department of Biochemistry, Faculty of Basic and Applied Sciences, College of Science, Engineering and Technology, Osun State University, Osogbo, Nigeria
[2]Department of Medical Biochemistry, Federal University of Health Sciences, Ila-Orangun, Osun State, Nigeria
[3]Osun State Ministry of Health, Public Health Department, Epidemiology Unit, Osogbo, Nigeria
[4]Osun State Primary Health Care Development Board, Osogbo, Osun State, Nigeria

Corresponding Author:
Rasaq Olugbenga Fafioye
Department of Biochemistry
Osun State University
ORCID Number: 0009-0004-3967-1458

Publication Date: 2026/05/22

Abstract: Type 2 diabetes mellitus (T2DM) to a large extent amplifies the chance of developing cardiovascular disease (CVD), identified by increased inflammatory indicators like interleukin-6 (IL-6), cardiac indicators such as cardiac troponin I (TnI) and imbalance of lipids (fats) in the blood, such as high LDL ("bad" cholesterol), low HDL ("good" cholesterol) or high triglycerides that reflect atherogenic indices. This research sought to assess the CVD risk of these particular indicators in type 2 diabetes mellitus patients in Osogbo, Osun State, Nigeria. We applied a correlational study to examine the composite of an individual physical, biochemical, and physiological traits. The research involved two groups: experimental group (diabetic) and control group (non-diabetic). Each group consists of one hundred (100) participants, recruited from selected four (4) primary health facilities in Osogbo, Osun State, Nigeria. Fasting veinous blood sample was obtained from respondents, for laboratory assay, using enzyme assay technique. Our findings revealed substantial increased systolic and diastolic hypertension, low density lipoprotein cholesterol (LDL-C), triglycerides (TG), and total cholesterol (TC) levels in experimental group (diabetic) compared to control (non-diabetic). Cholesterol ratios, serum interleukin-6 levels as well as raised troponin I (TnI), were observed in type 2 diabetes mellitus patients. Diabetic patients in Osogbo, Nigeria are at a greater risk of cardiovascular disease (CVD) as indicated by these unhealthy physiological and biochemical conditions. Timely detection and management of diabetes and CVD risk factors are, thus, essential.

Keywords: *Interleukin-6 (IL-6), Cardiac Troponin I (TnI), Type 2 Diabetes Mellitus (T2DM), Osun State Nigeria, Atherogenic Index, Cardiovascular Disease (CVD).*

How to Cite: Rasaq Olugbenga Fafioye; Ebenezer Idowu Olatubosun Ajayi; Bamidele Stephen Ajilore; Omolola Yinka Adeagbo; Yusuff Adewale Akeem (2026) Assessment of Cardiovascular Disease Biomarkers in Type 2 Diabetic Patients Attending Primary Health Centres in Osogbo, Osun State, Nigeria. *International Journal of Innovative Science and Research Technology*, 11(4), 5012-5018. https://doi.org/10.38124/ijisrt/26apr2137

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26apr2137

I. INTRODUCTION

Diabetes is a metabolic disease, distinguished by high blood sugar levels. This occurs when the body lacks insulin or cannot use it properly, leaving excess glucose in the blood [1, 2, 3]. The continuous increase in its prevalence has demanded for urgent attention on diabetes and its complication especially, cardiovascular diseases. Diabetes has been approximated to impact 500 million people by 2030 [4]. Diabetes causes injury to many organs including the heart [5]. Its mortality rates maintain the increase in incidence due to lack of early detection, poor management, illiteracy and increased poverty among the people in developing nations, which does not spare the study environment [6]. Across the world, cadiovascular diseases (CVD) represent an important burden of disease. Therefore, diabetes has been named as a well-known underlying ailment that increases the likelihood of developing cardiovascular disease. There are factors that have contributed to cardiovascular disease development in diabetic patients. Some of these factors include imbalance between free radicals and oxidants, inflammation and hyperlipidemia (high blood fat) [7, 8]. Interleukin-6 (IL-6), an inflammatory cytokine, assessed in this study have been identified as a contributing factor in the progression of cardiovascular disease in diabetic patients [9, 10]. Also implicated are heart enzymes, which troponin I (TnI) is one of them. Its higher levels in diabetic patients suggest association that predicts cardiovascular occurrence in diabetic patients. Cholesterol ratios are another important indices for the risk evaluation of cardiovascular disease (atherosclerosis), based on correlations between the lipoproteins, when comparing the levels of total cholesterol to that of high density lipoprotein (HDL)" good" cholesterol [11].

With the diabetes cases and cardiovascular disease becoming increasingly common in this country, this study assessed the likelihood of developing cardiovascular disease in diabetic patients in Osogbo, Osun State, Nigeria.

II. METHODOLOGY

Participants were drawn from selected four focal primary health facilities in Osogbo local government, Osun State, Nigeria. All the participants consented to participate in the study. The ethical clearances for the study were collected from the authorities of the Osun State Ministry of Health (OSMoH) and the Osun State Primary Health Care Development Board (OSPHCDB), with approval numbers OSHREC/PRS/569T/339 and OSPHCDB/315/232, respectively. Out of the three hundred and eighty-one (381) persons screened for the study, only one hundred (100) diabetic patients and one hundred (100) non-diabetic individuals met the inclusion and exclusion criteria, making a total of 200 participants. These were satisfied by the State Epidemiologist (a public health clinician) and the medical officers of health detailed to each facility. The participants were dwellers of communities within the catchment areas of the selected health facilities.

- *Inclusion Criteria*

Adults aged 18-65 years, including patients diagnosed with type 2 diabetes, as well as non-diabetic individuals from four selected health facilities in Osogbo, Osun State, Nigeria participated in the study.

- *Exclusion Criteria*

Participants with a history of organ transplantation, cancer, tobacco use (past or present), or pregnant women, were excluded from the study.

III. PHYSIOLOGICAL PARAMETERS MEASURED

- *Blood Pressure:*

A digital sphygmomanometer was used to measure blood pressure.

- *Body Mass Index and Waist-Hip Ratio:*

Body weight was measured using a standard weighing scale while body Mass Index (BMI) was calculated as:

$$\frac{Weight(kg)}{Height\ (m^2)}$$

Waist-hip ratio (WHR) was also determined as;

$$\frac{Waist\ circumference\ (cm)}{Hip\ circumference\ (cm)}$$

- *Sample collection and storage*

Five milliliters of fasting blood sample were collected through venipuncture in a sterile manner and discharged into plain sample bottles and then centrifuge at two hundred revolution per minute (200 rpm). Ice bag was used to carry the samples to the laboratory and then kept at -20 °C before analysis was carried out.

- *Determination of number of participants*

The two hundred participants that were involved in this study was calculated thus;

$n = \frac{Z^2 P(1-P)}{d^2}$ [12]

n = The sample size
Z = The standard deviation (95%) (at 1.96 confidence interval)
P = Prevalence
d = degree of precision, 5% (0.05)

$$\frac{1.96^2 x\ 0.85\ (1-0.85)}{0.05^2}$$

$n = 0.4898$ $\frac{0.4898}{0.0025}$

$195.92 \approx 200$

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26apr2137

➢ *Biochemistry assay*

Regulated glucose meter, Fine-Test Auto Premium was employed for the determination of fasting plasma glucose of the participants. The lipid-protein complexes were determined as follows:

- High density lipoprotein cholesterol (HDL-C) was assessed by precipitating Low density lipoprotein (LDL-C) in the serum sample using polyvinyl sulfate [13].
- Serum Low density lipoprotein (LDL-C) was calculated with this formula: LDL-C = $\frac{TC - TG}{2.2 - HDL\ cholesterol}$ where; TC = Total cholesterol, TG = Triglycerides and HDL = High density lipoprotein
- Triglycerides concentration in serum was measured quantitatively using VITROS TRIG Slides and VITROS Chemistry product kit, that was based on enzymatic method [14].
- Serum total cholesterol was determined after enzymatic hydrolysis and oxidation of cholesterol esters using N. S. Biotech cholesterol reagents. The absorbance of the final product gave the quantity of the total cholesterol present [15].

Cardiac enzyme, Troponin I (TnI) and inflammatory cytokine, interleukin-6 (IL-6) were assessed from the serum sample of participants, using plate based biochemical technique kits. ELABSCIENCE Human cardiac Troponin I (TnI) and Human interleukin-6 Enzyme Linked Immunosorbent Assay kits were used respectively [16]. Atherogenic indices and cholesterol ratios were calculated thus:

1. Atherogenic Index of Plasma (AIP) = $\frac{Log\ Triglycerides}{High\ Density\ Lipoprotein}$

2. Classical Ratio = $\frac{Low\ Density\ Lipoprotein}{High\ Density\ Lipoprotein}$

3. Atherogenic Coefficient = $\frac{Total\ cholesterol - High\ Density\ Lipoprotein}{High\ Density\ Lipoprotein}$

4. Cardiac Risk Ratio = $\frac{Total\ Cholesterol}{High\ Density\ Lipoprotein}$

IV. QUANTITATIVE ASSESSMENT

Basic statistics were used to describe the participants attributes. The average standard deviation for each measurement was determined mathematically. The student t-test was employed to check, if there were significant differences between the group averages. All data analysis were done using Statistical Package for Social Sciences (SPSS) software (version 25.0). The results were believed meaningful, if the p-values were less than 0.05 ($p<0.05$).

Table 1 show the socio-demographic attributes of the participants. The average age of both respondents, control group (non-diabetic) and experimental group (diabetic) was 52.76±10.9 and 57.1±8.5. There was a significant correlation between the two groups (p=0.008*), there was no substantial difference in sex distribution between the two tested groups (p=0.0625).

Table 1: Age and sex of the participants (n=200)

Parameters		**Age**					**Gender**	
		18-30	31-40	41-50	51-60	61-65	Female	Male
Statistics		p-value=0.008*					p-value=0.626	
Diabetes Status	**Diabetes**	1 (33.3%)	3 (17.6%)	20 (46.5%)	31 (53.4%)	45 (57.0%)	95 (50.0%)	5 (50.0%)
	Non-Diabetes	2 (56.7%)	14 (82.4%)	23 (53.5%)	27 (46.6%)	34 (43.0%)	95 (50.0%)	5 (50.0%)

Average ages were 52.76 and 57.1 years *for non-diabetic and diabetic subjects. Chi square analysis results for age is 0.050 with 5 degrees of freedom. The value for sex is 0.00 with 1 degree of freedom.*

Table 2 show the physiological parameters of respondents. It revealed that more diabetic patients were obese (34 subjects) compared to non-diabetic (10 subjects). Female diabetics had a higher waist-to-hip ratio in 88 subjects compared to 60 subjects in female non-diabetics. Systolic and diastolic hypertension were substantially higher in diabetic subjects compared to the control group (non-diabetic subjects). Six (6) and seven (7) diabetic patients (experimental group) had stage 2 systolic and diastolic blood pressure, compared to one (1) and zero (0) non-diabetic (control group) respectively .

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26apr2137

Table 2: Physiological Parameters of Respondents (n=200)

Parameters	Classification of individuals		Statistics
	Non-diabetic	Diabetic	
BMI (kg/m^2)	**Σ=19.51±5.3**	**Σ=25.66±4.8**	p-value=0.001*
≤18.5 (underweight)	13 (100%)	0 (0.0%)	
18.5-24.9 (normal)	59 (70.2%)	25 (29.8%)	
25 – 29.9 (overweight)	18 (30.5%)	41 (69.5%)	
>30 (Obese)	10 (22.7%)	34 (77.3%)	
Waist-Hip ratio	**Σ=0.8±0.1**	**Σ=0.82±0.3**	
Female			p-value=0.001*
Low (≤ 0.80)	12 (92.3%)	1 (7.7%)	
Moderate (0.81-0.85)	23 (79.3)	1 (20.7%)	
High (> 0.85)	60 (40.5%)	88 (59.5%)	
Male			p-value=0.037*
Low (≤ 0.95)	3 (75.0%)	1(25.0%)	
Moderate (0.96-0.10)	1 (33.3%)	2 (66.7%)	
High (>1.0)	1 (33.3%)	2 (66.7%)	
Systolic Pressure (mmHg)	**Σ=115.12±10.1**	**Σ=122.25±12.1**	p-value=0.059
<140 (Normal)	99 (51.3%)	94 (48.7)	
≥140 (Stage 2)	1 (14.3%)	6 (85.7)	
Diastolic Pressure (mmHg)	**Σ=62.12±9.3**	**Σ=70.22±11.2**	p-value=0.007*
<90 (Normal)	100 (51.8%)	93 (48.2%)	
≥90 (Stage 2)	0 (0.0%)	7 (100.0%)	

Results are shown as count and percentages. A p-value less than 0.05 means that the result is statistically substantial. The Chi-square test was used to check the substantiality for systolic blood pressure (df=1), diastolic blood pressure (df=3), body mass index (BMI, df=3), and Waist-Hip Ratio (W-HR, df=2).

Table 3 show the fasting blood sugar and lipid profile distribution of the respondents. It revealed that the experimental group (diabetic) had substantial higher fasting blood sugar compared to the control group (non-diabetic) (p-value=0.001*). The diabetic subjects showed higher levels of LDL, TG and TC than non-diabetic subjects. However, diabetic (70 subjects) had lower HDL cholesterol levels (< 1.03 mmol/dL) compared to the non-diabetic (zero subject). Serum IL-6 and cardiac troponin I (TnI) were substantially higher in diabetic (83 and 93 subjects) compared to non-diabetic (8 and 22 subjects) respectively.

Table 3: Fasting Blood Glucose, Lipid Profile, IL-6 and Cardiac Troponin I Characteristics of Respondents (n=200)

Parameters	Individual classification		Statistics
	Non-diabetic (n=100)	Diabetic (n=100)	
FBS (mmol/dL)			p-value=0.001*
<7 (impaired fasting glucose)	100 (95.2%)	5 (4.8%)	
≥7 (diabetes mellitus)	0 (0.0%)	95 (100%)	
LDL (mmol/dL)			p-value=0.001*
<1.3 (normal)	71 (80.7%)	17 (19.2)	
1.3 - 2.5 (moderately high)	22 (22.0%)	78 (78.0%)	
2.6 - 4.1 (high)	0 (0.00%)	5 (100.0%)	
HDL (mmol/dL)			p-value=0.001*
<1.03 (low)	0 (0.0%)	70 (100.0%)	
1.03 - 1.55 (moderately high)	47 (72.3%)	18 (27.7%)	
> 1.55 (high/normal)	53 (81.5%)	12 (18.5%)	
TG (mmol/dL)			p-value=0.001*
1.69 - 2.25 (normal)	45 (71.4%)	18 (28.6%)	
2.26 - 5.64 (moderately high)	22 (44.0%)	28 (56.0%)	
>5.65 (high)	33 (38.4%)	54 (61.6%)	

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26apr2137

IL-6 (mmol/dL)			p-value=0.001*
< 5	92 (86.8%)	14 (13.2)	
≥ 5	8 (8.9%)	86 (91.1%)	
TnI (ng/ml)			
0 - 0.4	78 (91.0)	7 (9.0%)	
≥ 0.4	22 (19.5%)	93 (80.5%)	

The results are shown as count and percentage. A p-value less than 0.05 means that the result is statistically substantial. The Chi-square test significance of LDL, HDL, Triglycerides, Total cholesterol, IL-6, and TnI, with different degrees of freedom (df). Abbreviation: LDL: Low density lipoprotein; HDL: High density lipoprotein; IL-6: Interleukine-6; TnI: Cardiac troponin I

Table 4 show the cholesterol ratios of the respondents which revealed that the experimental group (diabetic patients) is at a substantially higher risk of cardiovascular disease. There was no significant difference in the atherogenic coefficient (AC) between the groups. The atherogenic index of plasma (AIP) was substantially higher (> 0.21) in diabetic subjects (78) compared to non-diabetic subject (33)

Table 4: Cholesterol ratio of respondents (n=200)

Variables	**Individual Classification**		**Statistics**
	Non-diabetic	**Diabetic**	
Atherogenic coefficient (AC)			p-value= 0.259
2 - 2.49 (normal)	19 (95.0%)	1 (5.0%)	
2.5 - 3.49 (moderately high)	3 (9.37%)	29 (90.63%)	
> 3.5 (High)	1 (8.97%)	71 (91.03%)	
Cardiac risk ratio (CRR)			p-value=0.001*
< 3.5 (normal)	97 (95.1%)	5 (4.9%)	
3.5 - 5.0 (moderately high)	2 (7.69%)	24 (92.3%)	
> 5.0 (High)	1 (8.973%)	71 (91.03%)	
Atherogenic index of plasma (AIP)			p-value=0.001*
< 0.11 (normal)	45 (90.0%)	5 (10.0%)	
0.11 - 0.21 (moderately high)	17 (56.4%)	22 (43.59%)	
> 0.21 (High)	33 (29.73%)	78 (70.27%)	
Classical ratio (CR)			p-value=0.001*
< 2 (normal)	92 (82.14%)	20 (17.86%)	
2.1 - 4.9 (moderately high)	8 (12.9%)	54 (87.0%)	
> 5 (high)	0 (0.0%	26 (100%)	

Results are shown as count and percentages. A p-value less than 0.05 means that the result is statistically substantial. The Chi-square test was used to check substantiality for AC, CRR, AIP, CR, with 2 degrees of freedom for all.

V. DISCUSSION

Diabetes and cardiovascular disease (CVD) often co-exist as a co-morbidity in individuals who reported either one of these metabolic conditions [17, 18]. Both constitute a significant health and socioeconomic burden for patients and the health care system [19]. There is a need to control the prevalence of CVD and diabetes due to its metabolic nature, by controlling the lipid composition in the body in order to prevent further escalation of diabetes into CVD as a complication [20, 21]. This study has re-established the parameters and biomarkers to be taken into cognizance by healthcare providers, beyond the management of diabetes alone, especially in developing nations.

The substantial increase in systolic and diastolic hypertension observed in this study among type 2 diabetes patients is in agreement with previous studies which emphasized that hypertension and diabetes are diseases that coexist. An imbalance of lipids (fats) in type 2 diabetes patients, which is described with essential traits of higher low-density lipoprotein cholesterol, triglycerides, total cholesterol and lower high-density lipoprotein were observed in this study, which is in consonance with previous studies [22, 23]. Among other parameters that was heighten in the experimental group (diabetic patients) is interleukin-6, indicating an extreme inflammatory response, which also connects to greater chance of developing cardiovascular disease. These findings corroborate existing research findings that have demonstrated relationships that exist between interleukin-6 and cardiovascular disease [24, 25]. Serum cardiac troponin I (TnI) levels were also observed to be higher in diabetic patients compared to non-diabetic patients. This is an indication of cardiac damage which is attributed to raised troponin I levels predisposing to the development of cardiovascular disease with its attending fatalities in the form of cardiovascular events [26]. The substantially increased cholesterol ratio in diabetic patients points to an increase chance of developing phenotypic

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26apr2137

cardiovascular disease. The results of this study emphasize the significance of evaluating cholesterol indices and other related parameters in the monitoring and evaluation of diabetic patients' susceptibility in order to prevent the development and eventual occurrence of cardiovascular disease.

VI. CONCLUSION

Type 2 diabetes patients in Osogbo, Osun State, Nigeria displayed an increase chance of developing cardiovascular disease that would arise from abnormal metabolic and systemic parameters. Timely diagnosis and therapeutic intervention of type 2 diabetes mellitus as well as phenotypic biomarkers are extremely important to averting cardiovascular disease. Health care professionals should designate, and treat as most important, the evaluation of cardiovascular disease biomarkers in type 2 diabetic mellitus patients so as to minimize potential threat.

➢ *Authors Contributions*

Conceptualization, E.I.O.A. and B.S.A; methodology, E.I.O.A, R. O. F.; software, E.I.O.A.; validation, E. I. O. A., B. S. A., O. Y. A. and Y. A. A.; formal analysis, Y. A. A.; investigation, R. O. F. and O. Y. A.; resources, E. I. O. A., R. O. F., O. Y. A. and Y. A. A.; data curation, E. I. O. A. and B. S. A.; writing original draft, R. O. F.; review and editing, E. I. O. A. and B. S. A.; visualization, O. Y. A. and Y. A. A.; supervision, E. I. O. A. and B. S. A.; project administration, E. I. O. A.; funding, R. O. F.

➢ *Funding*

There was no grant received by the authors for this research.

ACKNOWLEDGEMENTS

Authors appreciate all the participants that participated in the study, and all the staff of the primary health facilities that were used. Finally, we acknowledge the authors of cited publications.

➢ *Conflict of Interest*

Authors declare no conflict of interest

REFERENCES

[1]. Ajilore, B. S., Adesokan, A. A., 2018. Antidiabetic effects of Tetracarpidium conophorum seed on biomarkers of diabetes-induced nephropathy in rats. Asian Pacific Journal of Tropical Biomedicine 8 (2): 593-597.

[2]. Ajilore, B. S., Olorunnisola, O. S., Owoade, O. A., 2020. Tetracarpidium conophorum (Africa Walnut) seed protects against diabetes-induced liver damage in rats treated with Streptozotocin. Romanian Journal of Diabetes, Nutrition and Metabolic Diseases 27 (2): 135-145

[3]. Nanayakkarra, N., Curtis, A. J., Heritier, S., Gadowski, A. M., Kenealy, T., Owens, D. R., 2021. Impact of age at type 2 diabetes mellitus diagnosis on mortality and vascular complications: systemic review and meta-analysis. Diabetologia, 64 (2): 275 - 287

[4]. International Diabetes Federation, Diabetes Atlas 11th Edition 2025/diabetesatlas.org ISBN 978-2-930229-96-6

[5]. Tashkandi, A. J., Gorman, A., McGoldrick, E. M., Carney, G., Yacoub, A., Setyaninasih, W. A. W., Kuburas, R., Margariti, A., 2025. Metabolic and Mitochondrialdysregulations in diabetic cardiac complications. Int. J. Mol. Sci., 26, 3016. https://doi.org/10.3390/ijms 26073016

[6]. Ogbera, A. O., and Ekpebegh, C., 2014. Diabetes mellitus in Nigeria: The past, present and future. World J. Diabetes 2014 December 15; 5(6): 905-911 ISSN 1948-9358 (online)

[7]. Oyedokun, A. O., Adekanle, O., 2017. Prevalence of diabetes mellitus in Osun State, Nigeria. Journal of Diabetes and Metabolic Disorders 16 (1): 1-6.

[8]. Szymon, S., Ramon, J., 2024. Body mass index and waist circumference as predictors of above average increased cardiovascular risk assessed by SCORE2-OP calculators and the proposition of new optimal cut values: cross sectional single-center study. J. Clin. Med 13 (7): 1931

[9]. Singh, N., Aggarwal, J., Batra, J., Srivasta, N., 2022. Biochemical cardiac markers. International Journal of Health Sciences 6 (2): 8421

[10]. Zarkasi, K. A., Abdul Murad, N. A., Ahmad, N., Jamal, R., Abdullah, N., 2022. Coronary heart disease in type 2 diabetes mellitus. Genetic factors and their mechanism, gene-gene, andgene-environment interactions in the Asian populations. Int. J. Environ. Res. Public Health 19 (2): 647

[11]. Strawbridge, R. J., van Zuydam, N. R., 2018. Shared genetic contribution of type 2 diabetes and cardiovascular disease: Implications for prognosis and treatment. Current diabetes reports 18 (8): 59

[12]. Madukosiri, C. H., Ezomoh, O. O., AmosTautua, B. M., Tatfeng, Y. M., Mishack, D., Akpki, N., Echendu, C. E., Songca, S. P., and Omu, E. T. (2023). A pilot study on the prevalence of Transcription Factor 7-like 2 gene (TCFL2), Rs290487 in ethnic groups with Type 2 Diabetes Mellitus in Bayelsa State of Nigeria. Nig. J. Pure and Applied Sci. 36 (1). e-ISSN 2756-4045

[13]. Assmanna, G. Jabs, H. U., Kohnert, U., Nolte, W., Schriewera, H., 1984. LDL-cholesterol determination in blood serum following precipitation of LDL with polyvinylsulfate. Clinical Chimica Actal 40 (1): 77-83

[14]. Fossati, P., Prencipe, L., 1982. Serum triglyceride determined colorimetrically with an enzyme that produce hydrogen peroxide. Clin Chim Actal 28: 2077-2080.

[15]. Tonk, D. B., 1967. The estimation of cholesterol in serum: A classification and critical review of methods: Clinical Biochemistry 1: 12-29

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26apr2137

[16]. Dobiasova, M., 2024. Atherogenic index of plasma [log(triglycerides/HDL-cholesterol)]: theoretical and practical implications. Clin Chem 50: 1113-1115
[17]. DeBoer, I. H., Bangalore, S., Benetos, A., Davis, A. M., Michos, E. D., Muntner, P., Bakris, G., 2017. Diabetes and hypertension: a position statement by the American Diabetes Association. Diabetes care, 40(9), 1273-1284
[18]. Chi, J. H., Lee, B. J., 2022. Risk factors for hypertension and diabetes comorbidity in a Korean population: A cross-sectional study. PLoS ONE **17** (1): e0262757.
[19]. Andrew, E. U., Anthonia, O. O., Esther, N. O., Olufemi, A. F., Adesoji, A. F., Osi, O. O., and Chinenye, S., 2012. Profile of Nigerians with diabetes mellitus-Diabcare Nigeria study group: Results of a multi-center study. Indian J. Endocrinol Metab. 16 (4): 558-564.
[20]. Lu, S., Bao, M. Y., Miao, S. M., Zhang, X., Jia, Q. Q., Jing, S. Q., Shan, T., Wu, X. H., Liu, Y., 2019. Prevalence of hypertension, diabetes, and dyslipidemia, and their additive effects on myocardial infarction and stroke: a cross-sectional study in Nanjing, China. Ann Transl Med. 2019 Sep;7(18):436. doi:10.21037/atm.2019.09.04.
[21]. Wang Z., Yang T., Fu H., (2021). Prevalence of diabetes and hypertension and their interaction effects on cardio-cerebrovascular diseases: a cross-sectional study. BMC Public Health. 2021 Jun 25;21(1):1224.
[22]. Reinhard, G. B., 2007. Comorbidity of diabetes mellitus and hypertension in the clinical setting: Areview of prevalence, pathophysiology, and treatment perspectives. Clinical Therapeutics 29 (S2):S35-S43.
[23]. de Boer, I. H., Bangalore, S. A., Benetos, A., Davis, A. M., Michos, E. D., Muntner, P., 2017. Diabetes and Hypertension: A Position Statement by the American Diabetes Association. Diabetes Care 40 (9):1273–1284.
[24]. Katkenov, N., Mukhatayev, Z., Kozhakhmetov, S., Sailybayeva, A., Bekbossynova, M., Kushugulova, A. (2024). Systematic Review on the Role of IL-6 and IL-1β in Cardiovascular Diseases. J Cardiovasc Dev Dis. 11(7):206
[25]. Aranha, L.N. (2021) TG/HDL-c ratio as a predictor of cardiovascular risk. Int. J. Cardiovasc. Sci.34(5), S1
[26]. Akbas, T., 2024. Elevated Cardiac Troponin Levels as a Predictor of Increased Mortality Risk in Non-Cardiac Critically Ill Patients Admitted to a Medical Intensive Care Unit. J Clin Med 13(20): 6025.
[27]. Garg, P., Morris, P., Fazlanie, A. L., Vijayan, S., Dancso, B., Dastidar, A. G., 2017. Cardiac biomarkers of acute coronary syndrome: from history to high-sensitivity cardiac troponin. Intern. Emerg. Med 12(2):147-155.