International Journal of Medical Toxicology & Legal Medicine **Volume 27, No. 4S, 2024**
e-ISSN: 0974-4614
p-ISSN: 0972-0448
https://doi.org/10.47059/ijmtlm/V27I4S/095

Triglycerides as a predictor of cardiovascular risk: association with BNP and Troponin T in type 2 diabetes patients

Ilyas Khairi Hussein Ilyas

Yanka Kupala State University of Grodno, Email: ajeenilyas@gmail.com

Received: 15.09.2024 Revised: 17.10.2024 Accepted: 20.11.2024

ABSTRACT
Heart disease (CVD) is still the main reason people get sick and die. People with type 2 diabetes mellitus (T2DM) are more likely to get it because they have metabolic problems like insulin resistance, high cholesterol, and chronic inflammation. This study aims to discover how different body mass indexes (BMIs) of people with T2DM are linked to different levels of triglycerides, BNP, and Troponin T. This will help find out their risk of heart disease. Two hundred twenty-four people took part in the study. There were three groups based on their weight: those who were a healthy weight, those who were overweight, and those who were fat. The study found that Troponin T and cholesterol levels went up as BMI went up, but BNP levels went down. People who are overweight and have T2DM are more likely to get heart disease. There were the most triglycerides (175.0 ± 15.91 mg/dl) and Troponin T (0.22 ± 0.20 ng/ml) in the obese patients, but the least BNP (37.54 ± 1.68 pg/mL) compared to the normal weight and overweight patients. The results show that BNP levels and BMI are strongly linked in a bad way. Having more Troponin T and fat in the blood also shows that being overweight is hard on the heart. Low BMI, low reactive stress, and low cholesterol are all very important for people with T2DM to keep their heart health in check. If people in this high-risk group change how they live and use treatments that target oxidative stress and cholesterol metabolism, they may have fewer heart diseases and deaths.

Keywords: Type 2 Diabetes Mellitus, Triglycerides, Cardiovascular Disease, B-type natriuretic peptide, Troponin T

INTRODUCTION

Nearly every day, people around the world die or are hurt by heart disease (CVD). People with type 2 diabetes (T2DM) are much more likely to get CVD. Some of the metabolic problems that come with diabetes are insulin resistance, long-term inflammation, and high cholesterol. These make heart problems like cholesterol worse [1,2]. As per Colombo et al. (2018), people with T2DM are more likely to have heart problems if they also have high triglycerides[3]. Having too many fats can often stop arteries, make capillaries not work right, and make the circulatory system swell. In this way, they help us figure out the chance of getting heart disease [4].

Triglycerides are a big part of breaking down energy. When the body has too much triglyceride, it can make LDL particles that are small and thick. These particles are more likely to cause atherosclerosis. This means that people with T2DM and high cholesterol are more likely to have heart issues (Hitsumoto, 2015). People with diabetes are more likely to get heart disease if they eat these fats [5]. Bashir et al. (2019) say we need to learn more about this link to help these people in new ways [6].

It is important for people with type 2 diabetes (T2DM) to get BNP and cTnT tests to find out how likely they are to get heart disease. The ventricles make a lot of BNP when the heart goes up in size or pressure [7]. You can tell if your heart is really sick or not this way. Not so with cTnT. It's only found in heart damage from a cardiac attack. If someone has diabetes and more BNP and cTnT in their blood, they are more likely to die and their blood flow will be worse [2].

People with diabetes are more likely to get heart disease, so it might be a good idea to find out how triglycerides are connected to heart disease signs. These links could help group people who are likely to get heart disease. It would be easier to find people who are at high risk and give them better care [4].

The study's objective is to discover if there exists a connection between the cholesterol levels of people with type 2 diabetes and the heart biomarkers BNP and Troponin T. We can figure out what part triglycerides play in this group of people's risk of heart disease by looking at how these markers are linked [6]. They might be able to learn more about risk and find new ways to treat heart problems linked to T2DM [7].

METHODOLOGY

1. Study Design

Type of Study

The purpose of this prospective observational study was to find out how cholesterol levels, BNP, and Troponin T are connected to heart disease risk in people with T2DM.

Study Groups

The study group was split into three different BMI groups based on standards from the World Health Organization (WHO):

- Normal weight group: BMI 18.5–24.9 (78 participants)
- Overweight group: BMI 25–29.9 (78 participants)
- Obese group: BMI ≥ 30 (78 participants)

It looked at people with BMIs between 46 and 65 years old to see how their blood flow and biomarker levels changed over time.

.

2. Patient Characteristics

Age Range

People aged 46 to 65 took part in the study. Folks in this age group are more likely to have heart problems, so it was chosen.

Gender

The study didn't say for sure how the patients were divided by gender, but it's likely that both male and female patients were included to get a group that is typical of the whole society.

History

The participants in each BMI group were further classified into two subgroups: "control" and "patients." Control subgroups had 26 individuals each, while patient subgroups had 52 individuals each, consisting of those diagnosed with T2DM.

3. Population Study

Sample Size

The total sample size was 234 participants, equally divided into three groups:

- 78 in the normal weight group
- 78 in the overweight group
- 78 in the obese group

Site of Study

The study was conducted at Nineveh General Hospital, in collaboration with the Medical Research Unit of Al-Nahrain University.

Period of Sample Collection

The study data were collected over a six-month period from June to November 2023. This timeframe was sufficient to gather the required data for achieving the study objectives.

4. Inclusion and Exclusion Criteria

Inclusion Criteria

- Participants without T2DM were assigned to the control group.
- All participants had a BMI ≥ 18.5.
- Each participant provided informed consent before participating.

Exclusion Criteria

- Individuals with a BMI < 18.5 were excluded.
- Participants with missing waist or neck circumference measurements were not included.
- Patients who refused to participate were excluded from the study.

5. Physical Examination

BMI

BMI was calculated using the standard formula:

$$\text{BMI} = \frac{body\ weight\ (kg)}{height\ (m)2}$$

6. Sample Collection Procedure

Blood Samples

Needles were used to cleanly take venous blood samples from the participants. In just two hours after these samples were taken, they were put in clean tubes and worked on. Blood samples were chilled to 4°C and spun at 3000 rpm for 15 minutes to separate the serum. The blood was kept at -20°C until we could test it again.

7. Cardiovascular Disease (CVD) Parameters

BNP (B-type Natriuretic Peptide)

The Human BNP ELISA Kit was used to find out how much BNP there was. We used a microtiter plate that had already been coated with an anti-BNP antibody to find everything. Tests were done with a spectrophotometer at 450 nm.

Troponin T

The Human TNT ELISA Kit was used to find out how much troponin T there was. The microtiter plate that came with the kit was first used to put a TROPONIN T antibody on it. It was then done to identify biotin-conjugated antibodies. Spectrophotometers set to 450 nm were used to look at the findings.

8. Ethical Considerations

The people who took part in the study all knew what it was about and agreed to do it. Ethics rules were followed to make sure that the data and people's anonymity were kept safe. The study was okay with the school's ethics review board.

9. Statistical Analysis

Descriptive and inferential statistics were used to analyze the data. The statistical methods included t-tests, ANOVA, and regression analyses to evaluate the relationships between triglycerides, BNP, Troponin T, and cardiovascular risk factors in patients with T2DM. Data were analyzed using SPSS software, and results were presented in tables and graphs for clarity.

RESULTS

The gender distribution among all groups is uniform, with a nearly equal division of males (about 53.8%) and females (46.2%). The equilibrium between control and sick groups within the BMI categories guarantees the minimization of gender bias in the analysis. The BMI values for each category adhere to the anticipated pattern: the normal weight group averages approximately 22 kg/m², the overweight group ranges from 27 to 28 kg/m², and the obesity group surpasses 30 kg/m². This facilitates the categorization of participants into their appropriate weight classifications.

Table 1. correlation between BNP, Troponin T, and Triglyceride levels across control and patient groups in normal weight, overweight, and obesity categories

		Normalweightgroup, n=78		**Overweightgroup, n=78**		**Obesitygroup, n=78**	
		Control , n=26	**Patient , n=52**	**Control , n=26**	**Patient , n=52**	**Control , n=26**	**Patient , n=52**
Gender	**Malen(%)**	14(53,8%)	27(51,9%)	14(53,8%)	27(51,9%)	14(53,8%)	27(51,9%)
	Femalen (%)	12(46,2%)	25(48,1%)	12(46,2%)	25(48,1%)	12(46,2%)	25(48,1%)
BMI (kg/m^2)		22.18±0.35	22.18±0.35	21.7±0.25	27.51±0.29	27.09±0.19	33.35±0.28
BNP (pg/mL)		79.35±1.33	65.69±0.62	78.58±1.37$^{\#}$	48.87±0.77$^{*\#}$	77.15±1.97$^{\#}$	37.54±1.68$^{*\#}$
TROPONINE_T (ng/ml)		0.02±0.011	0.03±0.006	0.03±0.11	0.05±0.01$^{*\#}$	0.03±0.005	0.22±0.20
TG (mg/dl)		116.8±8.94	141.2±17.44	122.4±9.12 $^{*\#}$	148.4±10.33$^{*\#}$	132.2±7.16 $^{*\#}$	175.0±15.91 $^{*\#}$

Note–Results are represented by mean±SE. *p<0,05 compared to the control group with normal weight,$^{\#}$ p<0,05 compared to the patient group with normal weight using a one-way ANOVA and Tukey's post-hoctest

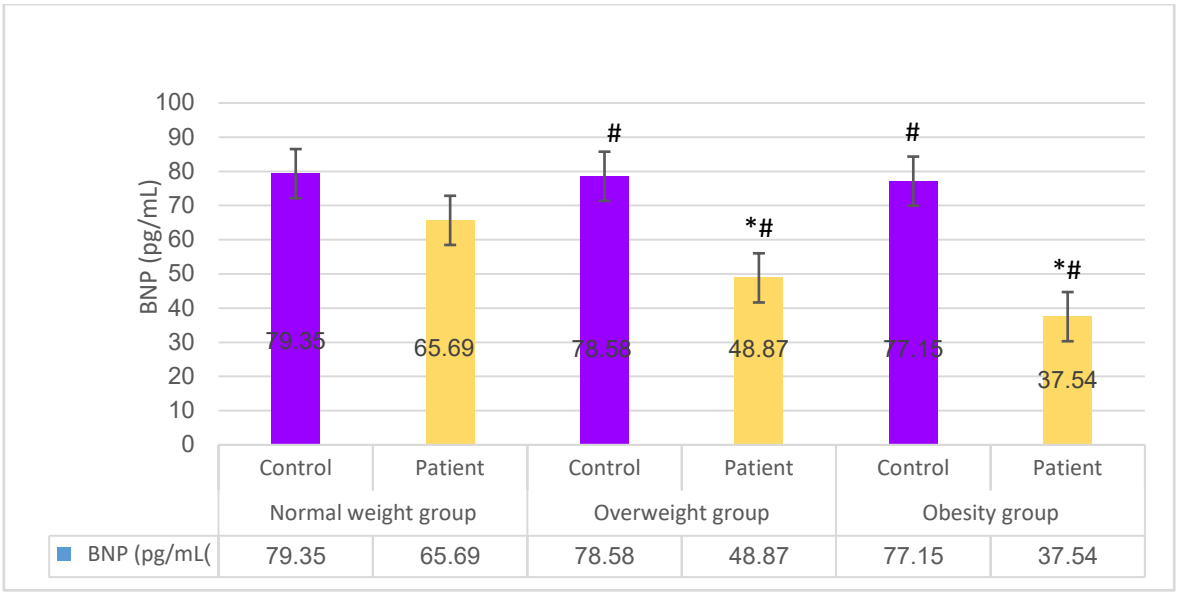

Figure 1. Comparison between BNP levels in the tested groups. Findings are displayed as mean± SE, * p<0,05 compared to the control group with normal weight, # p<0,05 compared to the patient group with normal weight using a one-way ANOVA and Tukey's post-hoc test

In figure 1, table 1, BNP is a substance that can indicate the presence of heart failure. The levels of BNP vary significantly amongst different groups. Patients in the normal weight group have significantly lower BNP levels (65.69 ± 0.62) in comparison to the control group (79.35 ± 1.33). Patients in the overweight group exhibit a notable reduction in BNP levels (48.87 ± 0.77) compared to both normal weight patients and overweight controls (78.58 ± 1.37). The obese group has the most minimal BNP values in patients (37.54 ± 1.68), which are significantly lower compared to the other categories. The observed pattern demonstrates an inverse relationship between BMI and BNP levels in patients, implying a potential escalation in the risk of heart failure with higher body weight.

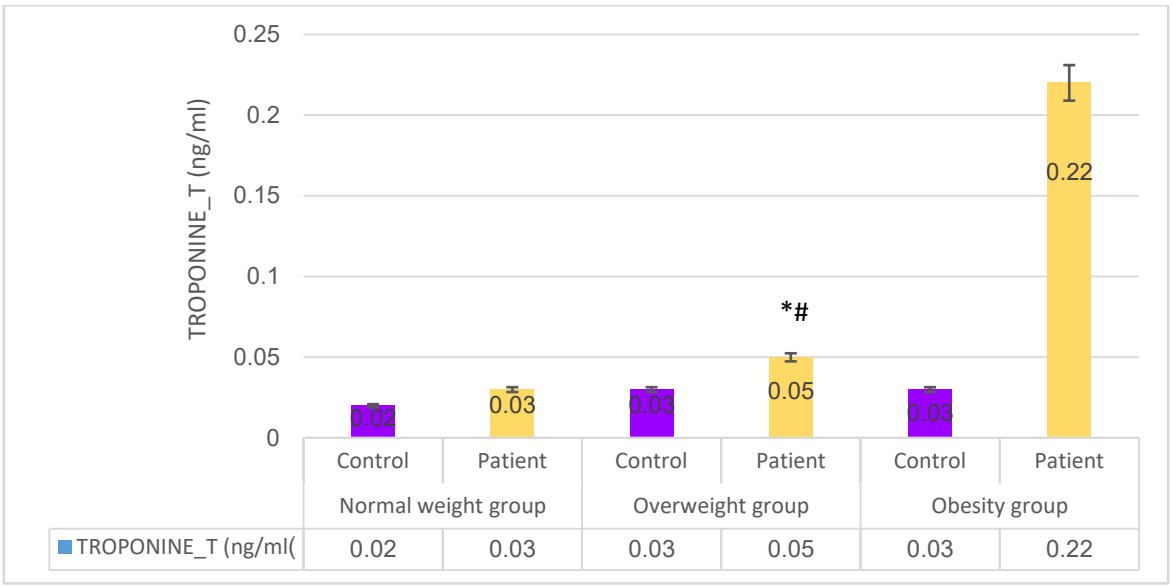

Figure 2. Comparison between Troponin T levels in the tested groups. Findings are displayed as mean± SE, * p<0,05 compared to the control group with normal weight, # p<0,05 compared to the patient group with normal weight using a one-way ANOVA and Tukey's post-hoc test

In figure 2, table 1, Troponin T levels, which are symptomatic of damage to the heart muscle, display intriguing patterns. Both controls and patients in the normal weight group exhibit comparable levels of 0.02 ± 0.011 and 0.03 ± 0.006, respectively. Patients in the overweight group exhibit a small yet noteworthy elevation in Troponin T levels (0.05 ± 0.01) when compared to the patient group with normal weight. The group of

individuals with obesity has the most elevated levels of Troponin T in patients (0.22 ± 0.20), which suggests a heightened likelihood of myocardial injury associated with higher BMI, especially in those who are obese.

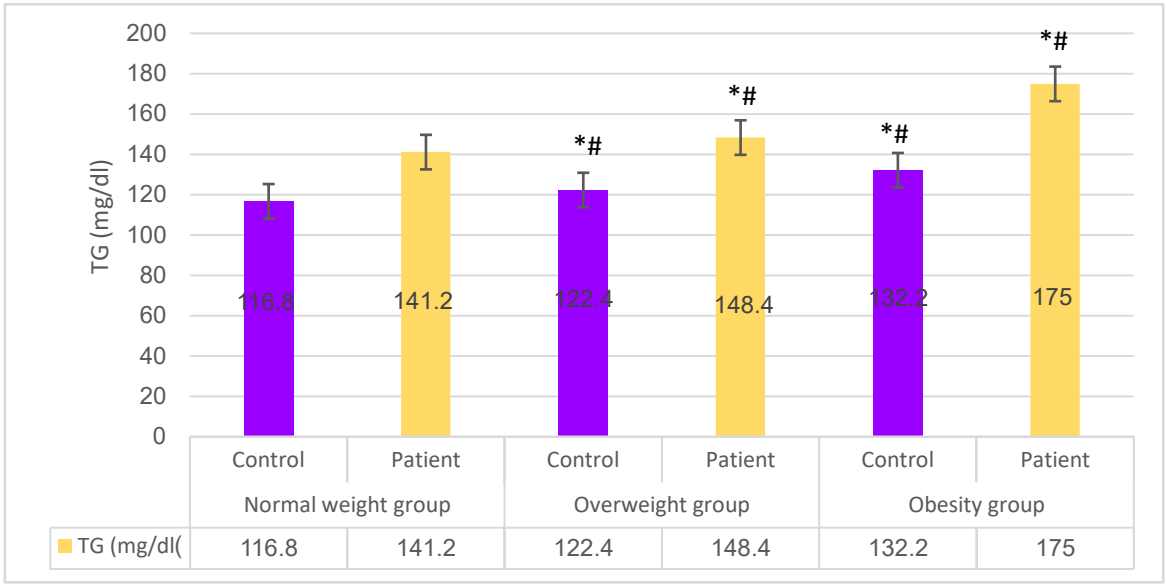

Figure 3. Comparison between TG (mg/dl) values in the tested groups. Findings are displayed as mean± SE, * p<0,05 compared to the control group with normal weight, # p<0,05 compared to the patient group with normal weight using a one-way ANOVA and Tukey's post-hoc test

In figure 3, table 1, triglyceride levels also exhibit substantial variability among the groups. Patients in the normal weight group exhibit elevated triglyceride levels (141.2 ± 17.44) in comparison to the control group (116.8 ± 8.94). Obese people exhibit markedly higher levels of triglycerides (148.4 ± 10.33) compared to both individuals with a healthy weight and overweight individuals without any health issues (122.4 ± 9.12). Obesity patients exhibit the highest triglyceride levels (175.0 ± 15.91), which suggests a greater prevalence of lipid disorders in those with higher BMI.

DISCUSSION

The relationship among biomarkers like BNP, Troponin T, and triglyceride levels concerning BMI categories corresponds with numerous research investigating cardiovascular and metabolic risk in individuals with T2DM. Our study revealed a notable inverse correlation between BNP levels and BMI among patient groups, paralleling the results of Pouresmaeil et al. (2023), who identified increased oxidative stress markers in individuals with T2DM, especially in those with elevated BMI [8]. Research indicates an inverse association between BNP and BMI, particularly within the obese demographic, showing that obesity may diminish BNP secretion despite heightened cardiovascular risk [9,10].

Troponin T levels in our patient cohorts, particularly the notable increase in the obese subgroup (0.22 ± 0.20 ng/ml), signify myocardial injury, supporting research that associates obesity and T2DM with heightened cardiac stress and myocardial [11,12]. This substantiates the notion that oxidative stress, intensified by hyperglycemia and hyperlipidemia, enhances the cardiovascular risk profile of T2DM patients, as outlined in the research by Jaid et al. and Najafi et al. (2021). The damage to the heart got worse because of reactive oxygen species (ROS) and oxidative stress. This made the link between having higher Troponin T levels and having a higher BMI stronger [13,14].

Ahemmed et al. (2021) found that our group of overweight patients had about the same amount of triglycerides (175.0 ± 15.91 mg/dl). Ahammed et al. (2021) discovered that a lot of people with T2DM have dyslipidemia, which means they have too much cholesterol. People with T2DM have insulin resistance, which changes how their bodies use fats[15]. Bawah et al. (2020) and Capurso & Capurso (2012) say that this makes the body store more fat and flush it out less. Triglyceride values are often high in people who are overweight. This means their liver doesn't work as hard as it should and makes too many lipoproteins that are high in triglycerides. This makes getting heart disease more likely [16,17].

It's interesting that being overweight, oxidative stress, and cholesterol metabolism are all linked. Triglyceride and BNP levels go up in overweight people while BNP levels go down. This and T2DM make people more likely to have heart problems, as shown by our study and those from Parsanathan& Jain (2020) and Ahmmed et al. (2021). People who are overweight and have T2DM may need to deal with reactive stress and changes in their cholesterol to lower their risk of heart disease [12,13].

Last but not least, our results and those of other experts show how important it is to keep a person with T2DM's BMI, oxidative stress, and cholesterol levels in check to lower their chance of death and heart disease. Obese or fat people with T2DM may be more likely to get heart disease. If you pay attention to these biological factors and take steps to improve your antioxidant defenses, this chance might go down [17,18].

CONCLUSION

People with type 2 diabetes who have a high body mass index (BMI) are more likely to have blood tests like BNP, Troponin T, and cholesterol. As BMI goes up, so do levels of troponin T and cholesterol. However, levels of BNP go down. Heart problems are more likely to happen to people who are overweight and have a high BMI. Heart disease is more likely to happen to people with type 2 diabetes who have insulin resistance, oxidative stress, or cholesterol levels that don't work right. It's important to understand the confusing link between type 2 diabetes and being overweight or obese, since both are becoming more common. The death and heart disease rates in this group will go down, and people will get better care. People with type 2 diabetes are told to keep their BMI in a healthy range by moving around and eating well. BNP, Troponin T, and cholesterol levels need to be checked often for heart health so that problems can be found quickly. You could also help these people deal with reaction stress and high cholesterol by giving them vitamins and drugs that lower cholesterol.

REFERENCES

1. Bellia, C., Lombardo, M., & Della-Morte, D. (2020). Use of Troponin as a predictor for cardiovascular diseases in patients with type 2 Diabetes Mellitus. *ClinicaChimicaActa*, *507*, 54-61. https://doi.org/10.1016/j.cca.2020.04.011
2. Berezin, A. E., & Berezin, A. A. (2020). Circulating cardiac biomarkers in diabetes mellitus: A new dawn for risk stratification—a narrative review. *Diabetes Therapy*, *11*(6), 1271-1291. https://doi.org/10.1007/s13300-020-00829-9
3. Colombo, M., Looker, H. C., Farran, B., Agakov, F., Brosnan, M. J., Welsh, P., ... & Colhoun, H. M. (2018). Apolipoprotein CIII and N-terminal prohormone b-type natriuretic peptide as independent predictors for cardiovascular disease in type 2 diabetes. *Atherosclerosis*, *274*, 182-190. https://doi.org/10.1016/j.atherosclerosis.2018.05.048
4. Giglio, R. V., Stoian, A. P., Haluzik, M., Pafili, K., Patti, A. M., Rizvi, A. A., ... & Rizzo, M. (2021). Novel molecular markers of cardiovascular disease risk in type 2 diabetes mellitus. Biochimica et BiophysicaActa (BBA)-Molecular Basis of Disease, 1867(8), 166148. https://doi.org/10.1016/j.bbadis.2021.166148
5. Hitsumoto, T. (2015). Factors associated with high-sensitivity cardiac troponin T in patients with type 2 diabetes mellitus. Journal of Nippon Medical School, 82(6), 274-280. https://doi.org/10.1272/jnms.82.274
6. Bashir, A., Azharuddin, M., Rashid, I., Murti, K., & Pandey, K. (2019). Predictors of cardiomyopathy in patients with type-2 diabetes mellitus with and without cardiovascular complications: A cross-sectional study. Diabetes Research and Clinical Practice, 154, 90-100. https://doi.org/10.1016/j.diabres.2019.06.013
7. Hillis, G. S., Welsh, P., Chalmers, J., Perkovic, V., Chow, C. K., Li, Q., ... & Woodward, M. (2014). The relative and combined ability of high-sensitivity cardiac troponin T and N-terminal pro-B-type natriuretic peptide to predict cardiovascular events and death in patients with type 2 diabetes. Diabetes Care, 37(1), 295-303. https://doi.org/10.2337/dc13-1165
8. Pouresmaeil, V., Al Abudi, A. H., Mahimid, A. H., & Sarafraz Yazdi, M. (2023). Evaluation of serum selenium and copper levels with inflammatory cytokines and indices of oxidative stress in type 2 diabetes. Biological Trace Element Research, 201(2), 617-626. https://doi.org/10.1007/s12011-022-03380-w
9. Parsanathan, R., & Jain, S. K. (2020). Novel invasive and noninvasive cardiac-specific biomarkers in obesity and cardiovascular diseases. Cardiovascular Pharmacology, 18(1), 10-30. https://doi.org/10.2174/1871525419666200724112403
10. Kozhuharov, N., Martin, J., Wussler, D., Lopez-Ayala, P., Belkin, M., Strebel, I., & Mueller, C. (2022). Clinical effect of obesity on N-terminal pro-B-type natriuretic peptide cut-off concentrations for the diagnosis of acute heart failure. European Journal of Heart Failure, 24(9), 1545-1554. https://doi.org/10.1002/ejhf.2545
11. Andreadi, A., Bellia, A., Di Daniele, N., Meloni, M., Lauro, R., & Della-Morte, D. (2022). The molecular link between oxidative stress, insulin resistance, and type 2 diabetes: A target for new therapies against cardiovascular diseases. Current Opinion in Pharmacology, 62, 85-96. https://doi.org/10.1016/j.coph.2022.03.006
12. Khalid Jaid, H., Muqdad Khaleel, F., Noori Salman, I., & Ahmed Abd, B. J. (2022). Evaluation of insulin resistance and glutathione-S-transferase in Iraqi patients with type 2 diabetes mellitus and diabetic peripheral neuropathy. Journal of Intellectual Property and Human Rights, 3(3), 129-136.

13. Najafi, A., Pourfarzam, M., &Zadhoush, F. (2021). Oxidant/antioxidant status in type-2 diabetes mellitus patients with metabolic syndrome. Journal of Research in Medical Sciences, 26, 6. https://doi.org/10.4103/jrms.JRMS_688_20
14. Checa, J., & Aran, J. M. (2020). Reactive oxygen species: Drivers of physiological and pathological processes. Journal of Inflammation Research, 13, 1057-1073. https://doi.org/10.2147/JIR.S275595
15. Ahmmed, M. S., Shuvo, S. D., Paul, D. K., Karim, M. R., Kamruzzaman, M., & Mahmud, N. (2021). Prevalence of dyslipidemia and associated risk factors among newly diagnosed type-2 diabetes mellitus (T2DM) patients in Kushtia, Bangladesh. PLOS Global Public Health, 1(12), e0000003. https://doi.org/10.1371/journal.pgph.0000003
16. Bawah, A. T., Darko, R., Abaka-Yawson, A., Seini, M. M., &Kinanyok, S. (2020). Dyslipidemia and its associated factors in patients with type 2 diabetes mellitus. Journal of Public Health, 29, 985-991. https://doi.org/10.1007/s10389-020-01284-5
17. Capurso, C., & Capurso, A. (2012). From excess adiposity to insulin resistance: The role of free fatty acids. Vascular Pharmacology, 57(2-4), 91-97. https://doi.org/10.1016/j.vph.2012.05.004
18. Bhatti, J. S., Sehrawat, A., Mishra, J., Sidhu, I. S., Navik, U., Khullar, N., & Singh, R. (2022). Oxidative stress in the pathophysiology of type 2 diabetes and related complications: Current therapeutics strategies and future perspectives. Free Radical Biology and Medicine, 184, 114-134. https://doi.org/10.1016/j.freeradbiomed.2022.02.002