

## Evaluation of Biochemical Parameters among Diabetes Patients and Healthy Participants in a Nigerian Tertiary Hospital

Yashim N<sup>1</sup>, Obazee D.Y.<sup>3</sup>, Ogbe O.P.<sup>2</sup>, Ajobiewe H. F.<sup>6</sup>, Ajobiewe J.O.<sup>5\*</sup>, Dah T.Y.<sup>4</sup>, Oyetunde B. A.<sup>1</sup>, Vamparious M.T.<sup>2</sup>, Dangana A.<sup>7</sup>, Ogunkoya O.F.<sup>1</sup>

<sup>1</sup>Department of Medical Laboratory Science Baze University Abuja Nigeria

<sup>2</sup>Haematology and Blood Transfusion Department National Hospital Abuja, Nigeria

<sup>3</sup>Medical Laboratory Services Department Nile University Teaching Hospital Abuja

<sup>4</sup>Department of Obstetrics and Gynaecology Federal Medical Centre Keffi, Nasarawa State of Nigeria

<sup>5</sup>Department of Microbiology and Parasitology National Hospital Abuja, Nigeria

<sup>6</sup>Department of Biological Sciences Bingham University New Karu Nasarawa State of Nigeria

<sup>7</sup>University of Abuja Teaching Hospital Gwagwalada Abuja, F.C.T. Nigeria

DOI: [10.36347/sjams.2022.v10i10.035](https://doi.org/10.36347/sjams.2022.v10i10.035)

| Received: 14.09.2022 | Accepted: 21.10.2022 | Published: 29.10.2022

\*Corresponding author: Ajobiewe J.O

Department of Microbiology and Parasitology, National Hospital, Abuja, Nigeria

### Abstract

### Original Research Article

**Background:** Diabetes mellitus (DM) burden is one of the key concerns in developing countries like Nigeria. This study aimed to evaluate the biochemical parameters among diabetes patients and healthy persons in Abuja, Nigeria.

**Methodology:** The study was a cross-sectional prospective study that included 60 DM patients (case) and 48 healthy individuals (control) aged 19 to 80 years from April 1 and June 30, 2018. Five ml of venous fasting blood samples were obtained under aseptic precautions and biochemical parameters were evaluated: fasting blood glucose (FBS) and liver enzymes were determined using Bio systems; A 25 fully automated biochemistry analyzer while hemoglobin A1c (HbA1c) was estimated by High-performance liquid chromatography (HPLC) method. Data analysis was performed using IBM SPSS version 25 and a value of  $P < 0.05$  was taken as statistically significant. **Results:** Mean FBS, HbA1c, AST, ALT, and LDH were significantly higher in DM than control ( $P < 0.05$ ). Mean values of FBS and HbA1c in DM were 9.00mg/dl and 5.99% respectively while liver enzymes; ALT and AST and ALP were 25.77U/L, 28.87U/L, and 214.35U/L respectively. The mean values of cardiac enzymes; LDH and CK-MB normal were 438.87U/L and 75.47U/L respectively. The mean values of HbA1c, AST, ALT, ALP, LDH and CK-MB were higher than normal range in 48.3%, 16.0%, 15.0%, 23.3%, 26.6%, and 36.6% DM respectively. **Conclusion:** Thus these liver enzymes can be used as a biomarker for the assessment of diabetes. With a thorough study about the level of liver enzymes, it is possible to monitor complications of diabetes.

**Keywords:** Diabetes mellitus, Aspartate Aminotransferase, Alanine Aminotransferase, Lactate dehydrogenase, alkaline phosphatase.

Copyright © 2022 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY-NC 4.0) which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.

## INTRODUCTION

Diabetes mellitus (DM), also referred to as diabetes, is a category of metabolic conditions in which blood sugar levels are elevated over a long period [1]. Symptoms of diabetes include; constant hunger and thirsty, hunger, weight loss, vision alterations, tiredness, weakness and frequent urination [1, 2]. If not treated, diabetics can result in acute complications such as diabetic ketoacidosis and non-ketotic hyperosmolar coma, stroke, liver injury, and fatty liver diseases [3]. Diabetes is most often caused by lack of insulin or a defect of the body's insulin receptor [1].

The morbidity and mortality of patients with type II diabetes have been significantly associated with liver disease [3-5]. The roles of the liver are significant during fasting and post-prandial cycles in the management of glucose homeostasis [6, 7]. Liver disease also causes abnormal liver enzymes in type II diabetic patients, especially chronic transaminase elevation [6-8]. Alanine transaminase (ALT) and aspartate transaminase (AST) elevation are also hepatic injury indicators, and serum gamma-glutamyl transferase (GGT) is a stable hepatic fat accumulation marker that can contribute to resistance to hepatic insulin and long-term resistance to hepatic insulin can lead to type II diabetes mellitus [9]. In a study

**Citation:** Yashim N, Obazee D.Y., Ogbe O.P, Ajobiewe H. F., Ajobiewe J.O., Dah T.Y., Oyetunde B. A., Vamparious M.T., Dangana A.7, Ogunkoya O.F. Evaluation of Biochemical Parameters among Diabetes Patients and Healthy Participants in a Nigerian Tertiary Hospital. Sch J App Med Sci, 2022 Oct 10(10): 1785-1789.

performed by Kashinakunti *et al.*, (2017), [6] the liver enzymes AST, ALT and ALP were found to be substantially elevated relative to controls in Type II DM patients.

In clinical practices, liver function tests (LFTs) are usually employed to study the advancement of known diseases and the effects of potentially hepatotoxic drugs [10]. Some of the LFTs are Aminotransferases; alanine aminotransferase (ALT) and (AST) which represents a marker of hepatocyte injury while alkaline phosphatase (ALP) and  $\gamma$ -glutamyl transferase ( $\gamma$ -GT) are markers of biliary function and cholestasis [10, 11]. This study was primarily aimed at evaluating the biochemical parameters among diabetes patients and healthy persons in Abuja, Nigeria.

## MATERIAL AND METHODS

This was a cross-sectional prospective study and included diabetic patients who have been confirmed to be having the disease and a control group (apparently healthy individuals who are not suffering from diabetes.) The study was carried out between April 1 and June 30, 2018. The study area was the University of Abuja Teaching Hospital. Abuja is the capital city of Nigeria. It is located in the center latitude 90° 4' 0" N 7° 29' 0" E of Nigeria. Based on the 2006 census, the population of Abuja was estimated 776,298 [12] which puts Abuja among the top ten cities with highest population in Nigeria. . There were 108 participants randomly selected for inclusion into this study which comprised of two groups. Group 1 (control group) consists of 48 healthy, non-diabetic patients who have met the inclusion criteria. Group 2 (test group) consisted of 60 patients who were diagnosed as having

Diabetes mellitus. A proportional representative sample of both male and female participants and of all age groups was selected in each study group. The sample size was calculated using an average population size of 500 patient attending clinics in UATH with an expected frequency of 10%, confidence limit of 5% and a cluster/design effect of 1.0. (Epi Info software was used). In Laboratory analysis; Five ml of venous fasting blood samples were obtained under aseptic precautions and biochemical parameters were evaluated: fasting blood glucose (FBS) and liver enzymes were determined using Bio systems; A 25 fully automated biochemistry analyzer while Hemoglobin A<sub>1c</sub> (HbA<sub>1c</sub>) was estimated by High-performance liquid chromatography (HPLC) method. All statistical analyses were performed using IBM SPSS version 25 and a value of  $P < 0.05$  was taken to indicate statistical significance. Results were presented as means  $\pm$  standard deviation (SD) or percentages for categorical variables according to diabetes.

## RESULT

A total of 108 with 60 (55.6%) confirmed diabetic patients and 48 (44.4%) non-diabetic controls were enrolled in this study. The minimum and maximum age of diabetic patients were 22 and 80 years. There were 38 (35.2%) males and 70 (64.8%) females. Among DM patients, mean values of FBS and HbA<sub>1c</sub> were estimated as 9.00 mg/dl and 5.99% respectively while the mean values of liver enzymes; ALT and AST and ALP were 25.77 U/L, 28.87 U/L and 214.35 U/L respectively. Moreover, cardiac enzymes; LDH and CK-MB were also estimated for DM patients and the mean values were 438.87 U/L and 75.47 U/L respectively (Table1).

**Table 1: Mean value of biochemical parameters among diabetes patients**

Variable (n=60)	Mean $\pm$ SD	Normal range	Number outside the normal range
<b>FBS (mg/dl)</b>	9.00 $\pm$ 4.69	3.8 - 6.4	33(55.0%)
<b>HBA<sub>1c</sub> (%)</b>	5.99 $\pm$ 1.39	<6	29(48.3%)
<b>AST (U/L)</b>	28.87 $\pm$ 12.45	<40	10(16.0%)
<b>ALT(U/L)</b>	25.77 $\pm$ 12.49	<40	9(15.0%)
<b>ALP(U/L)</b>	214.35 $\pm$ 99.84	M(<270) F(<240)	14(23.3%)
<b>LDH (U/L)</b>	438.87 $\pm$ 312.36	230 - 460	16 (26.6%)
<b>CK-MB (U/L)</b>	75.47 $\pm$ 68.24	M(<80) F(<70)	22 (36.6%)

FBS = Fasting Blood Sugar, HbA<sub>1c</sub> = Glycosylated haemoglobin, AST = Aspartate Transaminase, ALT = Alanine Transaminase, ALP = Alkaline Phosphatase, LDH = Lactate Dehydrogenase, CK-MB = Cretine Kinase; M = male and F = female

There were 26 male and 34 female diabetic patients with a mean age of 49.7 and 27.5 years for diabetic and non-diabetic patients respectively. The mean age of diabetic patients was significantly higher than the mean age of non- diabetic patients. Five of 60

diabetic patients were CRP positive while there was no CRP positive among non-diabetic patients. The mean values of FBS, HbA<sub>1c</sub>, AST, ALT, ALP, LDH, and CK-MB were significantly ( $p < 0.05$ ) higher among diabetic patients than the control (Table 2).

**Table 2: Demographics, Inflammatory marker, Liver and Cardiac enzyme profiles in DM patients and healthy controls**

Variable	Diabetes (n=60)	Non-diabetes (n=48)	P-value
Sex (Male/Female)	26/34	12/36	0.047*
FBS (mg/dl)	9.00 ± 4.69	4.11±0.55	0.000*
AST (U/L)	28.87±12.45	<40	10(16.0%)
ALT(U/L)	25.77±12.49	<40	9(15.0%)
ALP(U/L)	214.35±99.84	M(<270) F(<240)	14(23.3%)
LDH (U/L)	438.87±312.36	230 - 460	16 (26.6%)
CK-MB (U/L)	75.47±68.24	M(<80) F(<70)	22 (36.6%)
HBA <sub>1c</sub> (%)	5.99 ± 1.39	4.71 ± 0.76	0.000*
AST (U/L)	28.87±12.45	23.06±7.00	0.005*
ALT(U/L)	25.77±12.49	15.56±8.26	0.000*
ALP(U/L)	214.35±99.84	177.13±38.58	0.016*
LDH(U/L)	438.87±312.36	338.38±70.36	0.031
CK-MB(U/L)	75.47±68.24	68.81±15.02	0.509
CRP (Positive/Negative)	5/55	0/48	0.041*

The level of biochemical parameters in Normal individuals and Diabetic patients, values are expressed as Mean Standard Deviation.

## DISCUSSION

FBS, HBA<sub>1c</sub>, liver enzymes, cardiac enzymes and Co-creative protein) were estimated for both diabetic patients and control-non-diabetic people in this study. Although the overall mean values of HBA<sub>1c</sub>, AST, ALT, ALP, LDH, and CK-MB were within the normal range among diabetic patients, yet, 55.0% had FBS values above the normal range.

Also, the proportion of diabetic patients that had above normal range of HBA<sub>1c</sub>, AST, ALT, ALP, LDH and CK-MB, were 48.3%, 16.0%, 15.0%, 23.3%, 26.6%, and 36.6% respectively.

The mean values of FBS, HBA<sub>1c</sub>, liver enzymes as well as cardiac enzymes were also significantly higher in DM patients than in normal participants ( $P < 0.050$  except CK-MB which was not statistically significantly higher in DM patients than in normal participants ( $P > 0.050$ ). This is in agreement with literature Habte *et al.*, 2020 [13]; Lodgotra *et al.*, 2016 [14]; Wang *et al.*, 2016 [15]. Higher incidence of abnormal liver enzymes have been associated with Diabetes patients (type II) and elevated ALT being the most common abnormality as noted and documented earlier by the following authors Ahn *et al.*, 2014 [16]; Ghimire *et al.*, 2018 [3]; Habte *et al.*, 2020 [13]; Harris, 2005 [8]; Kashinakunti *et al.*, 2017 [6]. The overall mean values of all biochemical parameters were within the normal range, however, elevated values of FBS, HBA<sub>1c</sub>, AST, ALT, ALP, LDH and CK-MB were observed in 15.0% to 55.0% of the patients. This is similar to what was observed in an over four years cohort study of 959 diabetic patients in the United Kingdom, 15.7% had raised ALT, 10.4% had elevated alkaline phosphatase whereas only 3.9% had

hyperbilirubinemia (Gonem *et al.*, 2007) [10]. A similar study conducted to evaluate abnormal liver function tests in diabetes patients in Myanmar, Malaysia reported a raised value of ALT and AST in 18.5% and 14.8% diabetic patients even though the overall mean values were within the normal range (Ni *et al.*, 2012) [17].

In a similar study by Idris *et al.*, (2011) [18], 22% of the diabetic patients had at least one abnormal liver function test. In Nepales, raised ALT and AST were reported in (57%) and (46%) diabetic patients respectively (Ghimire *et al.*, 2018). Abnormal liver enzymes in diabetes patients can be attributed to several factors, the most common cause being non-alcoholic fatty liver disease (NAFLD) associated with insulin resistance and metabolic syndrome in diabetes (Hall *et al.*, 2012) [11]. Studies have also been associated between diabetes and hepatitis C virus infection that causes deranged liver enzymes (Mandal *et al.*, 2018 [4]; Nazer *et al.*, 2018 [19]; Shibabaw *et al.*, 2019) [7]. Though relatively infrequent, statin therapy can also contribute to abnormal liver enzymes (Harris, 2005) [8].

The fasting blood glucose(FBS), HbA<sub>1c</sub>, AST, ALT ALP and LDH and were raised significantly in diabetes mellitus patients compared to healthy controls ( $P < 0.05$ ), CK-MB also increased in DM cases than in controls but it was not statistically significant ( $P = 0.509$ ). According to a study in Sudan by Idris *et al.*, (2011) [18] where 50 diabetes patients and 30 normal control subjects were tested for liver function, the means of ALT, AST, total protein and albumin were reported to be significantly higher among diabetes compared to the control but in this study, only ALT showed statistically significant difference whereas AST was not. In the study by Kashinakunti *et al.*, (2017) [6], there was a significant rise in liver enzymes except for ALP, which also increased but it was not statistically significant ( $P = 0.236$ ).

In this study, a significant increase in ALP was observed among DM patients. Philip *et al.*, (2014) [9] in their study showed a significant increase in AST and ALT ( $P < 0.01$ ) as compared to healthy controls, findings of the present study were also similar. Agrawal (2015) [20] in North India, reported serum levels of AST, ALT and ALP and all were significantly elevated in diabetes mellitus patients as compared to controls ( $P < 0.05$ ). In the study of Ahmed (2015) [21], it was demonstrated that the levels of LDH and CK enzymes were highest in the study DM compared with control. All these findings earlier documented were authentically confirmed by our current findings.

## CONCLUSION

This study found that the mean values of FBS, HBA<sub>1c</sub>, AST, ALT, ALP and LDH were found to be significantly higher in diabetic patients when compared to the normal patients. Thorough checking of liver enzymes, ALT and AST and LDH, is advocated to screen the possibility of underlying fatty liver, which might need further evaluation and early intervention to prevent from progression into cirrhosis and chronic liver disease. Routine analysis of liver enzymes can help in early detection of liver injury and cardiovascular accident in diabetes mellitus patients. Timely diagnosis and management of the abnormal liver parameters may help to minimize liver-related morbidity and mortality in the diabetic population.

## REFERENCES

1. WHO. (2016). Global Report on Diabetes. ISBN, 978, 6-86. [http://www.who.int/about/licensing/copyrightform/index.html%0Ahttp://www.who.int/about/licensing/copyright\\_fonn/index.html%0Ahttps://apps.who.int/iris/handle/10665/204871%0Ahttp://www.who.int/about/licensing/](http://www.who.int/about/licensing/copyrightform/index.html%0Ahttp://www.who.int/about/licensing/copyright_fonn/index.html%0Ahttps://apps.who.int/iris/handle/10665/204871%0Ahttp://www.who.int/about/licensing/)
2. Kilmer, P. D. (2010). Evaluation of Biochemical Parameters and Trace Elements in Type-2 Diabetic Patients. *Journalism: Theory, Practice & Criticism*, 11(3), 369-373. <https://doi.org/10.1177/1461444810365020>
3. Ghimire, S., Shakya, S., Shakya, J., Acharya, P., & Pardhe, B. D. (2018). Abnormal Liver Parameters among Individuals with Type 2 Diabetes Mellitus Nepalese Population. *Biochemistry & Pharmacology: Open Access*, 7(1), 1-5. <https://doi.org/10.4172/2167-0501.1000243>
4. Mandal, A., Bhattarai, B., Kafle, P., Khalid, M., Jonnadula, S. K., Lamichane, J., Kanth, R., & Gayam, V. (2018). Elevated Liver Enzymes in Patients with Type 2 Diabetes Mellitus and Non-alcoholic Fatty Liver Disease. *Cureus*, 92(Ci). <https://doi.org/10.7759/cureus.3626>
5. Polat, S. B., Ugurlu, N., Aslan, N., Cuhaci, N., Ersoy, R., & Cakir, B. (2016). Evaluation of biochemical and clinical markers of endothelial dysfunction and their correlation with urinary albumin excretion in patients with type 1 diabetes mellitus. *Archives of Endocrinology and Metabolism*, 60(2), 117-124. <https://doi.org/10.1590/2359-399700000116>
6. Kashinakunti, S. V., Rangappa, M., & Kallaganada, G. S. (2017). Correlation between liver enzymes and lipid profile in type II diabetes mellitus. *IOSR Journal of Biotechnology and Biochemistry*, 3(5), 1-5. <https://doi.org/10.9790/264X-03050105>
7. Shibabaw, T., Dessie, G., Molla, M. D., Zerihun, M. F., & Ayelign, B. (2019). Assessment of liver marker enzymes and its association with type 2 diabetes mellitus in Northwest Ethiopia. *BMC Research Notes*, 12(1), 1-5. <https://doi.org/10.1186/s13104-019-4742-x>
8. Harris, E. H. (2005). Elevated liver function tests in type 2 diabetes. *Clinical Diabetes*, 23(3), 115-119. <https://doi.org/10.2337/diaclin.23.3.115>
9. Philip, R., Mathias, M., Kumari, S.N., Gowda, D.K. and Shetty, J.K. (2014). Evaluation of Relationship between Markers of Liver Function and the Onset of Type 2 Diabetes. *Journal of Health and Allied Sciences NU*, 04(02), 090-093. <https://doi.org/10.1055/s-0040-1703770>
10. Legesse, M. (2018). Comparison of Lipid Profile, Liver Enzymes, Creatine Kinase and Lactate Dehydrogenase of T2DM Patients who were on Statin Attending Diabetic Clinic of Tikur Anbesa Specialized Hospital. <https://doi.org/10.32964/tj17.05>
11. Hall, P., & Cash, J. (2012). What is the real function of the Liver "Function" tests? *Ulster Medical Journal*, 81(1), 30-36.
12. Eme, O. I., & Idike, A. (2015). Census Politics in Nigeria : An Examination of 2006 Population Census. *Journal of Policy and Development Studies*, 9(3), 47-72. <https://doi.org/10.12816/0011166>
13. Habte, M. L., Melka, D. S., Dedef, M., Menon, M. K. C., Yifter, H., & Feyisa, T. O. (2020). Comparison of lipid profile, liver enzymes, creatine kinase and lactate dehydrogenase among type ii diabetes mellitus patients on statin therapy. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy*, 13, 763-773. <https://doi.org/10.2147/DMSO.S234382>
14. Lodgotra, A., Verma, P., & Raj, S. S. (2016). Estimation of salivary and serum biomarkers in diabetic and non diabetic patients - A comparative study. *Journal of Clinical and Diagnostic Research*, 10(6), ZC56-ZC61. <https://doi.org/10.7860/JCDR/2016/19135.7995>
15. Wang, Y. L., Koh, W. P., Yuan, J. M., & Pan, A. (2016). Association between liver enzymes and incident type 2 diabetes in Singapore Chinese men and women. *BMJ Open Diabetes Research and Care*, 4(1), 2-9. <https://doi.org/10.1136/bmjdr-2016-000296>

16. Ahn, H. R., Shin, M. H., Nam, H. S., Park, K. S., Lee, Y. H., Jeong, S. K., Choi, J. S., & Kweon, S. S. (2014). The association between liver enzymes and risk of type 2 diabetes: The Namwon study. *Diabetology and Metabolic Syndrome*, 6(1), 1-8. <https://doi.org/10.1186/1758-5996-6-14>
17. Ni, H., Htoo Kyaw Soe, H., & Htet, A. (2012). Determinants of Abnormal Liver Function Tests in Diabetes Patients in Myanmar. *International Journal of Diabetes-Research*, 1(3), 36-41. <https://doi.org/10.5923/j.diabetes.20120103.02>
18. Idris, A. S., Faisal, K., Mekky, H., Eldin, B., Abdalla, E., & Ali, K. A. (2011). Liver function tests in type 2 Sudanese diabetic patients. *International Journal of Nutrition and Metabolism*, 3(2), 17-21.
19. Nazer, R. I., Abal Hassan, M. F., & Alburikan, K. A. (2018). Liver enzyme trends in patients taking uninterrupted metformin before and after coronary surgery. *Cardiovascular Diagnosis and Therapy*, 8(4), 469-479. <https://doi.org/10.21037/cdt.2018.05.04>
20. Agrawal, J. (2015). Prevalence of elevated hepatic enzymes among North Indian patients with type 2 diabetes mellitus. *Santosh University Journal of Health Sciences*, 1(1), 3-6.
21. Ahmed, M. A. A. (2015). Correlation between Salivary Enzymes Levels CK and LDH with Severity of Chronic Periodontitis among Type 2 Diabetic Patients. *IOSR Journal of Dental and Medical Sciences*, 14(3), 2279-2861. [www.iosrjournals.org](http://www.iosrjournals.org)