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ASSESSMENT THE LIPID PROFILES AND CERTAIN ELECTROLYTE SERUM LEVELS IN PEOPLE WITH TYPE 2 DIABETES MELLITUS

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Abstract

The current study aimed to estimate the levels of lipid profile and some electrolytes in the blood serum of a group of patients with type 2 diabetes mellitus (T2DM). In this study, 100 blood samples were collected and divided into two groups, one consisting of 70 samples from people with type 2 diabetes and the other consisting of 30 samples from healthy people considered a control group. The ages of the people ranged from 25 to 70 years . An estimate of glucose levels and lipid profile concentrations (total cholesterol, triglycerides, high-density lipoproteins for cholesterol, low-density lipoproteins for cholesterol, and very low intensity lipoproteins), and estimating the levels of some electrolytes (magnesium, potassium, and calcium). The results showed a very significant increase (P value < 0.0001) in the levels of glucose, total cholesterol, triglycerides, low-density lipoproteins (LDL), and very low-density lipoproteins (VLDL) in people with type 2 diabetes mellitus when compared with the control group. The results also showed a significant decrease (P value < 0.0001) in the average concentration of high-density lipoproteins (HDL) in people with type 2 diabetes mellitus when compared with the control group. The results also showed a significant decrease (P value < 0.0001) in the levels of potassium and magnesium concentrations, and a significant increase (P value = 0.001) was observed in the levels of calcium concentrations when compared with the control group.

Keywords: *Type 2 Diabetes Mellitus, Lipoproteins, Electrolytes, Lipid profiles*

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Introduction

Diabetes mellitus is a condition in which there is insufficient blood insulin because of a malfunction in the secretion of insulin, its function, or both. This results in abnormalities in the metabolism of carbohydrates, lipids, and proteins. This is what causes high blood sugar, and as a result, sugar is excreted in the urine (1). Diabetes is one of the most common chronic diseases because it affects children, young people, and the elderly alike, but its percentage in the elderly is higher than it is in the young (2). It is associated with increased blood fat and other factors such as obesity and high blood pressure and the resulting metabolic disorders, including protein metabolism (3). Due to the seriousness of its complications, which may develop into threatening diseases

such as heart disease, vascular disease, and kidney disease, it has become obligatory for researchers to pay attention to it as it is one of the most widespread diseases (4).

There are two primary forms of diabetes: type 1 diabetes is an autoimmune condition where the immune system assaults and kills insulin-producing cells in the pancreas by accident. People with type 1 diabetes need insulin injections or an insulin pump to manage their blood sugar levels (5,6) and diabetes type 2: This is the most prevalent kind of disease. This happens when the body stops producing enough insulin to keep blood sugar levels within normal ranges or becomes resistant to insulin (7).Insulin injections, oral medicines, and lifestyle modifications are frequently used to treat type 2 diabetes. (8). Another form of diabetes is called gestational diabetes, which normally disappears after delivery and develops throughout pregnancy (9). On the other hand, type 2 diabetes is more likely to strike women who have experienced gestational diabetes in the future (10).

Numerous physiological functions require electrolytes, such as calcium, magnesium, and potassium. For healthy bones, muscle contraction, and neuron function, calcium is essential. Maintaining appropriate muscular contraction, fluid balance, and cardiac rhythm all depend on potassium (11). The synthesis of energy, blood pressure regulation, and nerve and muscle function are all impacted by magnesium (12). Electrolyte imbalances can cause signs and consequences such as cramping, weakening in the muscles, and abnormal heart rhythms (13). Maintaining a balanced intake of these electrolytes is crucial and should be achieved with a nutritious diet and, if needed, supplementation under medical supervision (14). The purpose of this study is to assess the risk of type 2 diabetes mellitus based on the lipid profile and blood levels of several electrolytes, including potassium, magnesium, and calcium.

Methods

In this study, 100 blood samples were collected and individed into two groups, the first group contained 70 samples from people with type 2 diabetes, and the second group contained 30 samples from apparently healthy people, and they were considered a control group. The ages of the people in the two groups ranged from 25 to 70 years old.

Sample collecting

In this study, 5 ml of venous blood was collected from two groups, and then the serum was separated after clot shrinkage by centrifugation at 3000 rpm for 5 minutes at room temperature. The supernatant serum was collected with a micropipette. Then the following tests were conducted on her: The blood glucose level was estimated by the enzymatic method using a test kit from Biocompany Germany, while the levels of total cholesterol, triglycerides, and high-density lipoprotein cholesterol in blood serum were estimated using the enzymatic method using an analysis kit from (Syrbio, Syria). The level of very low-density lipoprotein cholesterol was estimated using the following equation [(15)]:

VLDL (mmo\L) = TG / 2.22

The level of low-density lipoprotein cholesterol was estimated using the following equation [16]:

LDL = Total cholesterol - (VLDL + HDL)

Electrolyte levels in blood serum were estimated by using a spectrophotometer [16].

Statistical Analysis

The SPSS software, version 23, was used to statistically evaluate the results, where the arithmetic mean and standard deviation (mean±SD) for the two groups were calculated and compared between them using the "Independent sample T test".

Result and Disscusion

The results in figure 1 showed a significant increase (P<0.0001) in the glucose concentration in people with type 2 diabetes compared to the control group. The average glucose concentration in the patients' blood serum reached 236.55±47.76, while in the control group the concentration was 98.66±14.61, and these results are consistent with the results reached by the researcher [17], where they showed that the reason for the high blood sugar is the body's inability to use insulin effectively or to produce an insufficient amount of insulin, while the researcher [18] explained that the reason for the high blood glucose in people with type 2 diabetes is insulin resistance, where the body's cells become less responsive to insulin and insulin production from the pancreas is weak. Other factors, such as obesity, a sedentary lifestyle, and genetic predisposition, can contribute to high glucose levels in patients with type 2 diabetes [19].

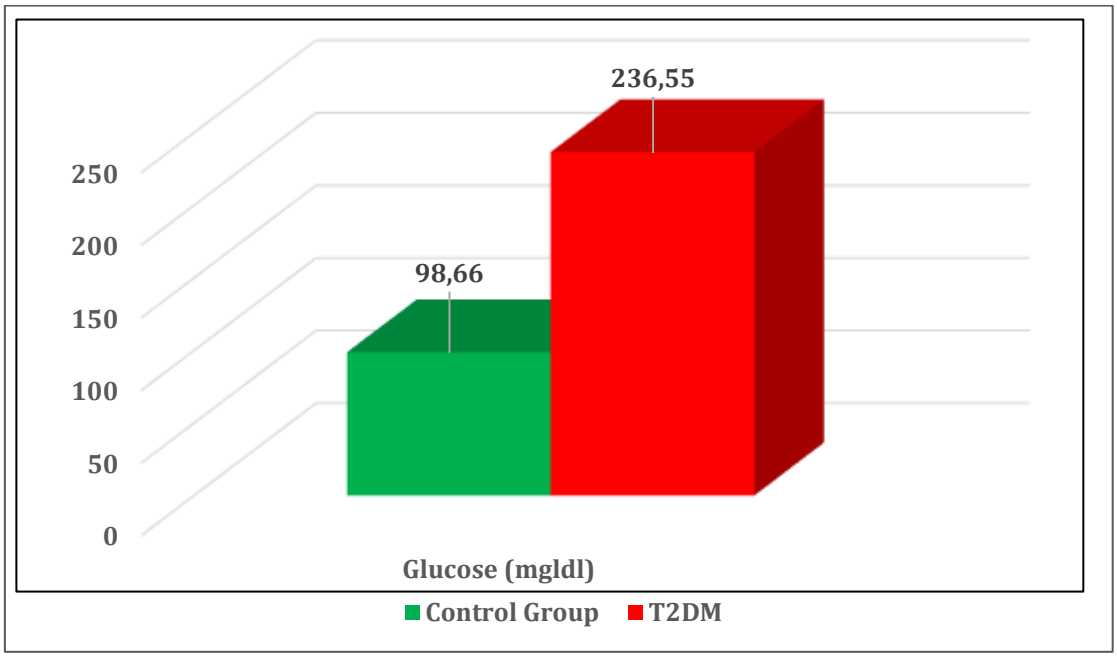

Figure (1): The mean glucose level in two groups: patients with type 2 diabetes mellitus and control patients.

Table (1): The mean lipid profiles level in two groups: patients with type 2 diabetes mellitus and control patients.

parameters	Control group mean±SD	Paitent with DM2 mean±SD	P-value
Total Cholesterol (mg/dl)	151.98±4.34	181.89±16.19	P<0.0001
Triglyceride (mg/dl)	129.59±8.76	245.71±36.69	P<0.0001
HDL (mg/dl)	51.31±6.01	33.66 ± 3.98	P<0.0001
LDL (mg/dl)	82.61±9.21	246.34±61.21	P<0.0001
VLDL (mg/dl)	24. 67±3.19	59. 57±8.21	P<0.0001

The results are also shown in Table 1: a very significant increase (P<0.0001) in the level of total cholesterol concentration in people with type 2 diabetes compared to the control group. These results agree with researchers [20]. The reason for the high total cholesterol in people with diabetes is attributed to Type 2 diabetes, which is primarily caused by a combination of insulin resistance, dyslipidemia, and other metabolic disorders common to diabetes. Insulin resistance leads to increased production of low-density lipoprotein (VLDL) cholesterol in the liver, which contributes to higher total cholesterol levels [21]. In addition, individuals with type 2 diabetes often have higher levels of triglycerides and lower levels of high-density lipoprotein (HDL) cholesterol, which contribute to higher total cholesterol [22]. Table 1 shows that there is a very significant increase (P<0.0001) in the level of triglyceride concentration in people with type 2 diabetes compared to the control group. Previous studies have shown that the cause of high triglycerides in people with type 2 diabetes is insulin resistance, leading to increased efflux of free fatty acids and impaired clearance of triglyceride-rich lipoproteins [23]. Other contributing factors include increased liver production of very low-density lipoproteins (VLDL), elevated levels of inflammatory adipokines, and changes in lipoprotein metabolism [24]. Lifestyle factors such as obesity and a high-carbohydrate diet can also worsen triglyceride levels in individuals with type 2 diabetes [25,26]. Table 1 shows a very significant decrease (P<0.0001) in the level of high-density lipoprotein concentration in people with type 2 diabetes compared to the control group. This is due to a defect in HDL metabolism and formation, in addition to insulin resistance. Hyperglycemic states in type 2 diabetes contribute to changes in HDL kinetics, composition, and function, leading to decreased concentrations of various lipid species and proteins in HDL particles [27]. In addition, insulin resistance affects lipoprotein metabolism, leading to increased triglyceride-rich lipoproteins and decreased HDL cholesterol levels [28].

The results shown in Table 1 show a very significant increase (P<0.0001) in the level of low-density lipoprotein concentration in people with type 2 diabetes compared to the control group. Insulin resistance leads to the excessive production of very large particles of low-density lipoprotein. VLDL in the liver, which subsequently undergoes lipolysis and is converted into LDL particles [29]. These LDL particles are often small and dense, making them more atherosclerotic and vulnerable to oxidation. In addition, there may

be a decrease in the removal of LDL particles from the bloodstream. These factors contribute to high LDL cholesterol levels in individuals with type 2 diabetes [30,31]. The results are also shown in Table 1: there is a very significant increase (P<0.0001) in the concentration level of very low-density lipoproteins in people with type 2 diabetes compared to the control group. This is due to insulin resistance. Insulin resistance leads to overproduction of VLDL particles in the liver, leading to higher levels of triglyceride-rich lipoproteins[32]. This is due to increased efflux of free fatty acids and impaired clearance of VLDL particles. In addition, hyperinsulinemia, which often accompanies insulin resistance, can contribute to excessive VLDL production [33].

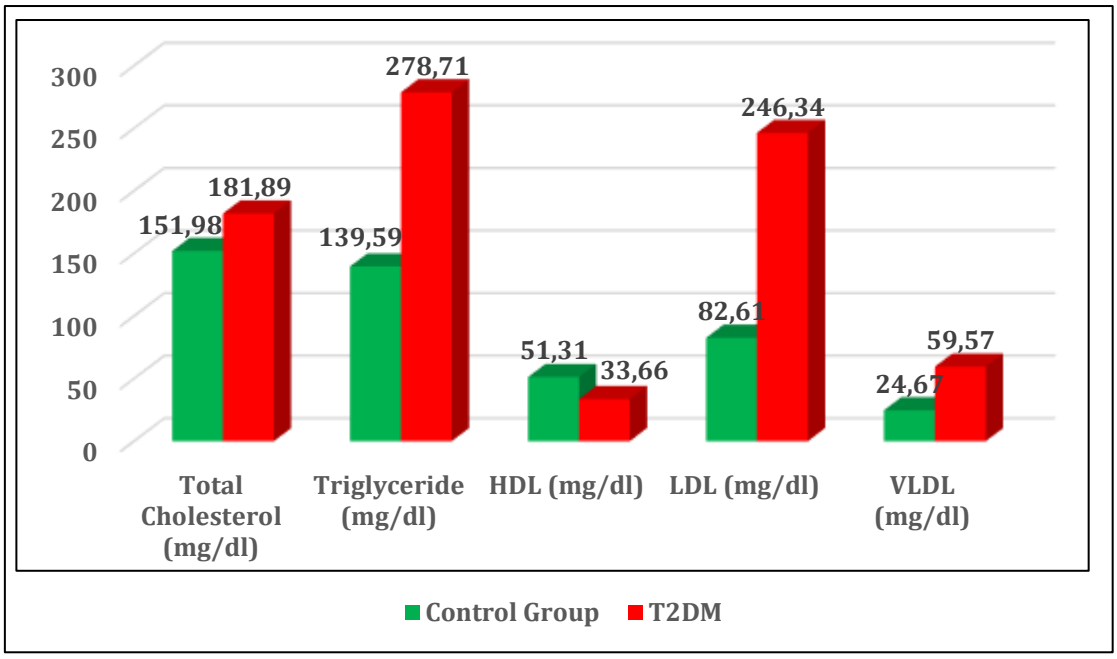

Figure (2): The mean lipid profiles level in two groups: patients with type 2 diabetes mellitus and control patients.

The results shown in Table 2 show that there is a very significant decrease (P<0.0001) in the level of potassium concentration in people with type 2 diabetes compared to the control group. This could be the reason for the low level of potassium in the blood (hypokalemia) in people with diabetes. Type 2 diabetes is multifactorial. One possible cause is the use of certain medications commonly prescribed to manage diabetes, such as insulin or certain diuretics [34]. Insulin can drive potassium into cells, resulting in lower blood potassium levels [35]. In addition, some diuretics can increase urinary potassium excretion, further contributing to hypokalemia [36]. Other factors that can contribute to low blood potassium in people with type 2 diabetes include insufficient potassium intake in the diet, excessive sweating, and kidney dysfunction. It is important for individuals with type 2 diabetes to work closely with their healthcare provider to effectively monitor and manage blood potassium levels [37]. However, the results in Table 2 show a very significant decrease (P<0.0001) in the level of magnesium concentration in people with type 2 diabetes compared to the control group. Several factors contribute to magnesium depletion in individuals with type 2 diabetes, including increased urinary magnesium excretion, low dietary magnesium intake, and poor magnesium absorption and utilization in the body [38,39]. Additionally, insulin resistance and poor blood sugar control can exacerbate magnesium deficiency [40].

The results in table 3 show a significant increase (P = 0.001) in the level of calcium concentration in people with type 2 diabetes compared to the control group. There are several factors that may contribute to a decrease in calcium concentration in patients with type 2 diabetes. One possible explanation is that insulin resistance, a feature of type 2 diabetes, may affect calcium metabolism and lead to high blood calcium levels [41]. In addition, impaired cellular calcium homeostasis and altered calcium handling have been observed in individuals with type 2 diabetes [42].

Table (2): Comparison of average levels of some electrolytes in blood serum between the two control groups and patients with type 2 diabetes mellitus.

Parameters	Control group mean±SD	Paitent with DM2 mean±SD	P-value
Potassium (mmol/L)	4.22±0.52	2.98±0.46	P<0.0001
Magnesium (mmol/L)	1.99±0.64	0.59±0.29	P<0.0001
Calcium (mg/dL)	9.17±0.66	10.92±2.78	P=0.001

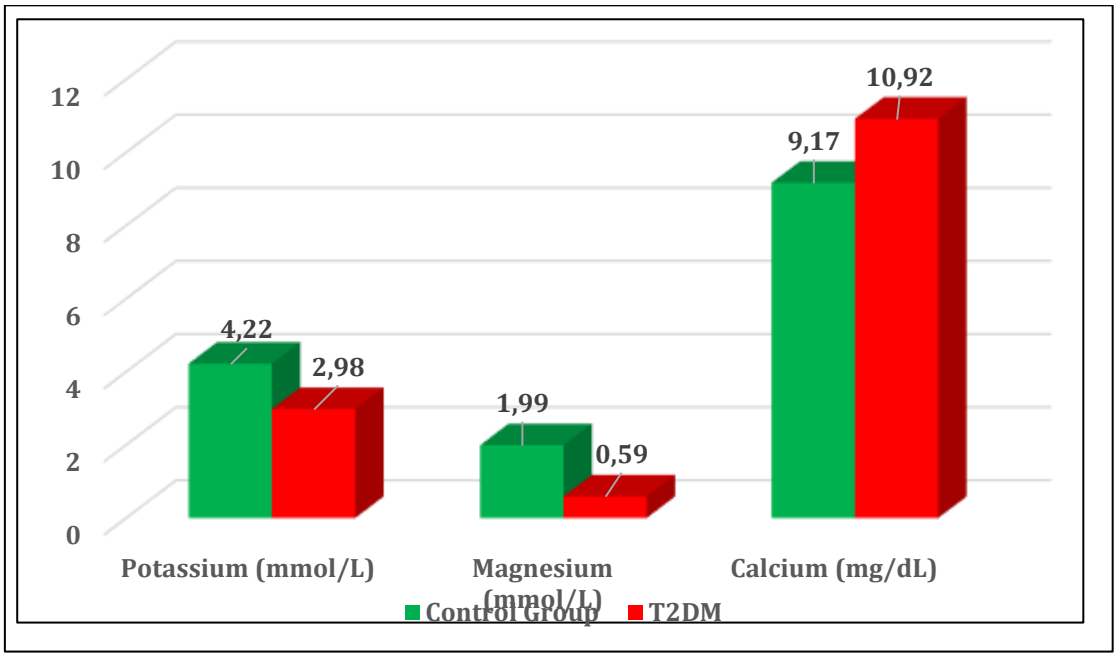

Figure (3): Average levels of some electrolytes in blood serum between the two control groups and patients with type 2 diabetes mellitus.

Conclusion

The most frequent side effect of diabetes mellitus is hyperlipidemia, which puts patients at risk for macrovascular problems and early atherosclerosis. Low HDL cholesterol, elevated triglycerides, and elevated LDL serum cholesterol are common lipid abnormalities in diabetes. Therefore, in individuals with diabetes mellitus who are not insulin-dependent, maintaining adequate glycemic control can stop lipid abnormalities from arising and from progressing. Studies assessing the impact of

concurrent micronutrient consumption on glucose metabolism variables in persons with type 2 diabetes are generally rare, particularly with regard to potassium, calcium, and magnesium. Since %HbA1c is the gold standard for glycemic control evaluation and is routinely evaluated in patients with T2DM, this emphasizes the significance of our results for an improved assessment of typical food intake in this population, which is a straightforward and inexpensive technique

References

Cloete, L. (2021). Diabetes mellitus: an overview of the types, symptoms, complications and management. *Nursing Standard (Royal College of Nursing (Great Britain): 1987)*, *37*(1), 61-66.

Hoogwerf, B. J., Sferra, J., & Donley, B. G. (2006). Diabetes mellitus—overview. *Foot and ankle clinics*, *11*(4), 703-715.

Mukhtar, Y., Galalain, A., & Yunusa, U. (2020). A modern overview on diabetes mellitus: a chronic endocrine disorder. *European Journal of Biology*, *5*(2), 1-14.

Marks, J. B. (2007). Overview of diabetes mellitus. In *Psychiatric Disorders and Diabetes Mellitus* (pp. 11-26). CRC Press.

Amin, N. (2018). An overview of diabetes mellitus; types, complications, and management. *International Journal of Nursing Science Practice and Research*, *4*(1), 119-24.

Suji, G., & Sivakami, S. (2003). Approaches to the treatement of diabetes mellitus: an overview. *Cellular and molecular biology (Noisy-le-Grand, France)*, *49*(4), 635-639.

Paschou, S. A., Papadopoulou-Marketou, N., Chrousos, G. P., & Kanaka-Gantenbein, C. (2018). On type 1 diabetes mellitus pathogenesis. *Endocrine connections*, *7*(1), R38-R46.

Gabbe, S. G., & Graves, C. R. (2003). Management of diabetes mellitus complicating pregnancy. *Obstetrics & Gynecology*, *102*(4), 857-868.

DeFronzo, R. A., Ferrannini, E., Groop, L., Henry, R. R., Herman, W. H., Holst, J. J., ... & Weiss, R. (2015). Type 2 diabetes mellitus. *Nature reviews Disease primers*, *1*(1), 1-22.

Pittas, A. G., Lau, J., Hu, F. B., & Dawson-Hughes, B. (2007). The role of vitamin D and calcium in type 2 diabetes. A systematic review and meta-analysis. *The Journal of Clinical Endocrinology & Metabolism*, *92*(6), 2017-2029.

Khan, R. N., Saba, F., Kausar, S. F., & Siddiqui, M. H. (2019). Pattern of electrolyte imbalance in Type 2 diabetes patients: Experience from a tertiary care hospital. *Pakistan Journal of Medical Sciences*, *35*(3), 797.

Liamis, G., Liberopoulos, E., Barkas, F., & Elisaf, M. (2014). Diabetes mellitus and electrolyte disorders. *World Journal of Clinical Cases: WJCC*, *2*(10), 488.

Datchinamoorthi, S., Vanaja, R., & Rajagopalan, B. (2016). Evaluation of serum electrolytes in type II diabetes mellitus. *Int J Pharm Sci Rev Res*, *40*(1), 251-253.

Shahid, S. M., Rafique, R. O. O. M. A. N. A., & Mahboob, T. A. B. A. S. S. U. M. (2005). Electrolytes and sodium transport mechanism in diabetes mellitus. *Pak J Pharm Sci*, *18*(2), 6-10.

Martins, J., Steyn, N., Rossouw, H. M., & Pillay, T. S. (2023). Best practice for LDL-cholesterol: when and how to calculate. *Journal of Clinical Pathology*, *76*(3), 145-152.

Nauck, M., Warnick, G. R., & Rifai, N. (2002). Methods for measurement of LDL-cholesterol: a critical assessment of direct measurement by homogeneous assays versus calculation. *Clinical chemistry*, *48*(2), 236-254.

Ulutas, K. T., Dokuyucu, R., Sefil, F., Yengil, E., Sumbul, A. T., Rizaoglu, H., ... & Gokce, C. (2014). Evaluation of mean platelet volume in patients with type 2 diabetes mellitus and blood glucose regulation: a marker for atherosclerosis?. *International journal of clinical and experimental medicine*, *7*(4), 955.

Chang, C. M., Hsieh, C. J., Huang, J. C., & Huang, I. C. (2012). Acute and chronic fluctuations in blood glucose levels can increase oxidative stress in type 2 diabetes mellitus. *Acta diabetologica*, *49*, 171-177.

Groeneveld, Y., Petri, H., Hermans, J., & Springer, M. P. (1999). Relationship between blood glucose level and mortality in type 2 diabetes mellitus: a systematic review. *Diabetic medicine*, *16*(1), 2-13.

Panahi, Y., Khalili, N., Sahebi, E., Namazi, S., Reiner, Ž., Majeed, M., & Sahebkar, A. (2017). Curcuminoids modify lipid profile in type 2 diabetes mellitus: a randomized controlled trial. *Complementary therapies in medicine*, *33*, 1-5.

Uttra, K. M., Devrajani, B. R., Shah, S. Z. A., Devrajani, T., Das, T., Raza, S., & Naseem, M. (2011). Lipid profile of patients with diabetes mellitus (A multidisciplinary study). *World Appl Sci J*, *12*(9), 1382-1384.

Artha, I. M. J. R., Bhargah, A., Dharmawan, N. K., Pande, U. W., Triyana, K. A., Mahariski, P. A., ... & Rina, I. K. (2019). High level of individual lipid profile and lipid ratio as a predictive marker of poor glycemic control in type-2 diabetes mellitus. *Vascular Health and Risk Management*, 149-157.

Tagoe, D. N. A., & Amo-Kodieh, P. (2013). Type 2 diabetes mellitus influences lipid profile of diabetic patients. *Annals of Biological Research*, *4*(6), 88-92.

Meenu, J., Jayendrasinh, J. M., & Neeta, M. (2013). Correlation between HbA1c values and lipid profile in type 2 diabetes mellitus. *Int J Basic Appl Physiol*, *2*(1), 47-50.

Isezuo, S. A., Badung, S. L. H., & Omotoso, A. B. O. (2003). Comparative analysis of lipid profiles among patients with type 2 diabetes mellitus, hypertension and concurrent type 2 diabetes, and hypertension: a view of metabolic syndrome. *Journal of the National Medical Association*, *95*(5), 328.

Sultana, R. (2010). Impact of duration of type 2 diabetes mellitus on lipid profile. *Gomal journal of medical sciences*, *8*(1).

Suryawanshi, N. P., Bhutey, A. K., Nagdeote, A. N., Jadhav, A. A., & Manoorkar, G. S. (2006). Study of lipid peroxide and lipid profile in diabetes mellitus. *Indian journal of clinical Biochemistry*, *21*, 126-130.

Kalsi, D. S., Chopra, J., & Sood, A. (2015). Association of lipid profile test values, type-2 diabetes mellitus, and periodontitis. *Indian Journal of Dentistry*, *6*(2), 81.

Shahwan, M. J., Jairoun, A. A., Farajallah, A., & Shanabli, S. (2019). Prevalence of dyslipidemia and factors affecting lipid profile in patients with type 2 diabetes. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, *13*(4), 2387-2392.

Samdani, T. S., Mitra, P., & Rahim, M. A. (2017). Relationship of glycated haemoglobin with lipid profile among patients with type 2 diabetes mellitus. *BIRDEM Medical Journal*, *7*(1), 43-47.

Cui, R., Qi, Z., Zhou, L., Li, Z., Li, Q., & Zhang, J. (2016). Evaluation of serum lipid profile, body mass index, and waistline in Chinese patients with type 2 diabetes mellitus. *Clinical interventions in aging*, 445-452.

Windler, E. (2005). What is the consequence of an abnormal lipid profile in patients with type 2 diabetes or the metabolic syndrome?. *Atherosclerosis Supplements*, *6*(3), 11-14.

Biadgo, B., Abebe, S. M., Baynes, H. W., Yesuf, M., Alemu, A., & Abebe, M. (2017). Correlation between serum lipid profile with anthropometric and clinical variables in patients with type 2 diabetes mellitus. *Ethiopian journal of health sciences*, *27*(3), 215-226.

Chatterjee, R., Yeh, H. C., Shafi, T., Selvin, E., Anderson, C., Pankow, J. S., ... & Brancati, F. (2010). Serum and dietary potassium and risk of incident type 2 diabetes mellitus: The Atherosclerosis Risk in Communities (ARIC) study. *Archives of internal medicine*, *170*(19), 1745-1751.

Kim, H. W., Lee, D. H., Lee, S. A., & Koh, G. (2015). A relationship between serum potassium concentration and insulin resistance in patients with type 2 diabetes mellitus. *International urology and nephrology*, *47*, 991-999.

Brandão-Lima, P. N., Carvalho, G. B. D., Santos, R. K. F., Santos, B. D. C., Dias-Vasconcelos, N. L., Rocha, V. D. S., ... & Pires, L. V. (2018). Intakes of zinc, potassium, calcium, and magnesium of individuals with type 2 diabetes mellitus and the relationship with glycemic control. *Nutrients*, *10*(12), 1948.

Hu, G., Jousilahti, P., Peltonen, M., Lindström, J., & Tuomilehto, J. (2005). Urinary sodium and potassium excretion and the risk of type 2 diabetes: a prospective study in Finland. *Diabetologia*, *48*, 1477-1483.

Ramadass, S., Basu, S., & Srinivasan, A. R. (2015). SERUM magnesium levels as an indicator of status of Diabetes Mellitus type 2. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, *9*(1), 42-45.

Chutia, H., & Lynrah, K. G. (2015). Association of serum magnesium deficiency with insulin resistance in type 2 diabetes mellitus. *Journal of laboratory physicians*, *7*(02), 075-078.

Kumar, P., Bhargava, S., Agarwal, P. K., Garg, A., & Khosla, A. (2019). Association of serum magnesium with type 2 diabetes mellitus and diabetic retinopathy. *Journal of family medicine and primary care*, *8*(5), 1671-1677.

Becerra-Tomas, N., Estruch, R., Bullo, M., Casas, R., Diaz-Lopez, A., Basora, J., ... & Salas-Salvado, J. (2014). Increased serum calcium levels and risk of type 2 diabetes in individuals at high cardiovascular risk. *Diabetes care*, *37*(11), 3084-3091.

Rooney, M. R., Pankow, J. S., Sibley, S. D., Selvin, E., Reis, J. P., Michos, E. D., & Lutsey, P. L. (2016). Serum calcium and incident type 2 diabetes: the Atherosclerosis Risk in Communities (ARIC) study. *The American journal of clinical nutrition*, *104*(4), 1023-1029.