How to Cite:
Ali, Z. K., Kanoos, H. M., Mukhlef, S. S., Mohamed, A. K., & Kadhim, A. (2022). Hematological changes of diabetes and non-diabetes patients in ministry of science and technology. *International Journal of Health Sciences*, *6*(S6), 10166–10173. https://doi.org/10.53730/ijhs.v6nS6.12645

Hematological changes of diabetes and non-diabetes patients in ministry of science and technology

Zainab K. Ali
Ministry of Science and Technology, Baghdad, Iraq
*Corresponding author email: zainabkali86@gmail.com

Hind M. Kanoos
Ministry of Science and Technology, Baghdad, Iraq

Suhaila S. Mukhlef
Ministry of Science and Technology, Baghdad, Iraq

Amal. K. Mohamed
Ministry of Science and Technology, Baghdad, Iraq

Alaa Kadhim
Genetic Enginnering and Biotechnology Institute, Baghdad University, Baghdad, Iraq

Abstract---Type 2 diabetes mellitus (DM) is a chronic condition marked by hyperglycemia. In order to ascertain the linkage in individuals with diabetes and non-diabetes of various ages, hyperglycemia in DM is closely related to Hba1c and hematological tests. Samples and data from the ministry of science and technology's lab were gathered utilizing questionnaires and biochemical data. The difference in the means of fasting blood sugar (FSB), white blood cells (WBC), hemoglobin (Hb), and packed cell volume (PCV), between the patients and the control group is shown by the hemoglobin a1c (Hba1c), which is statistically significant (P 0.01).

Keywords---Correlation, Fasting Blood Sugar(FBS), Diabetes Mellitus (DM), Hemoglobin(Hba1c).

Introduction

Diabetes mellitus is a group of metabolic illnesses characterized by hyperglycemia brought on by deficits in insulin synthesis, activity, or both. Hematological

problems are common in diabetics. These comprise anemia and other issues with red blood cells. Diabetes patients frequently have abnormalities in their platelet (PLT) and white blood cell (WBC) counts (Vinod *et al.,*2011). Blood sugar levels that are too high can eventually cause macrovascular and microvascular complications like retinopathy, neuropathy, and oxidative stress, which can harm tissues and cells by oxidizing them (Katrien *et al.,* 2011; Stratton *et al.,* 2000). Fasting blood sugar (FBS) and glycosylated hemoglobin A1C (HbA1c) levels are significantly higher in type 2 diabetes patients (Nanjo *et al.,* 2000; Kramer *et al.,* 2010).

An A1c test measures the amount of blood sugar (glucose) linked to hemoglobin. Hemoglobin, a component of red blood cells, carries oxygen from the lungs to the rest of the body. The average amount of hemoglobin-bound glucose over the past three months is determined by a HbA1c test. Red blood cells typically last for three months, therefore on average they last three months (Niederau *et al.,* 1998). Diabetes is a chronic condition that can cause serious health problems like heart disease, kidney disease, and nerve damage. High HbA1c readings may suggest the existence of this disease (Gaoyu and Suning 2018). The HbA1c test is not used to diagnose diabetes in children or gestational diabetes, a form of diabetes that only affects pregnant women (Turner *et al.,* 1998). Insulin and oral antidiabetics have long been used to treat type 2 DM. You can use these treatment models singly or in tandem. By controlling blood sugar and suppressing the chronic inflammatory process, the treatment's goal is to lessen diabetes consequences. Additionally, a HbA1c test may be less accurate in detecting diabetes if you have anemia or another form of blood problem (Liu *et al.,* 2015).

The hemoglobin A1c test reveals your average blood sugar level over the previous two to three months. Glycated hemoglobin test, HbA1c, and glycohemoglobin are further names for it. To check if their blood sugar levels are maintaining within normal range, diabetics require this test on a regular basis. It might indicate whether you need to modify your diabetic medication. Diabetes can also be identified with the A1c test (Bao *et al.,* 2010). Although HbA1c tests are frequently trustworthy, their accuracy has significant drawbacks. People with certain types of anemia, for instance, might not have enough hemoglobin for the test to be reliable and would need to get a fructosamine test instead. (Selvin *et al.*, 2010).

Age, smoking, illnesses that affect red cell turnover, blood glucose levels, and other variables can all have an impact on HbA1c levels (Soulminae *et al.,* 2014). The HbA1c measurement is affected by hematological disorders including the presence of carbamylated hemoglobin in uremia, a number of systemic illnesses such specific types of dyslipidemia, cancers, and liver cirrhosis. 1.62 billion individuals, or 24.8% of the world's population, suffer from anemia (Parag *et al.,* 2018)**.** Iron deficiency anemia Anemia is a major cause of anemia in the general population and is common in people with diabetes (14). An additional complication that has an impact on the quality of life is anemia in diabetes patients (Cavagnolli *et al.,* 2015).

Numerous hematological characteristics, including the activities of platelets and white blood cells (WBCs), have been found to be altered in diabetes individuals. Numerous studies have argued that elevated levels of WBC and red blood cells

(RBCs) are crucial for diagnosing metabolic syndrome (Ramachandran and Snehalatha 2009). Hematological parameters that are regularly examined, such as hematocrit (Hct) and WBC, have been linked in a number of studies to the occurrence of type 2 diabetes and insulin resistance in various population (Mbata *et al.,* 2015). The purpose of the study was to evaluate the relationship between fasting and hematological profile and glycosylated hemoglobin levels in Ministry of Science and Technology MOST type 2 diabetes patients.

Materials and Methods

Prospective research included 100 persons divided into two types, 50 people have diabetes, and 50 do not (controls) to compare between the FBS, HbA1c and hematological profile of type 2 DM, each of the patients and controls divided according to the gender, 25 male and 25 female. This study conducted in Ministry of Science and Technology (MOST) for period one year (April 2018 to April 2019). Hematological parameters like WBC differential, Hemoglobin (Hb), Packed cell volume (PCV), and Platelets (PLT) done in automated cell counter and Stanbio was used for HbA1c analysis. Subjects' responses to a standardized, pretested questionnaire were utilized to compile the data. A thorough medical history was obtained. For laboratory investigation 5ml of blood was placed should be prepared for analysis, place in EDTA tube (Ethylene Diamine Tetra Acetic Acid), all laboratory tests were done in laboratory of medical department in MOST. To identify the impact of various factors on research parameters, the Statistical Analysis System- SAS (2012) application was employed. In this study, a significant comparison between means was made using the T-test.

Results and Discussion

Many studies have indicated the association between FBS and HbA1c level we also founded that the mean of HbA1c 86.04 ± 1.77 and the mean of FBS 175.96 ± 7.72 was high significant (P<0.01) in patients and control. that show in table (1).

Table 1
Comparison between control and patients in HbA1c and FBS

Group	Mean ± SE	
	HbA1C ( )	FBS ( )
Control	5.33 ± 0.07	8.25 ± 0.21
`Patients	86.04 ± 1.77	175.96 ± 7.72
T-test	0.457 **	15.736 **
P-value	0.0001	0.0001
** (P<0.01).		

Among the mean values of Hb, there were significant differences (P<0.01), PCV 13.63 ± 0.24, 41.18 ± 0.51in patients and the mean of the Hb,PCV 12.39 ± 0.26, 39.31 ± 0.54 in the controls respectively. While we founded non-significant in the mean of platelet 204.26 ± 14.06, 225.18 ± 8.52 between them.

Table 2
Comparison between control and patients in Hb, PCV and PLT

Group	Mean ± SE		
	Hb ( )	PCV ( )	PLT ( )
Control	12.39 ± 0.26	39.31 ± 0.54	225.18 ± 8.52
Patients	13.63 ± 0.24	41.18 ± 0.51	204.26 ± 14.06
T-test	0.708 **	1.486 **	32.637 NS
P-value	0.0008	0.0104	0.206
** (P<0.01), NS: Non-Significant.			

The statistical analysis showed significant (P<0.05) in the mean of total white blood cells 8.54 ± 0.41 in diabetic patients compared with control.

Table 3
Comparison between control and patients in WBC Kinds

Group	Mean ± SE			
	WBC	Lymphocyte	Monocyte	Neutrophil
Control	7.47 ± 0.37	31.68 ± 1.14	7.19 ± 0.28	60.78 ± 1.34
Patients	8.54 ± 0.41	29.11 ± 1.27	8.18 ± 1.36	63.91 ± 1.34
T-test	1.004 *	3.406 NS	2.766 NS	3.781 NS
P-value	0.0510	0.137	0.476	0.104
* (P<0.05) , NS: Non-Significant.				

It was been observed that the mean HbA1c level was Non significant between male and female, but we disagree with (18,19) (Mohammad *et al., (*2016), and (Adham *et al.,* (2010) who showed high significant in female than male gender.

Table 4
Effect of gender on parameter analysis

Parameters	Mean ± SE		T-test
	Male	Female	
HbA1C ( )	8.33 ± 0.24	8.18 ± 0.36	0.879 NS
FBS ( )	167.88 ± 8.09	184.04 ± 13.15	32.04 NS
Hb ( )	14.40 ± 0.36	12.86 ± 0.24	0.880 *
PCV ( )	41.73 ± 0.83	40.62 ± 0.60	2.065 NS
PLT ( )	168.32 ± 13.77	240.20 ± 22.59	53.20 *
WBC	8.84 ± 0.58	8.24 ± 0.60	1.686 NS
Lymphocyte	26.08 ± 1.72	32.14 ± 1.71	4.885 *
Monocyte	9.82 ± 2.69	6.54 ± 0.33	5.458 NS
Neutrophil	66.75 ± 1.69	61.06 ± 1.96	5.209 *

Less evidence is known on the accuracy of HbA1c in the diagnosis of diabetes, despite the fact that it is an accurate marker for the risk of complications. It is not recommended as routine test for screening because there is many factors that affect the results HbA1c test such as Abnormal hemoglobin, hemolytic anemia, Iron deficiency, dyslipidemia, malignance, liver cirrhosis and some drugs which may generate false positive results (Kilpatrick 2008; Adham *et al.,* 2010 ; Zahra *et al.,* 2010). Increased circulating erythrocyte life span (reduced clearance) or decreased reticulocyte synthesis might result in falsely elevated HbA1c concentrations. On the other hand, conditions with a shortened erythrocyte life span (increased hemoglobin turning) or where a high number of Reticulocyte are created result in erroneously low HbA1c levels. (Bloomgarden, 2009).

Many studies have indicated the association between FBS and HbA1c level we also founded that the mean of HbA1c 86.04 ± 1.77 and the mean of FBS 175.96 ± 7.72 was high significant (P<0.01) in patients and control. that show in table (1). Our results were agreement with (Khattab , 2010 , Swetha,2014 ; Ketema *et al.*, 2015). Among the mean values of Hb, there were significant differences (P<0.01), PCV 13.63 ± 0.24, 41.18 ± 0.51in patients and the mean of the Hb,PCV 12.39 ± 0.26, 39.31 ± 0.54 in the controls respectively. While we founded non-significant in the mean of platelet 204.26 ± 14.06, 225.18 ± 8.52 between them, Our results were agreement with Suguna and Kusumadevi (2019) and who showed significant in mean Hb and PCV than in Non-diabetics. To ascertain how patients with type 2 diabetes mellitus' mean platelet volume (MPV) is affected by gender, advanced age, longer illness duration, and higher levels of glycosylated hemoglobin (Bastard *et al.,* 2006).

Insulin resistance has been proposed as a possible factor, even if the exact processes causing greater HbA1c levels in people with higher WBC counts but not having diabetes are yet unknown. It has been more clear over the past ten years that inflammation plays a significant role in insulin resistance (Bastard *et al.,* 2006). Through a variety of cytokines and signaling pathways, activation of proinflammatory signaling pathways that encourage WBC differentiation and maturation is implicated in the pathophysiology of insulin resistance (Chen *et al.*, 2015). Additionally, low-grade systemic inflammation and adipose tissue inflammation frequently coexist with insulin resistance (Wieser *et al.,* 2013). Regardless of the starting circumstances, the connection develops in a vicious cycle that is bidirectional (de Luca and Olefsky , 2008) . Accordingly, in this investigation, greater WBC levels were also significantly correlated with insulin resistance syndrome (metabolic syndrome)-related variables such raised TG, increased waist circumference, decreased HDL, hypertension, and HbA1c.

Many of the researchers have already demonstrated that inflammatory mechanisms contribute to the development of diabetes and its complications (Holman *et al.,* 2008) who showed the mean WBC was significantly in diabetics compared to non-diabetics, table (3). It was being observed that the mean HbA1c level was non-significant between male and female, but we disagree with Mohammad *et al.,* (2016) and Adham *et al.*, (2010) who showed high significant in female than male gender. Association between White Blood Cell Counts within normal range and hemoglobin A1c in a Korean population. Suguna and

Kusumadevi (2019) showed no significant between the HbA1c and platelet and lymphocyte in the gender .

Conclusion

According to the study, diabetes patients' hematological indicators differed statistically significantly from controls' in various cases. Therefore, in type 2 DM patients, hematological indices may serve as helpful markers of vascular complications and glycemic management. In our study, it was noted that the mean levels of (HbA1c, FBS, PCV, WBC, and Monocyte) were non-significant in the female gender, comparable to the outcomes in the male gender.

References

Adham M, Froelicher E, Batieha A, Ajlouni K. (2010). Glycaemic control and its associated factors in type 2 diabetic patients in Amman, Jordan. Eastern Mediterranean Health J; 16:732-9.

Bao Y, Ma X, Li H, Zhou M, Hu C, Wu H, *et al.* (2010). Gyrated hemoglobin A1c for diagnosing diabetes in Chinese population: Cross sectional epidemiological survey. BMJ;340:c2249.

Bastard J, Maachi M, Lagathu C, Kim M, Caron M, Vidal H (2006). Recent advances in the relationship between obesity, inflammation, and insulin resistance. Eur Cytokine Netw 17:4-12.

Bloomgarden Z. (2009). A1c: recommendations, debates, and questions. Diabetes Care. 32(12):141–7.

Cavagnolli G, Pimentel A, Freitas P, Gross J, Camargo J. (2015). Factors affecting a1c in non-diabetic individuals: review and meta-analysis. Clin Chim Acta. 2015;445:107–114. doi: 10.1016/j.cca..03.024.

Chen L, Chen R, Wang H, Liang F. (2015). Mechanisms linking inflammation to insulin resistance. Int J Endocrinol 2015; 508409.

de Luca C, Olefsky J. (2008). Inflammation and insulin resistance. FEBS Lett; 582:97-105.

Gaoyu X , Suning Z , (2018). Cost-Utility Analysis of Liraglutide in Type 2 Diabetes Patients in China after Chinese Reformation of Medical Care System Journal of Biosciences and Medicines Vol.6 No.12, December.

Handndrish K , Srinivasa S, Prabhakar K. (2017). Hematological profile of diabetes and non-diabetes patients in rural tertiary centre, International Journal of Advances in Medicine Kumar HS et al. Int J Adv Med. Oct;4(5):1271-1275.

Holman R, Paul S, Bethel M, Matthews D, Neil H. (2008).10-year follow-up of intensive glucose control in type 2 diabetes; N Engl J Med. ;359(15):1577-89.

Katrien B, Eberhard S, Chantal M, (2011). The importance of glycemic control: how low should we go with HbA1c? Start early, go safe, go low May-Jun;25(3):202-7.

Ketema E and Kibret K. (2015). Correlation of fasting and postprandial plasma glucose with HbA1c in assessing glycemic control; systematic review and meta-analysis. Arch Public Health 73:1-9.

Khattab M, Khader Y, Al-Khawaldeh A, Ajlouni K. (2010). Factors associated with poor glycemic control among patients with type 2 diabetes. J Diabetes Complications 24:84-9.

Kilpatrick E. (2008). Haemoglobin A1c in the diagnosis and monitoring of diabetes mellitus. J Clin Pathol. 61(9):977–82.

Kramer C, Araneta M, Barrett-Connor E. Hba1c and diabetes diagnosis 2010: the rancho bernardo study. Diabetes Care;33:101-3.

Lestari, Y. D., Armi, A., Koniasari, K., Setiawan, Y., Sartika, M., Rohmah, H. N. F., Nurpratiwi, Y., & Fahrudin, A. (2022). Effectiveness of the emotional freedom techniques to reducing stress in diabetic patients. International Journal of Health Sciences, 6(2), 555–562. https://doi.org/10.53730/ijhs.v6n2.6728

Liu S, Hempe J, McCarter R , Li S, (2015). Fonseca V. Association between inflammation and biological variation in hemoglobin A1c in U.S. non diabetic adults. J Clin Endocrinal Metab; 100:2364-71.

Mbata A, Adegoke A, Nwagu C, Nyeso W, (2015).Some Hematological Parameters in Diabetic Patients in Port Harcourt Nigeria. AJMS.; 3(2):2348-7186.

Mohammad H, Girish T, Sarvajeet K, (2016). Surulivelrajan Mallayasamy International Journal Of Pharmacy And Pharmaceutical Sciences Issn- 0975-1491. Vol 8, Issue 8.

Nanjo K, Bessho H.Nanjo K, et al. Nihon Naika Gakkai Zasshi. (2000).Classification and diagnosis of diabetes mellitus. Aug 10;89(8):1493-9.

Niederau C, Reinauer H, Glycohemoglobins In: Thomas L, ed(1998). Clinical Laboratory Diagnostics. Use and assessment of clinical laboratory results. Frankfurt/Main:TH-Books Verlagsgesellschaft mbH,: 142-148.

Parag B, Bhaskar P, Tripura S, Gorakh M, Nikhil D, Amandeep S, Amit Q, Salman M, Rishi J, (2018). World Health Organization. The global prevalence of anemia in 2011. Geneva: World Health Organization; 2015. Journal of Obstetrics and Gynecology, Vol.8 No.11, September 11,.

Ramachandran A, Snehalatha C. (2009). Current scenario of diabetes in India. J Diabetes.; 1(1):18-28.

Saxena, A. (2017). The impact of nutrition on the overall quality of life adolescent girls are living across the city of Kota. International Journal of Life Sciences, 1(1), 40–48. https://doi.org/10.21744/ijls.v1i1.21

Selvin E, Steffes M, Zhu H, Matsushita K, Wagenknecht L, Pankow J, *et al* (2010). Gyrated hemoglobin, diabetes, and cardiovascular risk in nondiabetic adults. N Engl J Med; 362:800-11.

Soulminae S, Simon D, Herman W, Lange C, Lee C, Colagiuri S, et al. (2014). Hba1c, fasting and 2h plasma glucose incurrent, ex-and never –smokers ,meta-analysis.Diabetalogia .,57.30-39.

Stratton I, Adler A, Neil H, Matthews D, Manley S, Cull C, *et al*. (2000). Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. Br Med J;321:405-12.

Suguna S and Kusumdevi M. (2019). Correlation of HbA1c levels with Monocyte lymphocyte and platelet lymphocyte ratios in type 2 Diabetics of Bangalore city international journal of physiology Vol.7 No. 4

Suryasa, I. W., Rodríguez-Gámez, M., & Koldoris, T. (2021). Get vaccinated when it is your turn and follow the local guidelines. *International Journal of Health Sciences*, *5*(3), x-xv. https://doi.org/10.53730/ijhs.v5n3.2938

Swetha N,(2014) Comparison of fasting blood glucose & post prandial blood glucose

Turner R, Holman R, Cull C,UK (1998).Prospective Diabetes Study (UKPDS) Group, “Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes”, Lancet, vol. 352(9131), pp. 837-853,.

Vinod R, Gyawali P, Raut PP, Regmi P, Singh KP, Raj Pandeya DP et.al., (2011). Association between glycaemic control and serum lipid profile in type 2 diabetic patients: Glycated haemoglobin as a dual biomarker. Biomedical Research;22 (3): 375-80.

Wieser V, Moschen A, Tilg H. (2013). Inflammation, cytokines and insulin resistance: a clinical perspective. Arch Immunolm Ther Exp (Warsz) (2013).;61:119-25.

with HbA1c in assessing the glycemic control International J. of Healthcare and Biomedical Research, Volume: 2, Issue: 3, April 2014, Pages 134-139

Zahra G,1 Ali Akbar Haghdoost, Sakineh Mohammad Alizadeh, Jamileh Atapour, and Farzaneh Zolala, MSc1A (2010). Comparison of HbA1c and Fasting Blood Sugar Tests in General PopulationInt J Prev Med. Summer; 1(3): 187–194.