Original Research

ASSESSMENT OF MICROBIAL INFECTION SUSPECTIBILITY IN RELATION TO ADENOSINE DEAMINASE AND GYCOSYLATED HEMOGLOBIN LEVEL IN TYPE 2 DIABETIC INDIVIDUALS; A CASE CONTROL STUDY IN NORTH WESTERN PART OF UTTAR PRADESH

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ABSTRACT

Background: Diabetes mellitus is a group of metabolic disorders characterized by hyperglycemia resulting from defects in insulin secretion, action, or both. Chronic hyperglycemia can lead to secondary damage in various organ systems, particularly the kidneys, eyes, nerves, and blood vessels. **Materials & methods:** The present study included 150 subjects, 75 of whom were cases of type 2 DM from the Outpatient Department of Varun arjun Medical College and Rohilkhand Hospital, and 75 healthy individuals as controls. **Results:** A total of 150 patients were recruited for the study, which included 43 patients with Type II Diabetes Mellitus and glycated hemoglobin levels greater than 8%, 32 patients with Type II Diabetes Mellitus and glycated hemoglobin levels of 8% or lower, and 75 healthy individuals who served as controls. The following parameters were analyzed: fasting plasma glucose, glycated hemoglobin (HbA1c), and serum adenosine deaminase (ADA). The results showed that blood sugar levels, mean HbA1c, and serum ADA levels were significantly higher in the diabetic group compared to the control group ($p = 0.0001$). The data was analyzed using SPSS software **Conclusion:** Increased ADA (Adenosine Deaminase) levels can indicate glycemic status and insulin resistance in patients with type 2 diabetes. Analyzing these levels helps assess glycemic control and can serve as an early warning for diabetic complications, allowing for preventive measures that improve health outcomes.

Keywords: Diabetes Mellitus, Adenosine Deaminase, Glycated hemoglobin

INTRODUCTION

is Type 2 diabetes mellitus (T2DM) is a metabolic disorder marked by chronic hyperglycemia and disturbances in the metabolism of carbohydrates, fats, and proteins. Prolonged hyperglycemia increases the risk of both microvascular and macrovascular complications over time.[1] In T2DM, hyperglycemia arises from insulin resistance in peripheral tissues and a gradual decline in β-cell function, ultimately leading to β-cell failure.[2]

The prevalence of diabetes is rising dramatically worldwide, presenting a significant challenge for India. According to the World Health Organization (WHO), in 2016, around 422 million people globally had diabetes, with estimates reaching 438 million by 2030 and 642 million by 2040 [3], according to the International Diabetes Federation (IDF). In India, diabetes affects 10-16% of the urban population and 5-8% of the rural population, though the epidemic is believed to be more prominent in rural areas.[4]

Glycated hemoglobin (HbA1C) is a commonly used marker for long-term glycemic control. It indicates the average blood glucose level and can predict the risk of complications in patients with diabetes. Serum adenosine deaminase activity (ADA) is an enzyme found in red blood cells and the walls of blood vessels. It catalyzes the irreversible hydrolytic deamination of adenosine to inosine and converts 2'-deoxyadenosine to 2'-deoxyinosine, which is further broken down into hypoxanthine, xanthine, and finally, uric acid (UA) [5]. Adenosine plays a crucial role in increasing glucose uptake into cells. Additionally, serum ADA is important for the maturation and activation of lymphocytes. High levels of lymphocyte ADA activity have been observed in diseases characterized by a cell-mediated immune response.

The Diabetes Atlas 2015 reports that India has approximately 69.2 million people with diabetes, a number expected to rise. However, studies on the relationship between ADA activity, serum uric acid levels, and glycemic control in Type 2 diabetes patients in this region are lacking.

The current study was designed to assess serum levels of glycosylated hemoglobin (HbA1C) and serum adenosine deaminase (ADA) in patients with and without type 2 diabetes mellitus attending a rohilkhand hospital in sahajahanpur (u.p).

In our study, we examined the following biochemical parameters: Fasting Blood Sugar Levels (FBSL), Glycosylated Hemoglobin (HbA1c), and adenosine Deaminase (ADA).

www.ajmrhs.com
eISSN: 2583-7761
Date of Received: 10-10-2025
Date Acceptance: 30-10-2025
Date of Publication: 28-11-2025

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MATERIALS AND METHODS

This case-control study was conducted between December 2023 and March 2024 on 75 patients with type 2 diabetes mellitus attending the Outpatient Department of rohilkhand hospital U.P . 75 age and sex-matched patients without type 2 diabetes mellitus attending the OPD were taken as controls. Before conducting the study, approval was obtained from the Institutional Ethics Committee (IEC), and all patients provided informed consent before being enrolled in the research.

Investigations were performed at the Department of Biochemistry Varun arjun medical college and rohilkhand hospital , The study was divided into two groups.

1. Diabetic patients (n = 75)
2. Control group (n = 75)

Inclusion Criteria:

Type 2 DM patients attending the OPD (Department of Medicine) of Varun arjun Medical College of the age group 20 – 70 years & consenting to the study.

Exclusion Criteria: Any patient

pregnant or lactating female.

With chronic diseases such as tuberculosis, rheumatoid arthritis, gout, renal failure, and immunological disorders that alter ADA level.

Patients on any drugs altering the study parameters

Control group:

A control group of 75 healthy non-diabetic individuals with similar age and gender distribution was selected for the comparative study. Detailed history, clinical examination, and relevant investigations were carried out to ensure that the control group did not include individuals with any diseases that could potentially impact serum ADA and blood glucose levels.

Methodology:

Patients provided detailed histories and underwent physical examinations. Informed consent was obtained before sample collection from both cases and controls, who shared the same exclusion criteria and were not on any influencing medications. The study received approval from the institutional Ethics committee, and blood samples were collected after overnight fasting using standard aseptic techniques.

Plasma blood sugar in fasting samples, HbA1c, and Serum ADA were estimated by the TRANSASIA ERBA EM 200 fully automatic biochemistry analyzer.

Reference ranges of Blood Glucose levels

a) Fasting blood glucose levels: 60-100 mg/dl

b) Post-prandial blood glucose levels: 80-140 mg/dl

c) Random blood glucose levels: 60-110 mg/dl

Reference ranges of Glycosylated (HbA1C):

a) Nondiabetic: 4.0-5.6%

b) Prediabetes: 5.7-6.4%

c) Diabetes: >6.4%

Reference range of Serum Adenosine deaminase (ADA): 4-22 U/L

STATISTICAL

Statistical Product and Service Solutions (SPSS) software analyzed all the biochemical study parameters.

RESULTS

The study was conducted at the Department of Biochemistry varun arjun Medical College and Rohilkhand Hospital,Banthra U.P. According to the proforma detailed in the methodology, 150 patients, including 75 individuals with diabetes and 75 healthy controls, participated in the study.

Table 1: Demographic details of study subjects

Demographic details	No. of Subjects			
	Diabetics groups (n=75)	per-centage	Control groups (n=75)	percentage
Male	49	65%	47	63%
Female	26	35%	28	37%

Age (years)						
Age groups distribution	Diabetics groups			Control groups		
	Male	Female	Total	Male	Fe-male	Total
20-30	2	1	3(4%)	3	1	4(5%)
31-40	10	5	15 (20%)	9	8	17 (23%)
41-50	13	7	20 (27%)	16	9	25 (33%)
51-60	17	10	27 (36%)	14	8	22 (29%)
61-70	7	3	10 (13%)	5	1	6(8%)

As shown in Table 1, most diabetic patients were aged between 51-60 years, comprising 36% of the group. Additionally, 20 patients (27%) were in the 41-50 age range, 15 patients (20%) were aged 31-40, 10 patients (13%) were between 61 and 70, and 3 patients (4%) were in the 20-30 age group. Furthermore, Table 1 indicates that 49 male patients (65%) and 26 female patients (35%) were within the diabetic cohort.

Table 2: represents the male-to-female ratio for all subjects of the study. The male-to-female distribution in the control group was 63:37, whereas in the Diabetic group, it was 65:35.

Groups	No. of cases (n)	Male	Female
Control	75	47(63%)	28(37%)
Diabetics	75	49(65%)	26(35%)

Table 3: represents the mean BSF level in the control group and the diabetic group. There was a significant difference in BSF level between the control and study groups.

Groups	No. of cases (n)	BSF (Mean±SD)	t-value	p-value
Control	75	67±10.28	34.782	<0.001
Diabetics	75	157.6±20.08		

Table 3: represents the mean HbA1c levels in the control group and the diabetic group. The mean HbA1c levels in the control group were 4.8±0.67%, and in the diabetic group was 8.63±0.89. The difference between the two groups was statistically significant

Table 4: represents the mean serum ADA levels in the control group and the diabetic group.

Groups	No. of cases (n)	HbA1C (%) (Mean±SD)	t-value	p-value
Control	75	4.8±0.67	29.774	<0.001
Diabetics	75	8.63±0.89		

Table 5: represents the mean HbA1c level in two diabetic groups. Further, the diabetic patients (n = 75) were sub-grouped on the basis of the HbA1c levels as: HbA1c ≤ 8% (Good Glycemic Control) n = 32 HbA1c ≥ 8% (Poor Glycemic Control) n = 43

Groups	No. of cases (n=75)	ADA (U/L) (Mean±SD)	t-value	p-value
HaA1C ≤ 8.0	32	7.7±0.79	8.691	<0.001
HbA1C >8	43	9.56±1.0		

Table 6: shows the correlation between Serum ADA, BSF, and HbA1c. When serum ADA and HbA1c were compared, there was a positive correlation ……

	Correlation Coefficient (r)	Significance (P-value)
Serum ADA VS BSF	0.1536	0.00050
Serum ADA vs HbA1C	0.263	0.0001

DISCUSSION

There is Diabetes mellitus is a group of metabolic disorders characterized by high blood sugar levels. As a chronic condition, it has reached epidemic proportions, and its long-term complications can have serious consequences. The condition is marked by absolute or relative insulin deficiency and insulin resistance.

Type 2 diabetes mellitus (T2DM) complications stem from persistent hyperglycemia, which leads to issues like diabetic retinopathy, peripheral neuropathy, poor wound healing, renal failure, and erectile dysfunction. Chronic hyperglycemia also increases free radical activity, as it promotes auto-oxidation and advanced glycation end products, resulting in various free radical generation mechanisms in diabetic patients.

The present study was carried out in the Outpatient Department of Varun Arjun Medical College and Rohilkhand Hospital, U.P.

The study included 150 individuals, who were divided into 2 groups, each consisting of 75 individuals.

a) Group 1 consisted of healthy, non-diabetic individuals

b) Group 2 consisted of diabetic individuals

The following parameters were analyzed in all groups: FBS, HbA1c, and Serum ADA activity. All three parameters, FBS, HbA1c, and ADA levels, were increased in patients with Type 2 DM compared to controls.

The mean levels of Group 2 were found to be significantly higher than Group 1 ($P<0.0001$).

The levels of ADA were significantly higher in Group 2 compared to Group 1 ($P<0.0001$).

This study shows that the cases exhibited significant hyperglycemia compared to the controls. The notably higher levels of ADA in the cases suggest that ADA may contribute to the pathophysiology of type 2 diabetes mellitus and its associated complications.

The observed positive correlation between ADA levels and good and poor glycemic control highlights its significant role in influencing the bioactivity of insulin. This suggests that elevated ADA activity may serve as an essential marker for the presence of insulin resistance in individuals. As such, measuring ADA levels could provide valuable insights into metabolic health and the effectiveness of insulin regulation.

ADA plays a crucial role in lymphocyte proliferation and differentiation, and its highest activity is seen in T-lymphocytes. High ADA activity might be due to abnormal T-lymphocyte responses or proliferation.

Another study done by Kurtul N. et al. (2004) found that serum ADA activity was higher in type 2 DM patients and correlated with HbA1c levels. They suggested that adenosine impacts insulin action in tissues, with ADA levels influencing adenosine concentration. Increased ADA activity may deplete adenosine, leading to insulin resistance and hyperglycemia, a key feature of diabetes mellitus.

A Study conducted by L Bagher L et al. on 33 patients with type 2 diabetes at the Diabetes Center of Shariati Hospital, Iran, 2016 found significant differences between total serum ADA (tADA) and ADA2 activities in the diabetic groups with HbA1c < 8 (%) and HbA1c ≥ 8 (%) concerning the values in healthy individuals.

Another Study by Shiva Prakash et al. on a group of thirty-six adult patients of either sex who had a history of not less than six years of diabetes mellitus and an equal number of healthy non-diabetics in 2005 in India found a significant increase in adenosine deaminase activity in diabetic subjects when compared to controls.

A Study by Ramani NS et al. on 101 study subjects in India concluded that serum ADA was significantly elevated in individuals with Type 2 diabetes, and ADA could be used as a marker of glycemic status in individuals with Type 2 diabetes mellitus.

The present study reported a significant rise in serum ADA levels in type 2 DM patients and demonstrated a significant association of ADA with glycemic index (measured by HbA1c).

CONCLUSIONS

This research has shown that serum ADA (adenosine deaminase) levels tend to rise as HbA1c levels increase. This correlation suggests that measuring serum ADA could effectively evaluate the glycemic status of individuals diagnosed with type 2 diabetes mellitus. By using serum ADA as a glycemic marker, healthcare providers may gain valuable insights into their patients' metabolic control, enhancing the management of this chronic condition.

Excitingly, we've observed a notable rise in serum ADA levels among individuals with Type 2 Diabetes mellitus! More extensive studies analyzing a more significant number of samples are essential to fully harness this potential, as ADA's short half-life and daily fluctuations present challenges. Establishing ADA as a routine diagnostic and prognostic marker could enhance our understanding and management of diabetes!

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How to cite this article: Brijendra Singh Hindoliya, Rajveer Singh, Junaid musarrat khan, K Vijay Kumar, Assessment of Microbial Infection Suspectibility in Relation to Adenosine Deaminase and Gycosylated Hemoglobin Level in type 2 Diabetic Individuals; a case Control Study in North Western part of Uttar Pradesh, Asian J. Med. Res. Health Sci., 2025; 3 (3):79-82.

Source of Support: Nil, **Conflicts of Interest:** None declared.