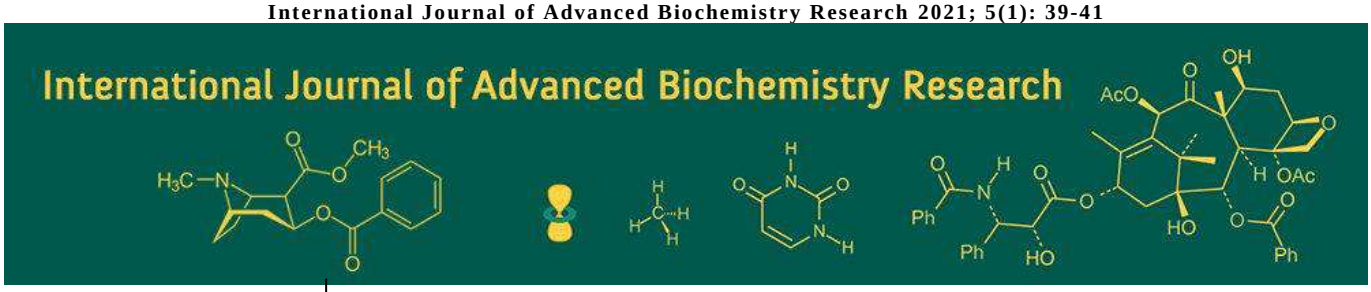


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# Comparative study of HbA1c and superoxide dismutase in type II diabetes mellitus in Jalgaon district

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**Abstract**
Type II diabetes, formerly known as adult-onset diabetes, is a type of diabetes that is characterized by high blood sugar, insulin resistance, and relative lack of insulin due to obesity, lack of exercise or genetically determined. HbA1c in diabetic patients provides valuable information about the changes occurring in the blood glucose level over the last three months. SOD is considered a first-line Defense against ROS, as it is present in almost all cells and it deals with the most hazardous radicals i.e. Superoxide ($O_2^-$). Oxidative stress is in the foreground of diabetes, which increases with an increase in severity of diabetes, keeping these facts in mind the present study was designed to compare the SOD level in type II D.M in Jalgaon district. In the present study, we have got inverse correlation (non-significant correlation) in these two parameters. As the levels of HbA1c increase, there is a decrease in SOD levels, which indicates that as the severity of diabetes increases the levels of SOD decrease.

**Keywords:** Type II diabetes, oxidative stress, superoxide dismutase, HbA1c

## Introduction
The glucose molecule in the blood normally binds to the haemoglobin molecule –known as glycated haemoglobin (HbA1c) or glycation. Its level is increased in diabetes mellitus and thus monitoring the levels of HbA1c in diabetic patients provides valuable information about the changes occurring in the blood glucose level over the period of three months. Diabetes is a metabolic disorder and is generally accompanied by increased levels of free radicals and decreased activity of antioxidants and various studies suggest that increased oxidative stress in diabetes mellitus may be due to increased formation of glycated haemoglobin (HbA1c). This increased glycation is thus involved in the progression of diabetes and its complications. **[**Yau JWY, *et al*., 2012 & the int. expert committee, 2009] [10, 2].
Oxidative stress produced is characterized by the production of different free radicals. One of this free radical is superoxide ($O_2^-$) which causes cellular damage. SODs are a ubiquitous family of enzymes that function to efficiently catalyze the disputation of superoxide anion. In the body there is a defense system which is actively engaged in destroying free radicals, e.g. Vitamins such as vitamin E, and vitamin C, enzymes such as catalase, superoxide dismutase, reduced Glutathione [Stitt A.W, 2009] [8]. SOD is considered a first-line defence against ROS, as it is present in almost all cells and it deals with the most hazardous radicals i.e. Superoxide ($O_2^-$). [Maxwell S.R, *et al*, 2003] [5] Oxidative stress is in the foreground of diabetes. It increases with an increase in severity of diabetes, keeping these facts in mind the present study was designed to compare the levels of HbA1c and SOD in type II D.M. and to see whether there is any correlation between these parameters.

## Aims and Objectives
**The aim of the present study was to**
1. Determine the activity of superoxide dismutase in erythrocyte (RBC-SOD).
2. To determine the levels of glycated haemoglobin (HbA1c) in type II D.M. patients (without any complications).
3. To evaluate the correlation between the above parameters in the patients having type II D.M.

## Materials and Methods

The present study comprised of 110 known diabetic patients (with blood glucose > 180 mg/dl) and 110 healthy controls (age and sex matched). This study was conducted in collaboration with Dr. Ulhas Patil Medical College and Government Medical College, Jalgaon from September 2018 to May 2020.

### Inclusion Criteria

Patients were diagnosed as type-II Diabetes Mellitus without any complications.

### Exclusion Criteria

Patients having type-I Diabetes Mellitus, Gestational Diabetes Mellitus, type-II diabetes mellitus patients with complications.

5ml blood was collected in EDTA and Heparin bulb after 12 hrs. Fast with prior well-informed written consent; under aseptic condition by vein puncture.

The blood samples collected were processed immediately for estimation of glycated hemoglobin (HbA1c) by Ion Exchange Resin. [Trivelli L.A, Ranney P.H, 1971] [9] and RBC Superoxide Dismutase by Kajari Das Method**.** [Kajari-Das, 2000, Irshad M, 2002 & Misra H, 1972] [4, 3, 6].

### Statistical Analysis

All the biochemical parameters measured in study group subjects were statistically compared with those estimated in controls. Results were presented as mean ± SD. Student unpaired 't' test used for statistical analysis between controls and cases for numerical variables.

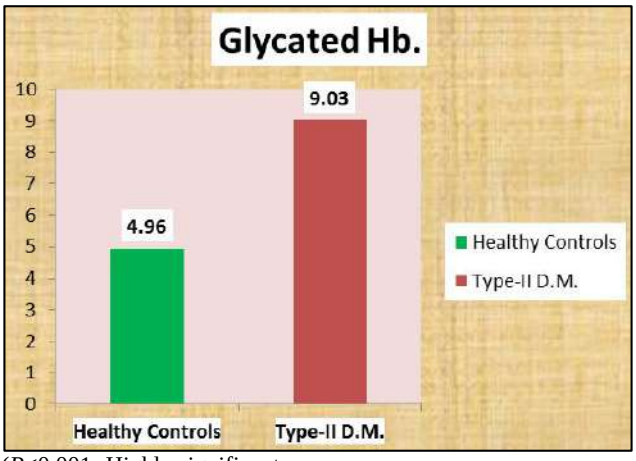
The correlation between HbA1c and SOD was found out by using Karl Pearson's Coefficient.

## Results and Observation

**Table 1:** Statistical Analysis of the Parameters of Glycemic Index in Healthy Controls and Type 2 D.M.

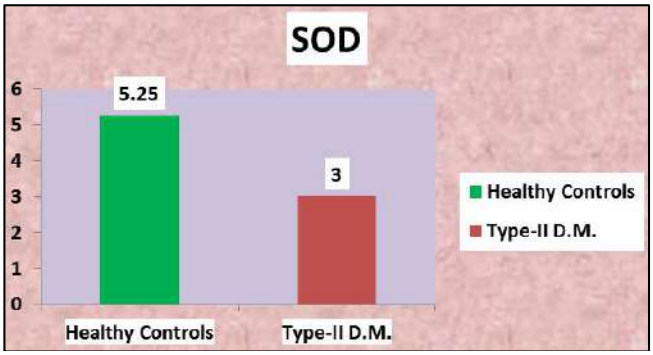
| Parameters | Healthy Controls n = 110 Mean ± SD | Type-II D.M. n = 110 Mean ± SD | 't' value | p-value | 'r' value |
|---|---|---|---|---|---|
| Glycated Hb % | 4.96 ± 0.60 | 9.03 ± 0.57 | 4.99 | <0.001 | -0.28 |
| SOD (U/gm. of HB) | 5.25 ± 0.49 | 3.00 ± 0. 44 | 25.83 | <0.001 | |

(n= number of cases, $p$<0.05 Significant value, $p$<0.001 highly significant)




($P$<0.001- Highly significant.

**Fig 1:** Concentration of Glycated Hemoglobin (%) in Healthy Controls and Type IIDM (Without any complications)




($P$<0.001- Highly Significant.)

**Fig 2:** Activity of SOD (U/gm. of Hb) by Kajari Das Method in Healthy Controls and type II diabetes (without any complications).

## Discussion

Oxidative stress is one of the important factors playing pathological role in diabetic complications and is a status in which disturbance in the balance between oxidants and natural antioxidants is seen. There are many possible explanations for increased oxidative stress observed in patients with D.M., one of them could be higher rates of glycation. Proposals have been made suggesting that increased glycation itself can lead to the production of free radicals [Palanduz S, *et al*, 2001] [7].

HbA1c can provide an accurate and reliable method to assess routinely the relative level of glycemic control.

In the present study, table no. 1 and figure 1 and 2 shows levels of glycated hemoglobin and SOD in healthy controls and type II diabetic patients. In diabetic patients, the mean HbA1C was increased as compared to control, this difference was statistically significant ($p$<0.001) when compared between study cases and healthy control subjects.

Superoxide Dismutase (SOD) is one of the defenses against oxidative stress. It catalyzes the dismutation of superoxide radicals to oxygen and hydrogen peroxide ($H_2O_2$). SOD is thought to be one of the major enzymes that protect cells from ROS. In the present study, figure no. 2 shows that erythrocyte SOD activity was significantly decreased in type 2 diabetic patients (without any complications) as compared to healthy controls ($P$<0.001).

Hyperglycemia seen in diabetes activates many reactions such as glucose autoxidation, non-enzymatic glycation of proteins, and activation of protein Kinase C. This results in the overproduction of Superoxide, Hydroxyl radicals and Hydrogen peroxide. So there is every possibility that while quenching superoxide, SOD may be utilized or SOD is inhibited by these oxidants and this causes a reduction in the SOD activity. Palanduz S *et al*. [7] observed that the SOD activity significantly decreased in diabetes mellitus. They suggested that there seems to be an imbalance between plasma oxidant and antioxidant systems in patients with type II diabetes. [Palanduz S, *et al*, 2001] [7]. Abdol Ijalal Marjani *et al*. also found decreased erythrocyte SOD enzyme activity with type II diabetes as compared to controls. These results led us to think if there is a relation between HbA1c level and SOD. This is the reason; we have correlated these two

parameters by using Karl Pearson's Coefficient. In the present study, we observed a non-significant inverse correlation ('r' value = -0.28). As the levels of HbA1c increase, there is a decrease in SOD levels. It indicates that there is an influence of glycemic control on antioxidant levels in diabetic subjects.

## Conclusion

From the present study, it is concluded that oxidative stress is in the foreground of diabetes. HbA1c the marker of glycemic control was compared with the oxidative stress marker SOD. There is an inverse correlation observed between these two markers. This indicates that as the degree of severity of diabetes increases, there is a decrease in SOD activity which leads to oxidative stress. It suggests that good glycemic control can reduce oxidative stress in diabetes mellitus.

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