# CORRELATION OF HbA1c, LIPID PROFILE AND FASTING BLOOD SUGAR AND DURATION OF DIABETES MELLITUS WITH SEVERITY OF DIABETIC RETINOPATHY

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## ABSTRACT
### BACKGROUND
We have studied patients having diabetic retinopathy attending the Department of Ophthalmology, Katuri Medical College, Guntur in a cross-sectional, hospital-based, non-interventional study.
Aim- To study the prevalence of different parameters like duration of diabetes mellitus, fasting blood sugar at the time of diagnosis of retinopathy, HbA1c, lipid profile and correlate with severity of diabetic retinopathy and assess the statistical significance.
Objective- To identify the important factors that can influence severity of Diabetic retinopathy in our area, in order to identify high-risk patients early, to prevent visual loss.

### MATERIALS AND METHODS
The present study is a hospital-based cross-sectional study, which was conducted at our tertiary care centre. We have studied a total of 302 patients diagnosed to have diabetic retinopathy for one and a half years in our tertiary care centre.

### RESULTS
Among the 302 patients taken into the study, 64% were females and 36% were males. Diabetic retinopathy predominantly occurred in patients above 50 years of age. HDL < 40 mg%, LDL > 100 mg% and VLDL > 40 mg% levels have significant correlation with different grades of retinopathy. This also denotes that these values are related to the severity of diabetic retinopathy. Glycosylated haemoglobin (HbA1c) above 7%, serum total cholesterol > 200 mg%, serum total triglycerides > 200 mg% and duration of diabetes mellitus > 9 years did not correlate with the severity of diabetic retinopathy.

### CONCLUSION
HDL < 40 mg%, LDL > 100 mg% and VLDL > 40 mg% levels have significant correlation with different grades of retinopathy. This also denotes that these values are related to the severity of diabetic retinopathy with chi-square test with p-value of < 0.05. HbA1c values and high fasting blood sugar did not correlate with severity of retinopathy.

### KEY WORDS
Diabetic Retinopathy, HbA1c, Lipid Profile, Triglycerides, Cholesterol.

## BACKGROUND
India is a high burden country of Diabetes with more than 62 million Diabetic individuals[1,2] and as a result Diabetic retinopathy is emerging as an important cause of visual disability reported by World Health Organisation.[3,4]

About 5.5 million adult patients with Diabetes have Diabetic retinopathy and 50,000 new cases of blindness occur per year, out of which 50% are caused by Diabetes, that too mostly by Diabetic retinopathy.[5]

Diabetic retinopathy is a vascular disorder affecting the microvasculature of retina.[2]

Diabetes mellitus is known to produce the microvascular complications,[6] and hyperlipidaemia causes endothelial

dysfunction due to reduced bioavailability of Nitric Oxide and breakdown of Blood-Retinal Barrier leading to exudation of serum lipid and lipoproteins, which result in Diabetic retinopathy changes and Diabetic macular oedema formation.[7,8]

The established risk factors for development and progression of Diabetic retinopathy include: Type, Duration, Age, Gender, BMI, Glycaemic control, Hypertension, Nephropathy, Smoking, Pregnancy and Serum lipid levels.[9,10]

HbA1c is presently the gold standard parameter, which detects the mean blood glucose levels over a period of 6 - 8 weeks and predicts the potential angiopathic complications.[11]

The pathogenic mechanisms of microvascular complications are same in Diabetic Retinopathy and Diabetic Nephropathy.[12]

### Aims and Objectives
- To study the relation of Fasting Blood Sugar at the time of Diagnosis, HbA1c and Lipid profile in different grades of Diabetic retinopathy.
- To correlate the severity of Diabetic retinopathy with Fasting Blood Sugars, HBA1C and Lipid profile.

- To identify the important factors that can influence severity of diabetic retinopathy in our area to identify high-risk patients early to prevent visual loss.

## MATERIALS AND METHODS
### Study Type
The present study is a hospital-based cross-sectional study, which was conducted at our tertiary care centre.

### Study Duration
The research study was conducted from April 2016 to October 2017.

### Inclusion Criteria
1. All the patients diagnosed as Diabetic Retinopathy above 20 years of age.
2. Patients of both sexes are taken into the study.

### Exclusion Criteria
Non-cooperative patients and patients with Diabetic retinopathy, who are seriously ill with other complications.

302 patients of Diabetes mellitus with Retinopathy were included in the study. All the patients with diabetic retinopathy were subjected to dilated fundoscopy with 90+ D lens direct ophthalmoscopy and were graded as follows:

- Microaneurysm (s) only- Grade I.
- Mild NPDR- Grade II.
- Moderate NPDR- Grade III.
- Severe NPDR- Grade IV.
- Proliferative DR- Grade V.

These patient's blood samples were assessed biochemically for glycosylated haemoglobin (HBA1C), lipid profile and Fasting Blood Sugar levels. HBA1C was assessed by Ion exchange resin method in a semi-auto chemistry analyser, whereas lipid profile was processed by fully auto-chemistry analyser.

Statistical Analysis: Descriptive statistics were used to present the findings. Chi-square test of association was used to study the association between severity of retinopathy and different variables under study.

## RESULTS

| Grade of Retinopathy | Males | Females | Total | % |
|---|---|---|---|---|
| Grade I | 36 | 48 | 84 | 27.81% |
| Grade II | 49 | 55 | 104 | 34.44% |
| Grade III | 43 | 39 | 82 | 27.15% |
| Grade IV | 08 | 08 | 16 | 5.29% |
| Grade V | 08 | 08 | 16 | 5.29% |
| Total | 144 | 158 | 302 | 100 |
| Percentage | 47.68% | 52.32% | 302 | 100 |
| *Table 1. Sex Distribution of patients of Diabetic Retinopathy* | | | | |

The Chi-square statistic for female preponderance is 1.61. The p-value is 0.806991. The result is not significant at p<0.05.

| Grade of Retinopathy | DM < 9 Years No. of Patients | DM > 9 Years |
|---|---|---|
| Grade I | 9 | 75 |
| Grade II | 8 | 96 |
| Grade III | 7 | 75 |
| Grade IV | 1 | 15 |
| Grade V | 1 | 15 |
| Total | 25 | 277 |
| *Table 2. Duration of Diabetes and Diagnosis of Retinopathy* | | |

The Chi-square statistic is 0.8111. P-value is 0.936949 and the value is not statistically significant for 0.05.

| Grade of DR | HbA1c < 7% | HbA1c 7 - 9% | HbA1c 9 - 11% | HbA1c > 11% | Total |
|---|---|---|---|---|---|
| Grade I | 01 | 29 | 42 | 12 | 84 |
| Grade II | 01 | 45 | 39 | 19 | 104 |
| Grade III | 02 | 37 | 34 | 09 | 82 |
| Grade IV | 01 | 06 | 06 | 03 | 16 |
| Grade V | 01 | 04 | 07 | 04 | 16 |
| Total | 06 | 121 | 128 | 47 | 302 |
| *Table 3. Diabetic Retinopathy and HbA1c* | | | | | |

The Chi-square statistic is 10.751. P-value is 0.550374. The result is not significant at p-value < 0.05.

| Grades of Retinopathy | FBS <100 mg% | FBS 100-200 mg% | FBS 200-300 mg% | FBS >300 mg% | Total |
|---|---|---|---|---|---|
| Grade I | 14 | 24 | 28 | 18 | 84 |
| Grade II | 19 | 33 | 38 | 23 | 103 |
| Grade III | 09 | 26 | 34 | 13 | 82 |
| Grade IV | 04 | 02 | 04 | 6 | 16 |
| Grade V | 03 | 04 | 03 | 6 | 16 |
| *Table 4. Fasting Blood Sugar and Grades of Retinopathy* | | | | | |

The chi-square statistic is 12.0226. The p-value is .443867 and the result is statistically not significant at p < 0.05.

**Lipid Profile and Diabetic Retinopathy**

| Retinopathy | LDL > 100 mg% = 266 | LDL < 100 mg% - 36 | Total |
|---|---|---|---|
| Grade I | 64 | 12 | **84** |
| Grade II | 88 | 16 | **104** |
| Grade III | 79 | 03 | **82** |
| Grade IV | 13 | 03 | **16** |
| Grade V | 14 | 02 | **16** |
| *Table 5. LDL > 100 mg% and Diabetic Retinopathy* | | | |

The Chi-square statistic is 13.9401. The p-value is .007489. The result is significant at p < 0.05.

| Retinopathy | HDL < 40 mg% = 242 | HDL > 40 mg% = 60 | Total |
|---|---|---|---|
| Grade I | 69 | 15 | **84** |
| Grade II | 59 | 24 | **104** |
| Grade III | 77 | 15 | **82** |
| Grade IV | 13 | 03 | **16** |
| Grade V | 13 | 03 | **16** |
| *Table 6. HDL < 40 mg% and severity of Retinopathy* | | | |

The Chi-square statistic is 38.3008. The p-value is <0.00001. The result is statistically significant at p < 0.05.

| Retinopathy | VLDL > 40 mg% = 185 | VLDL < 40 mg% = 117 | Total 302 |
|---|---|---|---|
| Grade I | 62 | 22 | **84** |
| Grade II | 75 | 29 | **104** |
| Grade III | 40 | 42 | **82** |
| Grade IV | 04 | 12 | **16** |
| Grade V | 04 | 12 | **16** |
| *Table 7. VLDL > 40 mg% and severity of Diabetic Retinopathy* | | | |

The Chi-square statistic is 33.8473. The p-value is <0.00001. The result is statistically significant at p < 0.05.

| Retinopathy | Cholesterol >200 mg% = 226 | Total Cholesterol <200 mg% = 76 | Total 302 |
|---|---|---|---|
| Grade I | 63 | 21 | **84** |
| Grade II | 76 | 28 | **104** |
| Grade III | 66 | 16 | **82** |
| Grade IV | 11 | 05 | **16** |
| Grade V | 10 | 06 | **16** |
| *Table 8. Total Cholesterol in Diabetic Retinopathy* | | | |

The Chi-square statistic is 3.1705. The p-value is .529709. The result is not statistically significant at p < 0.05.

| Retinopathy | TG > 200 mg% = 256 | TG < 200 mg% = 46 | Total 302 |
|---|---|---|---|
| Grade I | 73 | 11 | **84** |
| Grade II | 88 | 16 | **104** |
| Grade III | 72 | 10 | **82** |
| Grade IV | 12 | 04 | **16** |
| Grade V | 11 | 05 | **16** |
| *Table 9. Serum Triglycerides and Diabetic Retinopathy* | | | |

The Chi-square statistic is 5.2464. The p-value is .262934. The result is not significant at p < 0.05.

| Sl. No. | Variable | Chi-square Statistic | P-value | Significance at p < 0.05 |
|---|---|---|---|---|
| 1. | Female preponderance | 1.61 | 0.806991 | Not Significant |
| 2. | Duration of DM > 9 years | 0.8111 | 0.936949 | Not Significant |
| 3. | HbA1c | 10.751 | 0.550754 | Not Significant |
| 4. | Fasting Blood Sugar | 12.0226 | P 0.443867 | Not Significant |
| 5. | LDL >100 mg% | 13.9401 | P 0.007489 | Significant |
| 6. | HDL < 40 mg% | 38.3008 | P<0.00001 | Significant |
| 7. | VLDL > 40 mg% | 33.8473 | <0.00001 | Significant |
| 8. | Total Cholesterol | 3.1705 | 0.529709 | Not Significant |
| 9. | Serum Triglycerides | 5.2464 | 0.262934 | Not Significant |
| *Table 10. Statistical Summary* | | | | |

### Statistical Analysis

Descriptive statistics were used to present the findings. Chi-square test of association was used to study the association between severity of retinopathy and different variables under study.

### DISCUSSION

As diabetic retinopathy is one of the major causes of visual disability, assessing the risk factors will add an immense value to the study.

There is a female preponderance among cases of diabetic retinopathy. Similar findings were observed in several studies in India and abroad, though there is no statistical significance for female preponderance.

We correlated the duration of diabetes and severity of retinopathy. Though majority of the patients of DR have a diabetic history of > 9 years, the correlation has no statistical significance.

In our present study, glycosylated haemoglobin (HbA1c) in correlation with different grades of diabetic retinopathy showed P-value of 0.550754, which is not statistically significant. CURES Eye Study[13] with linear trends in prevalence of Diabetic retinopathy showed statistical significance (P-value < 0.001).

In a study conducted by Maberley DAL et al in 2007, it was found that poor glycaemic control was associated with increased risk of retinopathy in Diabetics.[14] In Rajiv Raman et al study, a strong association of HbA1c with sight threatening Diabetic retinopathy (P-value < 0.001) was found.[15]

Concerning lipid profile, in our study HDL (< 40 mg%), LDL (> 100 mg%) and VLDL (> 40 mg%) showed high significance and correlated with the severity of Diabetic retinopathy (p-value < 0.05) and Total Cholesterol and Triglyceride levels did not correlate with severity of Diabetic retinopathy. In Rahman et al study, HDL was significantly lower in patients with NPDR.

In Gnaneswaran et al study, TC and LDL were significantly higher in Diabetic retinopathy patients.[16]

In our study, high Fasting blood sugar did not correlate with the severity of diabetic retinopathy.

In a Chinese study, both FBG and higher HbA1c were found to be independent risk factors for Diabetic Retinopathy (DR) and Sight-Threatening Diabetic Retinopathy (STDR).[17]

In our study, duration of Diabetes mellitus did not correlate with severity of retinopathy. Many studies correlated development of DR with duration of diabetes mellitus.[18]

### Abbreviations

DR: Diabetic Retinopathy. NPDR: Non-proliferative Diabetic Retinopathy, LDL: Low Density Lipoproteins, HDL: High Density Lipoproteins, VLDL: Very Low Density Lipoproteins, HbA1c: Glycosylated Haemoglobin, NPDR: Non-proliferative Diabetic Retinopathy.

### CONCLUSION

HDL < 40 mg%, LDL > 100 mg% and VLDL > 40 mg% levels have significant correlation with different grades of retinopathy. This also denotes that these values are related to the severity of Diabetic retinopathy, Chi-square test with p-value of < 0.05. HbA1c values and High Fasting blood sugar did not correlate with severity of retinopathy.

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