

## The association of age with glycaemic and cholesterol control in patients with type 2 diabetes mellitus

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### Abstract

**Objective:** To find the risk of dyslipidaemia in diabetic patients of different age groups.

**Methods:** This cross-sectional study was conducted at Holy Family Hospital, Rawalpindi, and Pakistan Ordnance Factories Hospital, Wah Cantonment, Pakistan, from February to July 2014, and comprised type 2 diabetic patients. Patients' body mass index was calculated and biochemical tests were performed for high-density lipoprotein, total cholesterol, low-density lipoprotein, triglyceride and glucose. Data was analysed using SPSS 20.

**Results:** Of the 40 patients, 17(42.5%) were men and 23(57.5%) women. The blood glucose control of younger age group (30-40 years) was  $234 \pm 90.37$  mg/dl compared to older age group (60-70 years) with a mean of  $173.4 \pm 54.2$  mg/dl. Serum triglyceride levels of the youngest age group (30-40 years) were the highest with a mean value of  $216 \pm 137$  mg/dl. There was a significant association between age and triglyceride levels ( $p=0.03$ ), while the serum high-density lipoprotein level of this group was lowest with a mean of  $29.6 \pm 13.4$  mg/dl.

**Conclusion:** There was a significant association between triglyceride levels in the youngest age group of patients with type 2 diabetes.

**Keywords:** Age, women, HDL-C, Diabetes mellitus, Triglycerides, Hyperglycaemia. (JPMA 67: 33; 2017)

### Introduction

Diabetes mellitus (DM) occurs when enough insulin is not produced by pancreas or body cannot effectively use insulin. This leads to an increased concentration of glucose in the blood (hyperglycaemia).<sup>1</sup> Diabetes mellitus causes chronic harm, brokenness and malfunction of different organs.<sup>2</sup> The American Diabetes Association (ADA) depicts that immune system pulverisation of the beta ( $\beta$ )-cells of the pancreas with subsequent insulin insufficiency or insulin resistance drives to diabetes.<sup>3</sup> Type 2 diabetes mellitus (T2DM) develops in association with multiple genetic factors leading to decreased insulin secretion or insulin resistance amplified by lifestyle habits, such as overeating, lack of exercise and resultant obesity.

It is estimated that 415 million people worldwide have diabetes with about 80% living in low- and middle-income countries.<sup>4,5</sup> The International Diabetes Federation states that Pakistan has 10.1 million people with diabetes and the number may rise to 14.4 million people by the year 2040.<sup>6</sup>

It is reported that there is an increased risk of developing complications of diabetes with uncontrolled glycaemia.<sup>7</sup>

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The incidence of retinopathy, nephropathy, hypertension and deranged lipid metabolism is high in diabetic patients. The diabetic patients develop or are prone to develop atherosclerotic cardiovascular disease (CVD), cerebrovascular disease and peripheral arterial diseases.<sup>8</sup>

Dyslipidemia surges the risk of atherosclerosis which results in increased risk of cardiovascular disease. According to United States Centre for Disease Control and Prevention (CDC), 97% of people with diabetes are affected by dyslipidaemia.<sup>9,10</sup> For decreasing the threat of cardiovascular disease, controlling high triglycerides (TG) and cholesterol level is as important as regulating blood sugar and blood pressure.<sup>11</sup> The main features of altered lipid level in diabetes are increased plasma TG, decreased high-density lipoprotein (HDL) cholesterol and raised level of low-density lipoprotein (LDL) particles.<sup>12</sup> Increased free fatty acid results in changes in lipid metabolism in diabetes mellitus and is secondary to insulin resistance.<sup>13</sup>

Female and diabetic patients of younger age group i.e. < 45 years, are especially at risk.<sup>14</sup> Early exposure to hyperglycaemia in young adults leads to higher risk for dyslipidemia.<sup>15</sup> The present study was planned to compare blood sugar control and lipid profile with reference to gender and age in patients of type 2 diabetes.

### Patients and Methods

This cross-sectional study was conducted at Holy Family

Hospital, Rawalpindi, and Pakistan Ordnance Factories (POF) Hospital, Wah Cantonment, Pakistan, from February to July 2014, and comprised T2DM patients. Genetic mutations and single nucleotide polymorphism in the patients were identified with the help of real-time polymerase chain reaction (RT-PCR) and deoxyribonucleic acid (DNA) sequencing. As with all the genetic mutation and single nucleotide polymorphism studies, traditional sample size calculation was dispensed with. For a traditional cross-sectional study, the sample size calculation criterion was necessitated but not accounted for, considering the scope of genetic mutation and polymorphism studies, especially in the developing countries with limited resources. Therefore, the current study's data was considered to be of value for further evaluation to be carried out in an independent study especially designed for the purpose of further elaboration. Patients with type 1 diabetes mellitus (T1DM), gestational diabetes mellitus, and type 2 diabetics with CVD, liver disease and those taking statins were excluded. Study was endorsed by the institutional ethical committee and written consent was obtained from all the subjects. Patients' body mass index (BMI) was calculated and blood sample was collected in fasting state for analysis of lipid profile and blood glucose fasting (BSF). Serum cholesterol, HDL and TG levels were estimated by enzymatic colorimetric kit. LDL was calculated by Friedewald equation. SPSS 20 was used for data analysis. Sample t-test was applied to find out the difference in relation to gender and one-way analysis of variance (ANOVA) for different age groups. Data was expressed as mean  $\pm$  standard deviation (SD).  $P < 0.05$  was considered significant.

## Results

Of the 40 patients, 17(42.5%) were males and 23(57.5%)

**Table-2:** BSF and lipid profile of both males and females patients of type 2 diabetes.

Gender	Male patients of T2DM	Female patients of T2DM
BSF	180.2 $\pm$ 72.01	221.6 $\pm$ 94.39
Serum Cholesterol	171.1 $\pm$ 48.13	176.74 $\pm$ 68.08
Serum Triglycerides	168.5 $\pm$ 95.5	165.13 $\pm$ 77.9
Serum HDL	37.29 $\pm$ 8.99	33.65 $\pm$ 12.1
Serum LDL	107 $\pm$ 48.9	117 $\pm$ 53.9
Cholesterol to HDL ratio	4.49 $\pm$ .84	5.82 $\pm$ 2.4

BSF: Blood glucose fasting  
 HDL: High-density lipoprotein  
 LDL: Low-density lipoprotein  
 T2DM: Type 2 diabetes mellitus.

females. The participants' ages ranged from 30 to 70 years. Moreover, 21(52.5%) participants had dyslipidaemia while 19(47.5%) did not have the condition. Of the former, 10(47.62%) were males and 11(52.38%) were females, whereas of the former 7(36.84%) were males and 12(63.15%) females.

Besides, 8(20%) patients were aged between 30-40 years, 6(15%) 41-50 years, 12(30%) 51-60 years and 14(35%) 61-70 years. Blood sugar control of younger age group (30-40 years) was poor with a mean of 234 $\pm$ 90.37mg/dl as compared to older age group (61-70 years) with a mean value of 173.4 $\pm$ 54.2 mg/dl. The serum triglyceride level of the younger most age group (30-40 years) was the highest with a mean of 216 $\pm$ 137 mg/dl while the serum HDL level of this group was the lowest with a mean of 29.6 $\pm$ 13.4 mg/dl. The serum cholesterol level and serum LDL level of the 41-50 years' age group was the highest with a mean of 216 $\pm$ 110 mg/dl and 142.2 $\pm$ 79.32 mg/dl, respectively (Table-1).

The mean values of BSF (221.6 $\pm$ 94.39), serum cholesterol

**Table-1:** Blood sugar fasting and lipid profile of diabetic patients according to age.

Variables	Age of the Patients				P-value
	30-40	41-50	51-60	61-70	
BMI	25.9 $\pm$ 4.9	23.86 $\pm$ 7.8	24.7 $\pm$ 4.6	25.1 $\pm$ 4.7	0.97
BSF	234 $\pm$ 90.37	196.2 $\pm$ 127	221.3 $\pm$ 96.1	173.4 $\pm$ 54.2	0.25
Cholesterol	161.1 $\pm$ 131.9	216 $\pm$ 110	165 $\pm$ 47.4	175.3 $\pm$ 58.8	0.21
Triglycerides	216 $\pm$ 137	178.6 $\pm$ 109.2	168.69 $\pm$ 49	132 $\pm$ 56	0.06*
HDL	29.6 $\pm$ 13.4	38.8 $\pm$ 13	34.77 $\pm$ 8.6	37.5 $\pm$ 10.3	0.26
LDL	122.8 $\pm$ 63.8	142.2 $\pm$ 79.32	101.7 $\pm$ 42.4	107.9 $\pm$ 40	0.30
Cholesterol to HDL ratio	6.32 $\pm$ 2.5	5.52 $\pm$ 1.44	5.25 $\pm$ 2.25	4.56 $\pm$ 1.45	-

$p \leq 0.05$ (ANOVA)

BMI: Body mass index

BSF: Blood glucose fasting

HDL: High-density lipoprotein

LDL: Low-density lipoprotein

ANOVA: Analysis of variance.

(176.74±68.08) and serum LDL (117±53.9) were higher in females compared to 180.2±72.01, 171.1±48.13 and 107±48.9, respectively, in males. The mean levels of serum triglyceride (168.5±95.5) and serum HDL (37.29±8.99) of males were raised as compared to females (165.13±77.9, 33.65±12.1) (Table-2).

## Discussion

Dyslipidaemia in type 2 diabetes is very common. There are multiple effects of insulin resistance on fat metabolism. Raised plasma triglycerides (because of increased very low-density lipoprotein (VLDL) and lipoprotein remnants), high oxidised LDL and decreased HDL cholesterol are commonly seen in type 2 diabetes mellitus. Oxidised LDL is taken up by non-specific endocytosis that escalates atherosclerosis.<sup>16</sup>

Previous studies report an inverse relationship between glycaemic control and age.<sup>17,18</sup> Our study also demonstrated poor glycaemic control in younger age group compared to older age groups and it was associated with poor lipid profile in young patients. Early onset of poor glycaemic and lipid control results in a higher risk of both micro- and macro-vascular complications in younger patients and aggressive treatment was recommended for treating these patients.<sup>19</sup> Toh et al. reported that the exact cause of poor glycaemic control in younger patients compared to the older patients is not yet clear. One reason could be that the older patients take better care of their diabetes as they are more interested in taking medicine and in eating healthy low-fat diet. While it is a possibility that younger patients are careless about diabetes and they are not much interested in medication, lifestyle changes and diet restriction. In our study it was seen that the serum triglycerides levels improved with age and they are least in the older (60-70) age group. The reason may be that better glycaemic control decreased VLDL (triglyceride rich) production resulting in better triglycerides level.<sup>20</sup> Serum cholesterol and LDL were highest in the 41-50 years' age group. This could be due to the reason that the optimisation of serum total cholesterol and LDL is a slow process and lipoprotein turnover takes a longer time. Additionally, other factors like stress, lifestyle and hormonal changes may also have contributed to these elevated levels. In our study it was found that the female patients have poor blood sugar control, raised LDL and serum cholesterol and decreased HDL as compared to males. The reason behind this uncontrolled blood sugar and dyslipidaemia might be enhanced activity of hormone-sensitive lipase and lipoprotein lipase in females as compared to males.<sup>21</sup>

The current study was not without its limitations. The sample size was limited because of the overwhelming expenses involved in carrying out genetic studies resulting in financial constraints. Moreover, finding patients with type 2 diabetes not taking statins and without any cardiovascular disease was difficult. Complete lipid profile was not routinely done for type 2 diabetic patients due to funding constraints.

## Conclusion

Younger patients and female patients of type 2 diabetes had the worst blood glucose control and more atherogenic dyslipidaemia as compared to older patients and men. Subsequently, lifestyle adjustment is needed in these high-risk patients to combat the risk for dyslipidaemia and atherosclerosis. Further research to explore the causes for poor glycaemic control and dyslipidaemia at molecular level will be useful to find treatment among such patients.

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**Conflict of Interest:** None.

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