

Original Research Article

## Macrovascular Complications and Associated Risk Factors in Newly Diagnosed Patients of Diabetes Mellitus Type 2 in City Ajmer

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### ABSTRACT

**Background:** Diabetes and its macrovascular complications are notice in rapid alarming rate of prevalence and one of the leading causes of death and disability in the entire globe.

**Aim:** The aim of the study is to estimate the prevalence and associated risk factors of macro vascular complication among diabetes mellitus type 2 population of Ajmer, Rajasthan India.

**Method:** This is the study of 464 newly detected type 2 diabetic people screened for their biochemical parameters, attending outpatient department comprising of 256 male and 208 female. A baseline questionnaire was phrased for obtaining the information about socio demographic status, age, past history, family history, stress and complications. The presence of complications was evaluated by relevant investigations. The biochemical marker studies included blood glucose, HbA1C, cholesterol and triglycerides.

**Analysis:** Logistic regression analysis is used to establish the association between diabetes complications and risk factor with significant level ( $p < 0.05$ ).

**Result:** Macrovascular complications CAD was diagnosed in 104 (22%) diabetic patients of type 2, CVD cases in 144 (31%), PVD in 260 (56%) and foot diseases in 303 (65%) diabetic patients. Linear regression analysis concluded that age, BMI, duration, family history, stress, HBA1C, triglyceride and total cholesterol were significantly associated with vascular complications. Macrovascular complication was associated with age, BMI, family history and higher level of biochemical parameters such as cholesterol, triglycerides and blood glucose.

**Conclusion:** PVD and foot diseases were most prevalent macrovascular complication in type 2 diabetic population of Ajmer city. Macrovascular complication were delayed or controlled by biochemical parameters within normal range.

**Key words:** Diabetes Type 2, Macrovascular complication, Chronic or long term complication, CAD, CVD, PVD and foot diseases.

### INTRODUCTION

Diabetes is a metabolic disease that is diagnosed on the basis of sustained high concentration of glucose in the blood. Type 2 diabetes is characterized by resistance to the action of insulin and disorder of insulin secretion, either of which may be the predominant feature. If it is not properly treated or left untreated it is characterized by chronic hyperglycemia and disordered carbohydrate, lipid and protein metabolism.

Over time, diabetes can increase the risk of health-related problems including blindness, kidney damage, nerve damage, amputation of lower limbs and cardio vascular disease or is associated with the development of specific microvascular complications and of non specific macrovascular disease. <sup>[1]</sup> Macrovascular includes the complications of heart (Cardio Vascular Disease) and brain (Coronary Arterial Diseases) and nerves (Peripheral

Vascular Diseases). Diabetes people are at higher risk of developing a number of complications than people without diabetes.

The global prevalence and economic cost of diabetes and its complications are abnormally increasing with alarming rate. According to the diabetes atlas, seventh edition 2015 published by the IDF, the global number of diabetes in 2015 was estimated to be 415 million and this figure projected to increase in 2040 to 642 million. Out of this 298 million will live in developing countries. In India currently around 69.2 million is expected to rise to 123.5 million by 2040. [2]

Diabetes is likely to be underreported as a cause of death simply because diabetes leads to many complications that ultimately cause death. Estimated death due to diabetes in 2015 was 5.0 million. In every 10 seconds, diabetes causes one death and one amputation every 30 seconds.

Diabetes complications can affect many parts of body, manifesting in different ways in different people. It is found that due to variety of method of studying complications in different population, there are no internationally agreed standards for diagnosing and assessing diabetes complications. Therefore, we study the influence and prevalence of various modifiable and non-modifiable risk factors on complication.

### **Aim**

The aim of the present study is to describe the prevalence and associated risk factors of macrovascular complication among diabetic population of Ajmer Rajasthan India. Diabetes and its complication both are the major health challenge for small city of Ajmer.

### **MATERIALS AND METHODS**

A total of 500 diabetic patients of all age groups were invited to participate in the study but only 464 patients comprising of 256 male and 208 female agreed to sign a written consent of all related aspect and outcomes. This is the four years study

(January 2013 to Decemder 2016) of newly detected type 2 diabetes people screened for their biochemical parameters, attending outpatient department (OPD) especially consultations of Department of Biochemistry, JLN Medical college, and Saxena Diabetes Care Centre Ajmer. The approval was obtained by the Ethical Board of the JLN Medical College, Ajmer (Raj). Classification and diagnosis criteria of Diabetes Mellitus Type 2 was done on the basis of WHO (1999), according to which FPG  $\geq 110$ mg/dl and after 2hrs post load glucose PPG  $\geq 200$ mg/dl are diabetic. [3] The biochemical marker studies included blood glucose, HBAIC, cholesterol and triglycerides. A questionnaire was phrased for obtaining the information about age, socio demographic status, past history, family history, stress and complications. Anthropometric measurements, height, weight (BMI) of each participant was recorded. The presence of complications was evaluated by relevant investigations. Peripheral vascular disease and foot problem was diagnosed by history of numbness, tingling and burning sensations and confirmed by vibration test with biothesiometer and examination of peripheral pulses of feet or ankle branchial pressure index.

### **Analysis of data**

Entire data was entered in excel spreadsheet by masking personal identity of each respondent. Mean and percentage were calculated for each suitable studied variable. Linear regression analysis is used to establish the association between diabetes complication and risk factor. SPSS version 21 software is used for statistical analysis.

### **RESULT**

Total number of type 2 DM patients studied were 464. Macrovascular complications namely CAD was diagnosed in 104 (22%), CVD in 144 (31%), PVD in 260 (56%) and foot diseases in 303 (65%).

### **Modifiable risk factor**

In table 1 Regression analysis showed that advance age showed a

significant association with all complications of a P value <0.05. BMI was significantly (P value <0.05) associated with foot problems (P=0.003). Duration of diabetes is not significantly affecting the macrovascular complication (P = 0.11, 0.15, 0.12 and 0.48 respectively). Hereditary factor was significantly associated with CVD (P value = 0.01).

**In table 2** patients of type 2 DM were divided into seven age groups according to their age in years 11 to 20 is the lowest and 71 to 80 years is the highest group. Maximum patients were suffering from foot disease 100 (69%) and PVD 92 (64%) in age group of 51 to 60, CAD 32 (22%) and CVD 40 (40%). Maximum patients of foot disease are 116 out of 464, CAD 36, CVD 56 and PVD 80 was found in the overweight categories whose BMI were in between 25-29.99 kg/cm<sup>2</sup>. The maximum prevalence of foot problem (73%), was found in overweight categories of BMI. CAD (65%) and CVD (37%) was in obese I and PVD (70%) in obese class II. Highest incidences of macrovascular complication lie in the group of 1 to 5 years of duration of diabetes. Prevalence of vascular complication increased with duration, after 11 to 15 years 73% patients were suffering from foot disease and after 16 to 20 years of diabetes the prevalence of CAD and CVD was 29% and 53% respectively. Maximum incidences of vascular complications are found in categories those do not have any family history of diabetes. But prevalence of complication in CAD, CVD, PVD and foot problem was found 33% (father), 50% (sibling), 63% (mother) and 80% (both parents) respectively.

**Non modifiable risk factor**

**Table 1** mention various situation of stress that were significantly affect the CAD (P value = 0.00) and CVD (P value = 0.05). CAD (P value = 0.001) were significantly associated with triglycerides. CAD (P value = 0.01) and foot diseases (P value = 0.00) were significantly affected with HbA1C. High cholesterol level significantly affects all the Macro vascular complications (P

value <0.05) namely CAD, CVD, PVD and foot diseases.

**Table 1:** showing the correlation of modifiable and non-modifiable factor with diabetic complications:

Risk factors	Pearson Correlation	CAD	CVD	PVD	Foot problem
Age-group	Std. coefficients Beta	-0.199	-0.084	-0.198	0.118
	(Sig) P-value	0	0.036	0	0.005
BMI	Std. coefficients Beta	-0.029	0.014	-0.053	0.128
	(Sig) P-value	0.268	0.386	0.126	0.003
Duration	Std. coefficients Beta	-0.055	-0.047	0.053	-0.001
	(Sig) P-value	0.118	0.156	0.129	0.489
Family history	Std. coefficients Beta	-0.039	-0.104	0.013	0.024
	(Sig) P-value	0.199	0.013	0.393	0.3
Stress	Std. coefficients Beta	-0.202	-0.076	-0.009	-0.027
	(Sig) P-value	0	0.051	0.425	0.284
HbA1C	Std. coefficients Beta	0.102	0.007	0.011	0.158
	(Sig) P-value	0.014	0.442	0.404	0
Triglyceride (TG)	Std. coefficients Beta	-0.141	0.001	-0.006	-0.068
	(Sig) P-value	0.001	0.491	0.447	0.072
Total Cholesterol	Std. coefficients Beta	-0.155	-0.124	-0.144	-0.106
	(Sig) P-value	0	0.004	0.001	0.012

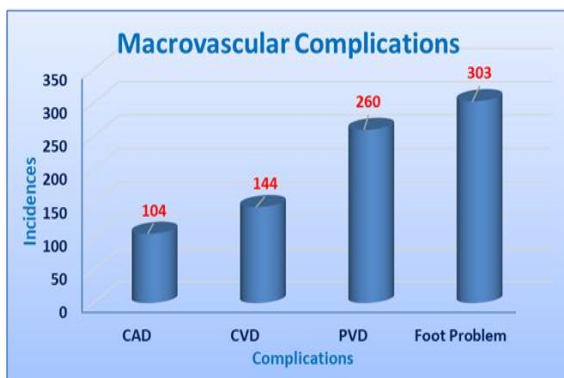
**Table 2:** Describes the prevalence and incidences of diabetic complications in non-modifiable factors

	Age group	Total	CAD	CVD	PVD	Foot Problem
		N (Pre. %)	N (Pre. %)	N (Pre. %)	N (Pre. %)	N (Pre. %)
Age Group	11-20 yrs	8 (2)	0 (0)	0 (0)	0 (0)	3 (38)
	21-30 Yrs	16 (3)	0 (0)	0 (0)	4 (25)	5 (31)
	31-40 yrs	40 (9)	4 (10)	12 (30)	12 (30)	20 (50)
	41-50 yrs	100 (22)	20 (20)	40 (40)	56 (56)	70 (70)
	51-60 yrs	144 (31)	32 (22)	40 (28)	92 (64)	100 (69)
	61-70 yrs	104 (22)	28 (27)	32 (31)	68 (65)	76 (73)
	71-80 yrs	52 (11)	20 (38)	20 (38)	28 (54)	29 (56)
	<b>Total</b>	<b>464 (100)</b>	<b>104 (22)</b>	<b>144 (31)</b>	<b>260 (56)</b>	<b>303 (65)</b>
Duration of Diabetes	11 month	88 (19)	22 (25)	31 (35)	57 (65)	58 (66)
	1-5 yrs	229 (49)	50 (22)	65 (28)	126 (55)	152 (66)
	6-10 yrs	88 (19)	14 (16)	29 (33)	48 (55)	53 (60)
	11-15 yrs	37 (8)	8 (22)	5 (14)	15 (41)	27 (73)
	16-20 yrs	17 (4)	5 (29)	9 (53)	9 (53)	9 (53)
	21-25 yrs	4 (1)	4 (100)	4 (100)	4 (100)	4 (100)
	26-30 yrs	1 (0)	1 (100)	1 (100)	1 (100)	0 (0)
	<b>Total</b>	<b>464 (100)</b>	<b>104 (22)</b>	<b>144 (31)</b>	<b>260 (56)</b>	<b>303 (65)</b>
BMI of Diabetic patients	<18.5	24 (5)	8 (33)	4 (17)	12 (50)	12 (50)
	18.5-24.99	144 (31)	24 (17)	44 (31)	84 (58)	85 (59)
	25-29.99	160 (34)	36 (23)	56 (35)	80 (50)	116 (73)
	30-34.99	76 (16)	24 (32)	28 (37)	44 (58)	53 (70)
	35-39.99	40 (9)	8 (20)	8 (20)	28 (70)	25 (63)
	>40	20 (4)	4 (20)	4 (20)	12 (60)	12 (60)
	<b>Total</b>	<b>464 (100)</b>	<b>104 (22)</b>	<b>144 (31)</b>	<b>260 (56)</b>	<b>303 (65)</b>
Family history	None	220 (47)	48 (22)	52 (24)	120 (55)	141 (64)
	Mother	96 (21)	16 (17)	44 (46)	60 (63)	59 (61)
	Father	60 (13)	20 (33)	16 (27)	32 (53)	38 (63)
	Both parent	20 (4)	4 (20)	4 (20)	12 (60)	16 (80)
	Parents and Sibling	44 (9)	8 (18)	16 (36)	24 (55)	32 (73)
	Siblings	24 (5)	8 (33)	12 (50)	12 (50)	17 (71)
	<b>Total</b>	<b>464 (100)</b>	<b>104 (22)</b>	<b>144 (31)</b>	<b>260 (56)</b>	<b>303 (65)</b>

**Table 3** showed that health and anxiety were the situation of stress in vascular complications. Total 312 diabetes type 2 patients were having triglyceride level above the normal range. Out of 464 diabetes patients 172 have fair control, 142 have poor and 21 were having very poor control on blood sugar.

**Table 3: Describes the prevalence and incidences of diabetic complications in modifiable factors**

	Description	Total	CAD	CVD	PVD	Foot Problem
		N (Pre. %)	N (Pre. %)	N (Pre. %)	N (Pre. %)	N (Pre. %)
Situation of stress	Death of close relative	16 (3)	4 (25)	8 (50)	12 (75)	9 (56)
	Anxiety persisting	40 (9)	0 (0)	12 (30)	20 (50)	28 (70)
	Health	192 (41)	36 (19)	48 (25)	104 (54)	127 (66)
	Financial problem	20 (4)	4 (20)	8 (40)	16 (80)	20 (100)
	Property	4 (1)	0 (0)	0 (0)	4 (100)	1 (25)
	Education and career	24 (5)	0 (0)	0 (0)	4 (17)	12 (50)
	Children marriage	12 (3)	8 (67)	12 (100)	12 (100)	1 (8)
	Work load	20 (4)	4 (20)	4 (20)	8 (40)	13 (65)
	Death of relative, Anxiety and Health	52 (11)	16 (31)	24 (46)	28 (54)	37 (71)
	Property and Financial	52 (11)	24 (46)	20 (38)	32 (62)	37 (71)
Triglyceride (TG)	Education, Child marriage and Work load	32 (7)	8 (25)	8 (25)	20 (63)	18 (56)
	<b>Total</b>	<b>464 (100)</b>	<b>104 (22)</b>	<b>144 (31)</b>	<b>260 (56)</b>	<b>303 (65)</b>
	(Optimal)	28 (6)	0 (0)	12 (43)	20 (71)	21 (75)
	(Normal)	124 (27)	24 (19)	32 (26)	60 (48)	79 (64)
	(High)	312 (67)	80 (26)	100 (32)	180 (58)	203 (65)
Hemoglobin glucose HbA1C	<b>Total</b>	<b>464 (100)</b>	<b>104 (22)</b>	<b>144 (31)</b>	<b>260 (56)</b>	<b>303 (65)</b>
	( non diabetic)	12 (3)	8 (67)	4 (33)	8 (67)	8 (67)
	(good control)	112 (24)	33 (29)	36 (32)	66 (59)	88 (79)
	(fair control)	172 (37)	24 (14)	52 (30)	84 (49)	93 (53)
	(poor control)	147 (32)	35 (24)	47 (32)	91 (62)	99 (67)
	(very poor)	21 (5)	4 (19)	5 (24)	11 (52)	15 (71)
Total Cholesterol	<b>Total</b>	<b>464 (100)</b>	<b>104 (22)</b>	<b>144 (31)</b>	<b>260 (56)</b>	<b>303 (65)</b>
	(normal)	32 (7)	0 (0)	0 (0)	16 (50)	20 (63)
	(Optimal)	144 (31)	28 (19)	48 (33)	64 (44)	94 (65)
	(high)	288 (62)	76 (26)	96 (33)	180 (63)	189 (66)
	<b>Total</b>	<b>464 (100)</b>	<b>104 (22)</b>	<b>144 (31)</b>	<b>260 (56)</b>	<b>303 (65)</b>



**Fig. 1: Incidences of Macrovascular complications in Type 2 DM patients in Ajmer district**

## DISCUSSION

### Coronary Arterial Diseases (CAD)

Fuster and Voute et al., 2007 [4] reported cardiovascular mortality has been

1.5 to 2 times higher among the working population in India and also concluded that in low- and middle-income countries, smoking and obesity affect a larger proportion of younger patients. Our finding collaborates with these previous research findings. Jayashankar and Andrews et al., 2016 [5] reported serum LDL cholesterol and hyperuricemia may serve as independent predictors of CAD among Asian Indian with type 2 DM. Mohan and Deepa et al., 2001 [6] identified age and LDL cholesterol as the risk factors for CAD. Berry et al., 2012 [7] after reviewing the lifetime risks of cardiovascular disease in 18 studies reported significant differences were noted by blood pressure, cholesterol level, smoking status, diabetes status in different age group as well as gender and race.

### Cardio Vascular Disease (CVD)

Gray et al., 2015 [8] and Mutsert and Sun et al., 2014 [9] concluded that High BMI (BMI >40 kg/m<sup>2</sup>) in diabetic women and adulthood is associated with increased risk of CVD complications. However, in our study, BMI, duration of diabetes, hyperglycemia, and triglycerides were not identified as independent predictors but age, total cholesterol, family history, stress are proven CVD risk factors. This could probably be due to small sample size of our study and warrants further evaluation.

### Peripheral Vascular Disease (PVD)

Ramachandran and Snehalatha et al., 1999 [10] showed age had a significant association with PVD but hypertension was not associated with the complications of PVD. Mohan V, Premalatha et al., 1995 [11] showed that serum cholesterol, serum creatinine, systolic BP, duration of diabetes and ischaemic heart disease were strong predictive factors for PVD. AWORI DM., 2016 [12] reported in their dissertation that age, gender, diabetes were significantly associated with the PVD but smoking and hypertension did not reached at significant level. Our results showed that age and cholesterol are significantly associated with peripheral vascular diseases and are more consistent with the recent finding of Mohan



V et al. and partly with other earlier findings.

### Foot problem

Manda V et al., 2012 <sup>[13]</sup> concluded Asian middle-aged male diabetics are most likely to have foot complications whose HDL levels were high whereas post-prandial blood glucose levels were comparatively low in diabetics with foot ulcers than without. Al Kafrawy et al., 2014 <sup>[14]</sup> concluded that peripheral neuropathy, duration of diabetes, peripheral vascular disease, and poor glycemic control were significant predictors of Diabetic Foot Ulcers. Mayfield et al., 1996 <sup>[15]</sup> Peripheral neuropathy, peripheral vascular disease, deformity, and a prior ulcer were associated with an increased risk of lower extremity amputation. Shahi et al., 2012 <sup>[16]</sup> reported age, duration of diabetes, tobacco use, oral hypoglycemic treatment/insulin use and rural location were identified as important risk factors in north India. Rubeaan et al., 2015 <sup>[17]</sup> concluded that Charcot joints, peripheral vascular disease (PVD), neuropathy, diabetes duration  $\geq 10$  years, insulin use, retinopathy, nephropathy, age  $\geq 45$  years, cerebral vascular disease (CVD), poor glycemic control, coronary artery disease (CAD), male gender, smoking, and hypertension to be significant risk factors. Our result partly supports the findings that reports age, poor glycemic control or higher HbA1C and cholesterol are identified as a risk factor for diabetes foot.

### CONCLUSION

Screening with some simple test ECG, biothesiometer and lipid, protein and fat profile at the diagnosis for all cases of diabetes is essential to identify the complications at an early age. Macrovascular complication were delayed or controlled by biochemical parameters within normal range. PVD and foot diseases were most commonly found in diabetic patient of Ajmer city. No such studies in the past have been done in this region, through which comparisons could be made. Further studies are required to justify the conclusion

of risk and complications in Ajmer Rajasthan (India). Poorly managed diabetes leads to serious complications, reduced quality of life and early death. Diabetes complications can be prevented or delayed by maintaining blood glucose, blood pressure and cholesterol levels as close to normal.

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