

Vascular Complications and their Risk Factors in Patients of Diabetes Mellitus, Type 2

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ABSTRACT

Introduction: To evaluate the vascular complications and their correlation with different risk factors among type-2 diabetic patients in Hyderabad, Sindh, Pakistan.

Methodology: Cross-sectional study was conducted at the department of medicine Isra University Hospital, Hyderabad from March to September 2021. Type 2 diabetics of either sex, between ages 20 and 70 years, on diabetic medication, were included in the study. While patients with type I diabetes, unconscious or with any mental health issues were excluded. A Non-random consecutive sampling technique was applied for the selection of participants. Socio-demographic, disease and medication information was collected using a written questionnaire while serum glucose level, albumin and lipid profile was analyzed.

Results: Over half of the participants (51.72%) were females, while most (70.87%) of the participants were aged < 40 years. A total of 124(28.5%) patients showed symptoms of macro-vascular complications with most (16.78%) of them having coronary artery disease. A significant relation ($p < 0.05$) was found between coronary artery disease and age, duration of diabetes, blood pressure, body mass index and serum triglycerides. Peripheral vascular disease was significantly related ($p < 0.05$) to the duration of diabetes, systolic blood pressure and serum triglyceride. While significant relation ($p < 0.05$) between cerebrovascular disease with age, systolic and diastolic BP was there.

Conclusion: Coronary artery disease seems to be the most common macro-vascular complication among type 2 diabetic patients, with a high prevalence of risk factors such as advanced age, duration of DM, male sex, hypertension, Body Mass Index, and serum triglycerides.

Keywords: Coronary artery disease, diabetes mellitus type 2, Macro-vascular complications, peripheral vascular disease.

Authors' Contribution:

¹Conception; Literature research;
^{1,2}manuscript design and drafting;
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Introduction

Diabetes mellitus (DM), is a universally occurring non-communicable disease as well as an exemplary health problem affecting people worldwide¹. The overall incidence of DM is increasing at a staggering rate and this rise in number poses an enormous social and economic burden to the population. International diabetes federation reported that roughly 463 million people between ages 20 and 79 years are living with DM this toll is expected to rise up to 700 million by 2045. Over two third of DM cases are residing in low and middle-income countries.²

Diabetes mellitus Type 2 (DMT2) is the most common type of DM that accounts for around 90% of DM cases throughout the globe.³ Approximately, 374 million people are already at risk of developing type 2 diabetes worldwide.¹ Numerous micro and macro-vascular complications are associated with DMT2 that may have severe individual and social consequences.⁴ Peripheral neuropathy (PN) and peripheral vascular disease (PVD) are long-term complications of diabetes and are difficult to diagnose because they are asymptomatic, resulting in foot ulceration, infection, and ultimately amputation. Early detection and treatment, on the other hand, reduce the incidence of ulceration.⁵ Other macro-vascular complications like Coronary artery diseases (CAD) and cerebrovascular diseases like stroke are rapidly growing and strongly associated with DMT2 and 2-4 folds more common in DMT2 patients compared with those without diabetes.⁶ According to the world health organization (WHO), the prevalence of CAD only in the Eastern Mediterranean region (EMRO) is 54% while these deaths may vary from 13% to 49% depending on the country also accounts for a considerable number of deaths in the region.⁷

Pakistan is amongst the low-middle income country where overall 70% of the global burden of diabetics is present.⁸ The IDF reported the prevalence of DM is 6.8% during the year 2019 among 20–79 years' age

adults in Pakistan. While the prevalence of DMT2 has risen significantly, 33 million adults in Pakistan are affected by this type of diabetes which is a 70% increase in toll since 2019. With the rise in the prevalence of DMT2 in Pakistan, the complications associated with the disease are also on the rise among the Pakistani population. Studies have reported that among the complications, CAD is a more frequently reported complication of T2DM.⁹ While a significant relationship between T2SDM and stroke in Asian countries like Pakistan also reported by different studies. Despite this rise in prevalence, very limited studies have reported the burden of DM complications and the risk factors linked with the complications of the disease in the country.¹⁰

Prevalence studies on the complications of DM give noticeable and significant information that have a significant impact on policy and practice. But still the scantiness of information related to the risk factors for the co-morbidities in DM patients in Pakistan specially in Sindh and its cities demand a need for attention, screening and interventional program to estimate the prevalence and correlation of risk factors of different co-morbidities of DM in Sindh. For this reason, the present study was designed with an objective to evaluate the macro-vascular complications and its relationship with different risk factors among type-2 diabetic patients in at tertiary care hospital of Hyderabad, Sindh, Pakistan.

Methodology

After getting ethical approval from ethical and research review committee of Isra University # IU/RR-10-IRC-21/N/2021/037, cross-sectional study was conducted at the department of medicine Isra University Hospital (IUH), Hyderabad from March to September 2021. All patients admitted or visited the medicine department Hyderabad with positive history of DMT2, taking any diabetic medication (insulin or oral hypoglycemic drugs or both), between age of 20 and 70, either sex, regardless of socioeconomic status or religion, given consent of

participation were included in the study. Patients with type I DM, not willing to participate, mentally compromised or unconscious were excluded from the study.

Informed consent was obtained from all the participants individually prior to the commencement of the interviews. Sample size of was calculated using online sampling calculator Open-epi.¹¹ Keeping 95% confidence interval, 5% margin of error and prevalence of macro-vascular complications among type II diabetics of 27.2%¹⁵, after adding $\pm 10\%$ the sample size of 335 was drawn. Non-random consecutive sampling technique was applied for the selection of participants. A pre-designed and pre-tested written questionnaire was used to collect information of all the study participants.

The questionnaire comprises of three parts, first part of the questionnaire having questions regarding socio-demographic variables like; age, sex, economic status, education status. Second part of the questionnaire with information of Body Mass Index (BMI), duration of disease, medication history, family history of diabetes and smoking history. The third section contains the details of the laboratory diagnostic as well as any comorbidities discovered during the test.

The height was measured without shoes and the body weight was estimated while wearing the least amount of clothing possible using stadiometer with weighing scale. The usual formula (weight (kg) per height) was used to calculate BMI (m^2) that is if a person having BMI between 18.5 and 24.9 was labelled as healthy while BMI <18.5 (Underweight), 25.0-29.9 (overweight) and ≥ 30.0 was considered as obese.

Using aseptic measures, 5cc of blood was drawn and sent for serum glucose (Random and Fasting) levels, Glycated hemoglobin (HbA1c), and total lipid profile were measured on a fully automated chemistry analyzer. Blood pressure was measured using a

mercury sphygmomanometer by trained nursing staff to assess the patient's hypertension (HTN) status using the WHO standard definition for HTN. Peripheral neuropathy was assessed by testing the strength of muscles, Monofilament as well as tendon reflex. Patients with painful PN were confirmed if they had a history of body pain that worsened at night. Diabetic nephropathy was evaluated by urinalysis for macro and micro-albuminuria.

SPSS version 22 was used for statistical analysis. Descriptive statistics were used to show demographic variables and co-morbidities. For quantitative data, mean and standard deviation (SD) were calculated. The relationship between macro-vascular disease and clinical variables was determined using the Student t-test. $P < 0.05$ was considered significant.

Results

A Total of 335 patients fulfilled the selection criteria; Of them 173 (51.6%) were females and 162 (48.4%) were males. Most (70.8 %) participants belong to 40 and above year while 29.13% were younger than 40 years of age. The mean age of participants was 48.7 ± 10.9 years (age range 27-71 years). The duration of DM was between 3–31 years with the mean duration of DM being 8.7 ± 4.6 years. HbA1c levels revealed that 86.58% of all participants had levels $\geq 7\%$.

Table I: Complications prevalent among diabetic patients (n=335)

COMPLICATIONS	n (%)
Coronary artery disease	56 (16.7)
Diabetic Nephropathy	53 (16.0)
Diabetic Neuropathy	104(31.0)
Diabetic Retinopathy	82 (24.5)
Cerebrovascular disease	22 (6.5)
Peripheral vascular disease	18 (5.3)

Table II: Socio-demographic and clinical details of study participants (n=335)		
SOCIO-DEMOGRAPHIC & CLINICAL FEATURES	Total	
	335	
	n	%
Family history of DM		
Positive	159	47.5
Negative	176	52.5
Duration of DM		
Upto 5 years	108	32.3
Over 5 years	227	67.7
Hypertension (mmHg) (n=254)		
Systolic HTN	157	62.0
Diastolic HTN	97	38.0
BMI (kg/m ²)		
Normal	191	57.0
Overweight	114	34.0
Obese	30	9.0
Smoker		
Yes	128	38.2
No	207	61.8
Laboratory findings	Mean	S.D
Glycemic status		
FBS (mg/dL)	210.1	87.5
2 hours ppbg* (mg/dL)	309.4	112.9
HbA1c (%)	9.6	2.5
Lipid profile (mg/dL)		
Total cholesterol	188.2	48.1
HDL Cholesterol	42.1	28.7
LDL Cholesterol	141.2	43.7
TGs	221.5	115.4

* ppbg: Post prandial blood glucose

Table III: Gender wise distribution of demographic, clinical and laboratory findings (n=335)				
SOCIO-DEMOGRAPHIC & CLINICAL FEATURES	Male		Female	
	173		162	
	n	%	n	%
Family history of DM				
Positive	91	52.6	68	42.3
Negative	82	47.4	94	57.4
Duration of DM				
Upto 5 years	45	26.0	63	39.0
Over 5 years	128	74.0	99	61.0
BMI (kg/m ²)				
Normal	114	66.0	77	47.6
Overweight	44	25.4	70	43.2
Obese	15	8.6	15	9.2
Smoker				
Yes	110	63.6	18	11.0
No	63	36.4	144	89.0
LABORATORY FINDINGS	Mean	S.D	Mean	S.D

Glycemic status				
FBS (mg/dL)	203.5	81.3	206.4	92.1
2 hours ppbg* (mg/dL)	301.7	100.3	309.6	115.2
HbA1c (%)	8.81	2.4	9.4	2.7
Lipid profile (mg/dL)				
Total cholesterol	186.2	47.7	188.8	47.9
HDL Cholesterol	43.5	26.7	42.6	25.4
LDL Cholesterol	140.3	42.6	143.5	45.3
TGs	231.1	126.9	213.1	103.4

* ppbg: Post prandial blood glucose

* HTN: Hypertension

Table IV: Macro-vascular complications and their relation with different risk factors					
PERIPHERAL VASCULAR DISEASE					
	Yes 18		No 317		P-value
	Mean	±S.D	Mean	±S.D	
Age (years)	54.6	8.4	53.9	9.6	0.73
Duration of DM (years)	11.4	8.4	5.9	6.2	0.00*
Systolic BP (mmHg)	144.5	22.7	134.4	21.1	0.02*
Diastolic BP (mmHg)	88.5	13.7	84.9	11.5	0.14
HbA ₁ C (%)	8.6	2.1	9.3	2.7	0.22
BMI (kg/m ²)	22.7	3.4	23.8	3.9	0.18
Serum Cholesterol (mg/dL)	182.6	56.3	188.4	43.3	0.53
HDL Cholesterol (mg/dL)	41.5	27.8	43.3	26.5	0.75
Serum Triglyceride (mg/dL)	285.5	113.7	237.3	112.6	0.04*
LDL Cholesterol (mg/dL)	136.1	47.3	144.5	42.7	0.36
CORONARY ARTERY DISEASE					
	Yes 56		No 279		P-value
	Mean	±S.D	Mean	±S.D	
Age (years)	58.4	10.4	51.7	10.7	0.00*
Duration of DM (years)	10.7	6.8	5.8	6.2	0.00*
Systolic BP (mmHg)	148.3	27.8	135.3	26.5	0.00*
Diastolic BP (mmHg)	89.3	15.8	83.5	13.8	0.00*
HbA ₁ C (%)	9.4	2.3	9.2	2.1	0.46
BMI (kg/m ²)	24.4	3.6	22.3	4.1	<0.001*
Serum Cholesterol (mg/dL)	185.4	51.3	189.3	47.4	0.52
HDL Cholesterol (mg/dL)	45.7	42.4	40.1	19.3	0.07
Serum Triglyceride (mg/dL)	240.2	151.5	211.3	100.8	0.04*
LDL Cholesterol (mg/dL)	140.9	44.8	141.2	43.6	0.95
CEREBROVASCULAR DISEASE					
	Yes 22		No 313		P-value
	Mean	±S.D	Mean	±S.D	
Age (years)	59.6	11.2	50.6	11.3	<0.001*
Duration of DM (years)	9.4	5.2	7.4	5.4	0.058
Systolic BP (mmHg)	150.3	26.8	135.7	25.4	0.003*
Diastolic BP (mmHg)	90.5	13.3	82.6	12.3	0.001*
HbA ₁ C (%)	9.2	2.4	9.6	2.7	0.44
BMI (kg/m ²)	24.3	4.7	23.3	4.1	0.21

Serum Cholesterol (mg/dL)	191.6	49.0	186.9	49.7	0.62
HDL Cholesterol (mg/dL)	43.2	18.5	41.7	23.2	0.73
Serum Triglyceride (mg/dL)	253.5	167.0	219.6	112.8	0.13
LDL Cholesterol (mg/dL)	138.6	44.1	140.2	42.4	0.84

Discussion

DM is a complex metabolic disorder, which has emerged not only as a major public health issue around the world but also as a major cause of economic burden worldwide.¹² The global incidence of DM is rising at an astonishing rate and this mounting toll of DM related morbidities and mortalities is posing a serious threat to the developing as well as developed world.¹³ The complications related to the disease are affecting masses not only socially but also economically. While the complications related to DM are further imposing economic burden on the country and specifically the common man. Proper knowledge about the incidence rate of these DM related complications as well as early diagnosis and possible strategies to treat these complications is the need of the hour for developing and developed countries alike.^{14,15}

The findings of this study provided a potential insight of the prevalence of complications and their risk factors in the type 2 DM patients of Sindh. Our study findings strongly suggest that there is an association between DM and chronic macro vascular complications. The overall prevalence of macro vascular complications among our study population with type 2 DM was 28.5%. In comparison to previous studies, rising trends in the prevalence of complications were observed. A study conducted in Punjab, Pakistan by Gillani et al.¹⁶ reported the prevalence of macro vascular complication in their study was 21.7%. While a study by Li J. et al. reported that comparable proportion of their participants with DMT2 were having macro vascular complication.¹⁷ A study from Saudi Arabia reported 12.1% of total macro vascular diseases among their diabetic participants that is quite lower than our study.¹⁸

In the present study, among the patients of macro vascular complication, 16.7% had CADs, 6.5% had CVD and 5.3% had PVD. Several studies also reported similar trend of macro vascular complications as demonstrated in this study. Alaboud et al. reported the consistent findings of macro vascular complications in their study participants. Another study by Gedebjerg et al. also reported higher prevalence (15%) of CADs in their patients followed by 5% CVDs and 2% PVDs in their study. Moreover, Uddin et al. reported prevalence of 8.5% CADs, 2.0% CVD and 2.2% PVD in their newly diagnosed diabetics patients.¹⁹

The risk factors analysis in the present study demonstrated that duration of DM was the main risk factor ($p < 0.05$) for CAD and PVD but not for CVD while systolic hypertension was the risk factor common ($p < 0.05$) in CAD, PVD and CVD. Ahmed M.S et al also reported the findings consistent with our study.²⁰ Moreover, age and diastolic blood pressure were significantly associated with CAD and CVD, but not PVD. A Pakistani study by Gillani et al. reported the strong association between age and CAD, which is consistent with the findings of present study.¹⁶ Serum triglycerides was a common significantly associated ($p < 0.05$) factor of CAD and PVD in this study. This may be due to fact that high serum triglycerides may lead to increase chances of thrombus formation within the vessels and lead to blockage of blood circulation in the vessels. With strengths, there are many limitations in the study. Foremost, limited duration and resources only one center was included in the study. Furthermore, only macro vascular complications were studied in the present study while many risk factors like economic status, treatment etc. are not included for the study.

Conclusion

The CAD seem to be the most common macro vascular complication among type 2 diabetic patients, with a high prevalence of risk factors such as advanced age, duration of DM, male sex, hypertension, BMI, and serum triglycerides.

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