

## Original Research Article

# Study of determinants of cardiovascular morbidity among diabetes patients

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## ABSTRACT

**Background:** With the change in lifestyle and behavior among individuals, the prevalence of T2DM is on rise. Many modifiable and non-modifiable risk factors are attributable for the cardiovascular morbidity among the diabetics which is the leading cause of mortality and morbidity among them, also increasing their burden of expenditure. The purpose of this study was to determine the prevailing factors responsible and its associate co morbidities among the Type 2 Diabetes Mellitus patients.

**Methods:** It was a descriptive, observational and cross sectional study conducted for 30 days. 226 patients who visited the diabetes OPD of the Medical College were interviewed using a pre-designed questionnaire, anthropometric measurements, systemic and general examinations were performed. The data was analysed using suitable statistical analysis.

**Results:** Out of 226 patients, 47.8% were suffering from cardiovascular morbidity, majority being heart failure (57.4%). Most of them were contributed 46.3% and 38.9% by age group 50-59 years (46.3%) and 60-69 years (38.9%), 55.6% were smokers and 64.4% were overweight. 70.4% complained of stress in their daily life while 48.1% were unaware of their heart conditions until checkup. 18.5% of the patients also suffered from retinopathy and 37.03% from diabetic foot ulcer. 64% of them had hypertension and 67.2% had sedentary life style.

**Conclusions:** Many modifiable and non-modifiable risk factors were found associated with cardiovascular morbidity among the type 2 diabetes mellitus patients. So a proper awareness and life style modifications might be necessary to decrease cardiovascular morbidity among them.

**Keywords:** Atherosclerosis, Cardio vascular morbidity, Diabetes, Hypertension

## INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic condition that occurs when the body cannot produce sufficient insulin or effectively use insulin, induced by a genetic predisposition coupled with environmental factors.<sup>1</sup> Long standing diabetes and notably abnormal glucose metabolism is often accompanied by some characteristic long-term complications notably retinopathy, nephropathy and neuropathy.<sup>2</sup>

Over the decades, DM has been a well-established risk factor for cardiovascular diseases (CVD). People with type 2 diabetes mellitus (T2DM) tend to have a higher cardiovascular morbidity and mortality when compared with non-diabetic subjects.<sup>3</sup> The pathophysiology between diabetes and cardiovascular disease (CVD) is complex and multifactorial. Cardiovascular disorders include not only peripheral vascular disease (PVD), stroke, coronary artery disease (CAD) but also neuropathy and nephropathy. Diabetes, especially abnormal glucose metabolism affects the heart muscles thereby causing

both systolic and diastolic heart failure. A variety of factors come into the interplay for the pathogenesis of cardiovascular morbidity like micro-vascular and macro-vascular atherosclerosis, diabetic autonomic neuropathy (DAN), decreased bioavailability of Nitric Oxide, a potent vasodilator, as well as increased secretion of the vasoconstrictor endothelin-1, excessive release of pro-inflammatory cytokines and oxidative stress along with diabetes itself being a hypercoagulable state.<sup>4</sup> Diabetic vascular disease is responsible for two to four times rise in the occurrence of coronary artery disease and stroke and two to eight times increase in the risk of heart failure.<sup>5</sup> However, subsequent and recent studies have revealed other results which indicate more that diabetes status may not be a CVD equivalent in all conditions, thus highlighting the necessity for multivariate approach as a suitable basis for risk stratification and identification for CVD prevention in people with diabetes.<sup>6</sup> Most of the risk factors associated with an increased prevalence in cardiovascular disease among diabetes are hypertension, dyslipidemia and obesity in these subjects along with many other.

In 2019, around 463 million adults (20-79 years) were living with diabetes; which is expected to rise to 700 million by 2045. Of these, 79% belonged to low- and middle-income countries. With the change in lifestyle and behaviour, the proportion of people with type 2 diabetes is increasing in most countries and also around 374 million people are at increased risk of developing type 2 diabetes in the subsequent years. There were 4.2 million deaths due to diabetes in 2019, with majority being contributed by cardiovascular morbidity.<sup>7</sup> Across the full spectrum of fasting glucose, glycosylated hemoglobin A1c (HbA1c), or 2-hour glucose test results, each one is associated with a 6-20% increased risk of cardiovascular disease events.<sup>8</sup> The most common and classic types of cardiovascular events associated with diabetes are coronary heart disease, cerebrovascular disease, peripheral artery disease and congestive heart failure, often these are manifested as specific events like hospitalizations, procedures and deaths from acute coronary syndromes, myocardial infarction and ischemic and hemorrhagic stroke. A number of modifiable and non-modifiable risk factors are attributable for cardiovascular morbidity in diabetes not only taking a toll in quality of life and life-expectancy, but also increasing the burden of expenditure on health. Although great advances in cardiovascular therapy and prevention have reduced diabetes-related coronary mortality, it still remains high in majority of the patients with diabetes. So there is an ardent need for risk stratification and risk factor assessment so as to promote prevention and delay the onset of cardiovascular morbidity among diabetes.

### **Objectives**

To determine the proportion of patients with cardiovascular morbidity among those with type 2 diabetes mellitus visiting the diabetes OPD. To identify

the factors associated with cardiovascular morbidity among the patients with type 2 diabetes mellitus visiting diabetes OPD of a tertiary Hospital of Kolkata, West Bengal. To find out other co-morbidities if any among these patients.

## **METHODS**

### **Type of study**

The study conducted was an observational, descriptive study carried out in a cross-sectional manner.

### **Place of study**

The study was conducted in the Diabetes OPD of a Tertiary Hospital of Kolkata, West Bengal.

### **Duration of study**

The study was conducted over a period of 30 days from 1st January 2020 to 30th January 2020.

### **Study population**

The study population was comprised of 226 patients who attended the Diabetes OPD during the study period.

### **Inclusion criteria**

The patients must be previously diagnosed with type 2 diabetes mellitus irrespective of their duration of diabetes. The patients with cardiovascular morbidity who were determined on the basis of their Echocardiography reports or ECG report or Tread Mill Stress Test or on the basis of their past history of hospital admission due to AMI or Heart Failure or CVA. The patients who are willing to participate in the study and gave informed consent.

### **Exclusion criteria**

Those patients who were severely ill. Those patients who were not willing to participate. Those patients who were not diagnosed with type 2 diabetes mellitus but some other forms of diabetes.

### **Study design**

The study was an observational, descriptive study in a cross sectional manner where 226 patients with type 2 diabetes mellitus, who attended the diabetes OPD of a Tertiary Hospital of Kolkata, West Bengal during the study period were selected on the basis of their investigation reports and past history over a period of 1 month. They were then interviewed with the aid of a pre-designed and pre-tested questionnaire. Systemic and general examinations along with anthropometric measurements were also performed and reports and prescriptions examined. The data were then compiled

using suitable tables and diagrams and were analyzed using suitable descriptive statistics. All these were done after obtaining ethical clearance from the institutional ethical committee.

### Study tools

A pre-designed and pretested questionnaire, measuring tape, weighing machine, sphygmomanometer, torch, stethoscope, Modified Kuppaswamy Socioeconomic scale, 2019.

## RESULTS

Out of 226 patients, 126 (55.8%) were males and 44.2% females. Majority of the patients belonged to the age groups 50-59 years (26.1%), followed by 60-69 years (22.1%). Among the 226 patients, 122 (53.9%) were Hindus while 98 (43.4%) were Muslims, 1(0.4%) was Christian and 5 (2.2%) belonged to the Sikh Community. (Table 1).

**Table 1: Socio-demographic profile of study population (n=226).**

Age groups (in years)	Male N (%)	Female N (%)	Total N (%)	Hindu N (%)	Muslim N (%)	Christian N (%)	Sikhs N (%)	Total N (%)
20-29	7 (77.8)	2 (22.2)	9 (4.0)	4 (44.4)	4 (44.4)	1 (11.2)	-	9 (4.0)
30-39	15 (50.0)	15 (50.0)	30 (13.3)	13 (43.3)	16 (53.3)	-	1 (3.4)	30 (13.3)
40-49	17 (51.5)	16 (48.5)	33 (14.6)	17 (51.5)	14 (42.4)	-	2 (6.1)	33 (14.6)
50-59	32 (54.2)	27 (45.8)	59 (26.1)	36 (61.0)	23 (39.0)	-	-	59 (26.1)
60-69	32 (64.0)	18 (36.0)	50 (22.1)	28 (56.0)	20 (40.0)	-	2 (4.0)	50 (22.1)
70-79	14 (50.0)	14 (50.0)	28 (12.4)	15 (53.6)	13 (46.4)	-	-	28 (12.4)
80-89	9 (52.9)	8 (47.1)	17 (7.5)	9 (52.9)	8 (47.1)	-	-	17 (7.5)
Total	126 (55.8)	100 (44.2)	226 (100.0)	122 (54.0)	98 (44.4)	1 (0.4)	5 (1.2)	226 (100.0)

**Table 2: Distribution of population according to religion and cardio-vascular morbidity (n=108).**

Religion	N (%)	Number of patients with cardio-vascular morbidity No. (%)
Hindu	122 (57.9)	60 (55.6)
Muslim	98 (43.4)	46 (42.6)
Sikh	5 (2.21)	1 (0.9)
Christian	1 (0.49)	1 (0.9)
Total	226 (100)	108 (100)

**Table 3: Distribution of population according to age and cardio-vascular morbidity (n=108).**

Age group (in years)	Patients with cardio-vascular morbidity N (%)
20-29	2 (1.85)
30-39	0
40-49	4 (3.7)
50-59	50 (46.3)
60-69	42 (38.9)
70-79	6 (5.5)
80-89	4 (3.7)
Total	108 (100)

Among the 226 patients who visited diabetes OPD, 108 (47.8%) were suffering from cardiovascular morbidity out of which, 60 (55.6%) were Hindus followed by 46 Muslims (42.6%), 1 (0.9%) was Christian and 1 (0.9%) was Sikh. (Table 2). Out of the patients with cardiovascular morbidity, 60 (55.6%) were male. Of these

patients with cardiovascular morbidity, maximum was contributed by the age group of 50-59 years 50 (46.3%) followed by the age group of 60-69 years 42 (38.9%) while 6 (5.5%), 4 (3.7%), 4 (3.7%) and 2 (1.8%) belonged to the age groups of 70-79 years, 80-89 years, 40-49 years and 20-29 years respectively (Table 3). Out of the total patients who visited the diabetes OPD, 60 (26.5%) belonged to lower class, among those belonging to lower class 23 (38.3%) had cardiovascular morbidity while 80 (35.4%) patients belonged to middle socio-economic class among them 47 (58.7%) had cardiovascular morbidity (Table 4). Around 78 (72.2%) diabetic patients with cardiovascular morbidity reported to have a family history of cardiovascular morbidity and mortality.

**Table 4: Distribution of population according to socio-economic status and cardiovascular morbidity (n=226).**

Socio-economic status	Patients visiting diabetes OPD N (%)	Patients with cardiovascular morbidity N (%)
Upper	30 (13.3)	10 (33.3)
Upper middle	36 (15.9)	15 (41.7)
Lower middle	44 (19.5)	32 (72.8)
Upper lower	56 (24.8)	28 (50.0)
Lower	60 (26.5)	23 (38.3)
Total	226 (100)	108 (47.8)

Among 108 patients with cardiovascular morbidity, 62 (57.4%) suffered from congestive heart failure, 22 (20.4%) had a past history of hospital admission due to

AMI, 20 (18.5%) were suffering from peripheral vascular disease, 2 (1.8%) had past history of hospital admission due to ischemic stroke and 2 (1.8%) had valvular heart diseases (Table 5).

**Table 5: Distribution of patients with cardiovascular morbidity according to type of cardiovascular morbidity (n=108).**

Type of cardiovascular morbidity	N	%
<b>Congestive heart failure,</b>	62	57.4
<b>Past history of hospital admission due to AMI</b>	22	20.4
<b>Peripheral vascular disease</b>	20	18.5
<b>Past history of hospital admission due to ischemic stroke</b>	2	1.8
<b>Had valvular heart diseases</b>	2	1.8
<b>Total</b>	108	100

Out of 226 patients with diabetes mellitus, 102 patients (45.1%) had addictions among which 58 (25.7%) were smokers while 44 (19.5%) were addicted to other forms of tobacco (Table 6). Among these patients with addiction, 70 (68.6%) reported the total duration of addiction to be more than 10 years, while 30 (29.4%) reported their duration ranging from 5-10 years and 2 (1.9%) were addicted for less than 5 years. Also, 20 (19.6%) reported to have an addiction to alcohol. Among the patients with cardiovascular morbidity, 72 (66.6%) reported to have addiction of which 40 (55.5%) were smokers and 32 (44.5%) were addicted to other forms of tobacco (Table 6). 38 (52.7%) patients with cardiovascular morbidity gave history of addiction for more than 10 years, 32 (44.4%) were addicted ranging from 5-10 years while 2 (2.8%) had addiction for less than 5 years.

**Table 6: Distribution of population according to addiction and cardio-vascular morbidity (N=226).**

Type of addiction	Patients visiting diabetes OPD N (%)	Patients with cardio-vascular morbidity N (%)
<b>Smoking</b>	58 (25.7)	40 (69.0)
<b>Other forms of tobacco</b>	44 (19.5)	32 (72.7)
<b>Not addicted</b>	124 (54.8)	36 (29.0)
<b>Total</b>	226 (100)	108 (47.8)

BMI (body mass index) was calculated for all the 226 patients and 152 (67.2%) were found to be overweight (BMI above 23 kg/m<sup>2</sup>) according to the Asian-Indian BMI criteria of which 110 (72.4%) were obese (BMI above 25 kg/m<sup>2</sup>). Out of diabetic patients with cardiovascular morbidity 98 (64.5%) of these overweight patients reported to have cardiovascular morbidity among which 62 (65.3%) were obese.

Out of the total diabetics, 152 (67.3%) reported to have sedentary lifestyles while 59 (26.1%) were moderate workers and 15 (6.6%) were heavy workers. Out of 108 patients with cardiovascular morbidity, 80 (52.6%) were sedentary while 24 (40.7%) were moderate and 4 (26.7%) were heavy workers (Table 7).

**Table 7: Distribution of population according to lifestyle of the patients and cardio-vascular morbidity (n=226).**

Lifestyle of the patients	Number of patients visiting diabetes OPD (%)	Number of patients with cardiovascular morbidity (%)
<b>Sedentary</b>	152 (67.3)	80 (52.6)
<b>Moderate</b>	59 (26.1)	24 (40.7)
<b>Heavy</b>	15 (6.6)	4 (26.7)
<b>Total</b>	226 (100.0)	108 (47.8)

Most of the diabetics, 158 (69.9%) were aware of their food habits and dietary plans and adhere to them while the rest were unaware. Among those with cardiovascular morbidity, 60 (55%) were actually aware of their dietary habits and recommendations and adhere to them.

General examination of these 226 diabetic patients revealed 35 patients (15.5%) had pallor among which 30 (85.7%) patients reported cardiovascular morbidity while edema was found in 62 (27.4%) of the diabetic patients and all of them were having cardiovascular morbidity.

Out of the total diabetics, 125 (55.3%) were also found to be hypertensive among which, 80 (64%) also had cardiovascular morbidity. However, 70% of the diabetics with cardiovascular morbidity had their blood pressure within normal range after medication, and the rest had their blood pressure poorly controlled.

Dyslipidemia was found in 98 (90.7%) patients with cardiovascular morbidity among which 82 (83.6%) were on medication with statin therapy.

Among the patients with cardiovascular morbidity, around 92 (85.2%) reported their duration of diabetes to be more than ten years while the rest reported their duration ranging from five to ten years. None reported to be less than five years. Out of 108 patients with cardiovascular morbidity, 92 (85.2%) were strictly adherent to medicine and compliant according to treatment and 85 (78.7%) had a good glycemic control based on their recent HbA1c report (HbA1c below 7.0).

76 (70.4%) of the diabetic patients complained of stress in their daily life. 45 (48.1%) of patients with cardiovascular morbidity were unaware of their heart conditions until checkup. Around 20 (18.5%) of the patients suffering from cardiovascular morbidity also suffered from retinopathy while 40 (37%) of them also



had diabetic foot ulcer. Around 27 (25%) were suffering from chronic renal failure.

## DISCUSSION

In the current study, 226 patients were interviewed and examined out of which, 47.8% were suffering from cardiovascular morbidity. This was quite high when compared to 32.2% found in the study by Einarson et al conducted globally.<sup>9</sup> However, the cardiovascular morbidity outcome percentage was similar to the other studies conducted in India where cardiovascular disease outcome was found to be 42.6%.<sup>8</sup> In another study by Mohan, et al the prevalence of coronary artery disease among diabetics was found out to be 21.4%.<sup>10</sup>

The most frequent type of CVD reported was congestive heart failure (57.4%) and lowest was stroke and valvular heart diseases (1.8%). Along with diabetes, cardiovascular disease is associated with several risk factors, obesity, age, addiction, sedentary life style and dietary habit, lipid profile status and hypertension.

Age is a well-known risk factor for CVD. In this study, majority of the patients were from the age group 50-59 years (46.3%) and 60-69 years (38.9%). Nine studies identified revealed similar relationship between age and CVD.<sup>11-18</sup> However, on the other hand, four studies reported no differences between age categories.<sup>19-22</sup>

In the current study, out of 67.2% diabetic patients were overweight and 64.5% were found to have cardiovascular morbidity. Obesity is an established risk factor for cardiovascular disease.<sup>23,24</sup> It was also shown that overweight and obesity are highly prevalent in T2DM patients with high CV risk and that BMI and waist circumference are related to major cardio metabolic risk factors.<sup>25</sup>

Among the 102 diabetics in the current study who gave a history of addiction and 70.6% of them had cardiovascular morbidity. Also, 54.3% who revealed an average duration of more than ten years for addiction were affected by cardiovascular morbidity. Behavioural lifestyle was also an important association with cardiovascular morbidity. Out of the total diabetics, 67.2% reported to have sedentary lifestyles. 53.7% of the diabetic patients with cardiovascular morbidity were also found to be leading a sedentary life. Around 55% of the patients with cardiovascular morbidity actually know about their dietary and lifestyle habits and recommendations. The association between unhealthy lifestyle and cardiovascular disease among diabetics was also found in a study from China where the relationship between lifestyle behaviors and multiple cardiovascular risk factors in 25,454 people with T2DM were analyzed. It was found that unhealthy lifestyles were common and were associated with poor blood sugar, poor blood lipid, and poor blood pressure control.<sup>26</sup> In the current study 70.4% of the Diabetic patients complained of stress in

their daily life and 48.1% of patients with cardiovascular morbidity were unaware of their heart conditions until checkup.

Out of the patients with cardiovascular morbidity, 85.2% had their duration of diabetes for more than ten years and among them 78.7% had a good glycemic control. So, screening people with type 2 diabetes for cardiovascular risk has emerged as an important strategy for reducing mortality and cardiovascular disease events as shown in a study from Denmark.<sup>27</sup>

Dyslipidemia was found in 90.7% patients with cardiovascular morbidity among which 83.6% were on medication with statin therapy. Lipid profile has long been considered important risk factors for cardiovascular disease in diabetes, and have been confirmed by several trials that lowering LDL-cholesterol in T2DM was effective in reducing the risk of cardiovascular disease.<sup>28,29</sup> In the present study 69.9% of diabetic patients were found to be aware of their food habits and dietary plans and adhere to them while the rest were unaware. Among those with cardiovascular morbidity, 55% were actually aware of their dietary habits and recommendations and adhere to them.

Among 108 patients with cardiovascular morbidity, 57.4% suffered from congestive heart failure, 20.4% had a past history of hospital admission due to AMI, 18.5% were suffering from peripheral vascular diseases while 1.8% had past history of hospital admission due to ischemic stroke and valvular heart diseases. In a study by Mohammedi et al, it was found that major peripheral arterial disease presenting as lower-extremity ulceration or amputation and peripheral revascularization was associated with an increased risk of death and cardiovascular events in people with diabetes.<sup>30</sup> In the current study it was found that 15.5% patients had pallor among which 85.7% patients reported cardiovascular morbidity and retinopathy. Diabetic foot ulcer and chronic renal failure were other co morbidities detected.

However, there are also some limitations with the present study as we were limited by the availability of the quality literature and the validity and quality of the articles. Furthermore, the findings of our literature were limited to a selected patient population and in this research, we recorded data from adults only with type 2 diabetes mellitus. This study was also challenged by the fact that cardiovascular disease and its associated conditions were described differently across the literature. Health status, lifestyle and treatments have varied over time, which could impact the prevalence rates in the previous studies. As it was a hospital based cross-sectional study, it was difficult to assess the exact prevalence rate.

## CONCLUSION

Dietary modifications, regular physical activity, healthy life style, weight reduction, avoidance of stress and

cessation of smoking have proven beneficial in preventing cardiovascular diseases. Also regular follow up, monitoring and screening people for diabetes and cardiovascular risk at regular intervals is necessary for detection of diabetes at an early age and early identification of complications. And these may be used as an important strategy for reducing mortality and CVD events. The patients should also be aware of the benefits of regular medication for diabetes, hypertension and dyslipidemia in order to achieve a good control of blood sugar and blood pressure so as to prevent complications of long term of cardiovascular morbidity and mortality. So a multivariate approach is necessary for risk stratification and identification of cardiovascular prevention in people with diabetes.

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