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Original Article

Coronary artery disease with type 2 diabetes and other risk factors: A tertiary care hospital in Bangladesh

Parvin Akter Khanam[1*], Tanjima Begum[2], Abhijit Chowdhury[3], Samira Humaira Habib[4]

Abstract:

Background: *The aim of this study was to determine the prevalence of coronary artery disease (CAD) and to identify the various risk factors related to this complication in subject with diabetes.*

Methods: *The study was cross-sectional and conducted in out-patients department of BIRDEM, from July 2016 to December 2017. Subjects were considered at age 30 to 70 years and duration of diabetes was 5-10 years. Investigations included socio-demographic (age, sex, education etc.), anthropometry (height, weight) and blood pressure. Blood samples were collected for HbA1c, fasting blood glucose (FBG), 2 hour after breakfast (2HABF), lipid profile and CAD were taken from the record books which was diagnosed by respective physician.*

Results: *A total of 221 type 2 diabetes mellitus (T2DM) patients data were taken from the record books. There were 38 patients who had developed CAD and the prevalence of CAD was 17.2%. The study found that it had no significant difference between gender and CAD. The study also found that advanced age (OR=2.16;p=<0.025), lack of physical exercise (OR=3.46; p=0.001), rural patients (OR=2.09; p=0.043), no schooling (OR=4.06; p=0.001), long duration of diabetes (OR=2.87;p=0.018), SBP(OR=2.99; p=0.003), DBP(OR=2.33; p=0.025) and increasing 2HABF (OR=2.6; p=0.026) were independent significant risk factors for CAD.*

Conclusions: *The study concluded that the prevalence of CAD in Type 2 diabetes was more common and comparable to other developed countries. The study also proved that older age, rural community, lack of education, lack of physical exercise, long duration of diabetes, high blood pressure and high blood glucose were significantly independent risk factors for development of CAD. Therefore, the study concluded that lifestyle modification and tight blood pressure control with diabetes is key part to reduce CAD.*

Key Words: *Coronary Artery Disease (CAD); Risk Factors; Type 2 Diabetes Mellitus(T2DM).*

Introduction

The number of people with diabetes mellitus has become increasing globally and also in Bangladesh. About 425 million people are diagnosed with diabetes mellitus (DM) and by the year 2045[1] it will be 629 million. In Bangladesh, the prevalence of diabetes is 6.9% and almost 6.9 million people are suffering from type 2 diabetes[1].

Diabetes Mellitus is a well established risk factor for cardiovascular disease (CVD). In most epidemiological studies, it has been found that the subjects with T2DM are at greater risk of cardiovascular disease (CVD) and it is therefore, a leading cause of death globally. The prevalence of CAD in the diabetic population ranges from 14.4% to 21.4%[2,3], whereas in the general population, it was reported to be 1.85–3.4%[4,5] and current estimates of 21.9% of total death by CVD are projected to increase to 26.3% by 2030[6]. Several studies have observed that obesity, hypertension (HTN), hyperglycemia, dyslipidemia and hyperinsulinemia are the contributory risk factors of atherosclerotic cardiovascular disease[7,8,9]. It's not new findings and CVD has been increasing for future day and is thought to be epidemic in near future[9].

There were plenty of study on risk factors with micro and macro-vascular complications of T2DM in the developed countries; but very few studies have been found in Bangladesh [10]. Particularly, no study has been found on coronary artery disease (CAD) with diabetic patients in our country. Therefore, the study emphasized to estimate the prevalence and its risk factors of CAD with diabetic patients.

Methods:

The study was a cross-sectional and conducted from July 2016 to June 2017. The data were collected from out patient department of tertiary care hospital (BIRDEM General Hospital). Thirty to seventy years old patients were considered for the study. All the data were collected from patients' history file registered at BIRDEM. In this study data were collected on socio-demographic, anthropometric, clinical and biochemical parameters. These variables included patient's age, gender, residence, education, family history of

1. Associate Professor, Department Epidemiology and Biostatistics, BIRDEM General Hospital Dhaka, Bangladesh
2. Department Epidemiology and Biostatistics, BIRDEM General Hospital, Dhaka, Bangladesh.
3. The University of Newcastle, Australia
4. Health Economics Unit, Diabetic Association of Bangladesh, Dhaka, Bangladesh

***Corresponding Author:**

Parvin Akter Khanam, PhD
Associate Professor
Department Epidemiology and Biostatistics,
BIRDEM General Hospital Dhaka, Bangladesh
e-mail: parvin_khanam@yahoo.com

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diabetes and physical exercise as well as history taken on coronary artery disease (CAD) from the medical record books, which was diagnosed by respective physician. Body mass index (BMI) was calculated as weight in kg/ height in meter square (m^2). Investigations included fasting blood glucose and 2-h after breakfast, HbA1c, lipid profile, SBP and DBP were taken from the last record of medical record books.

The study protocol has been approved by the Diabetic Association of Bangladesh (BADAS) Ethical Review Committee. Informed consent was taken from each and every patient and they were informed about the study and information will be keep as confidential.

Statistical Analysis:

Data were described as simple percentage. Chi-square and t-tests were used for comparison between two groups (CAD and without CAD). Independent binary logistic regression analysis was used to find out the association between risk factors with CAD. At 5% level of significance was considered and SPSS version 20.0 was used.

Results:

A total numbers of 221 T2DM subjects were studied. The age of the patients was 30 to 70 years and mean ± SD age was 50.09±7.92. The mean duration of diabetes was 8.26 and ranged 5 to 10 years. Of the total patients, the male were 50.7% and female were 49.3%. Among the study subjects no schooling was in 16.7% and rest of them were literate (83.3%). Occupationally, 31.2% were involved in services, 20.4% were involved in business, 39.4% were housewives and 9.0% were retired person. Of the total study subjects, family history of diabetes in first-degree relatives has been found in 61.5%. Residentially, 69.2% came from urban area and rests of them (30.8%) from rural area. About 53.4% patients do physical exercise regularly and 46.6% didn't. Of all the T2DM patients, the prevalence of CAD was 17.2% (shown in Table 1).

In Table 2 characteristics are compared between CAD and without CAD of the study subjects using t-test. In this table we found that higher age (49.42 ± 7.84 vs. 53.32 ± 7.57; p< 0.01) and long duration of diabetes (8.13 ± 1.84 vs. 8.89 ± 1.53; p < 0.02) were significantly associated with those who had developed CAD than those who didn't developed CAD yet. Though the mean values with standard deviation (SD) of BMI, SBP, DPB, FBG, 2HABF, HbA1c, TC, TG, HDL and LDL did not show significant difference.'

The study also found that the older age group (>50y) had a greater prevalence of CAD than their younger age group (≤ 50y) and it had significant (6.4% vs. 4.6%; χ^2= 4.32, p<0.04) which shown in table 3. The female participants demonstrated a greater prevalence of CAD than their male counterpart, but it had no significant difference (18.3% vs. 16.1%; χ^2=0.65, p<0.654). The study also revealed that rural participants had greater prevalence of CAD than compared with urban participants (25% vs. 13.7%; χ^2=4.2, p<0.04). The illiterate participants were significantly more affected by CAD than compared with literate participants (37.8% vs. 13.0%; χ^2=13.3, p<0.001). The study also found that physical activity significantly lower CAD incidence in comparison to physical inactivity (26.2% vs. 9.3%; χ^2=11.02, p<0.001).

Table 1: Demographic and clinical characteristics of the study population (n=221).

Variables		Number (%)
Sex:		
	Male	112 (50.7%)
	Female	109 (49.3%)
Age:		
	≤ 50y	116 (52.5%)
	> 50y	105(47.5%)
Residence:		
	Rural	68 (30.8%)
	Urban	153 (69.2%)
Occupation:		
	Service	69 (31.2%)
	Business	45 (20.4%)
	Housewife	87(39.4%)
	Retired	10(4.5)
	Others	10 (4.5)
Educational Level:		
	No schooling	37(16.7%)
	Schooling	184(83.3%)
Physical Exercise:		
	Yes	118 (53.4%)
	NO	103(46.6%)
Family History DM:		
	Yes	136(61.5%)
	No	85(38.5%)
SBP:		
	≤ 130	165 (74.7%)
	>130	220 (25.3%)
DBP :	≤ 80	166 (75.1%)
	>80	55 (24.9%)
Coronary artery disease (CAD):	Yes	38(17.2%)
	No	183(82.8)

Table 2: Mean and standard deviation of the metabolic parameters of T2DM patients with and without CAD

Variables	No CAD Mean ± SD	CAD Mean ± SD	P value
Age (y)	49.42 ± 7.84	53.32 ± 7.57	< 0.01
Duration of DM (y)	8.13 ± 1.84	8.89 ± 1.53	< 0.02
BMI	23.91± 3.57	23.31± 2.96	0.333
SBP (mmHg)	129.23± 25.76	131.05± 21.69	0.685
DBP(mmHg)	81.09± 9.18	82.11± 9.49	0.539
FBG (mmol/l)	8.33± 3.01	8.52± 3.03	0.720
2-hBG (mmol/l)	11.71± 4.45	12.96± 4.47	0.115
HbA1c	7.55 ± 1.87	7.52± 1.75	0.932
Chol (mg/dl)	192.34 ± 42.01	185.05 ± 47.14	0.342
TG(mg/dl)	202 ± 136	196 ± 108	0.760
LDL (mg/dl)	122 ± 45	110 ± 44	0.154
HDL (mg/dl)	37.08 ± 8.3	38.67± 8.0	0.294

The high blood glucose (FBG>7.5; ABF2>10.0) were significantly affect CAD than comparatively lower blood glucose level in the study participants (FBG: 21.2% vs. 11.2%; χ^2=3.7, p<0.05; ABF2: 21.7% vs. 9.6%; χ^2=5.33, p<0.02).The study also revealed that CAD had a higher prevalence in high blood pressure (SBP>130; DBP>80) than compared with normal blood pressure (SBP<=130; DBP<=80) and the difference was statistically significant for SBP (30.4% vs. 12.7%; χ^2=9.13, p<0.01) and DBP (27.3% vs. 13.9%; χ^2=5.2, p<0.02). No significant difference found in family history of diabetes and CAD. Also the same result has been found for smoking habits, HbA1c and CAD in this study.

We have used the independent binary logistic regression model to quantify which variables are significant risk factors for CAD. The outcome variables were age, gender, physical exercise, area of residence, schooling, duration of diabetes, FBG, 2HABF, HbA1c, SBP, DBP with CAD as a dependent variable (Table 4). The study found that the significant risk factor for CAD were: older age (OR=2.16; 95% CI: 1.05-4.44; p<0.04), lack of physical exercise (OR=3.46; 95% CI: 1.62-7.39; p<0.001), rural participant (OR=2.09; 95% CI: 1.02-4.29; p<0.05), illiterate participant (OR=4.06; 95% CI: 1.84-8.95; p<0.001) and long duration of diabetes (OR=2.87; 95% CI: 1.20-6.87; p<0.02). Again, the effect of increasing: 2HABF (OR=2.60; 95% CI: 1.13-5.99; p<0.03), SBP (OR=2.99; 95% CI: 1.44-6.21; p<0.01) and DBP (OR=2.33; 95% CI: 1.11-4.88; p<0.03) were found to be significant risk factors for CAD. Other variables (gender, Fasting, HbA1C) were proved not to be significant risk factors for CAD.

Table 3: Prevalence of coronary artery disease (CAD) according to age, sex, residence, occupation, physical exercise, family history of diabetes, diabetes and hypertension

Variables	CAD (%)	χ2	p-value
Age			
≤ 50	12.1	4.505	0.034
>50	22.9		
Gender		0.20	
Men	16.1		0.654
Women	18.3		
Residence			
Urban	13.7	4.20	0.04
Rural	25.0		
Occupation			
Service	11.6		
Business	20.0	2.22	0.696
Housewife	19.5		
Retired	20.0		
Others	20.0		
Physical Exercise			
Yes	9.3	11.02	0.001
No	26.2		
FHD			
No	14.1	0.92	0.338
Yes	19.1		
Schooling			
No	37.8	13.301	<0.001
Yes	13.0		
Smoking			
No	16.8	0.153	0.696
Yes	19.4		
FBG			
≤7.5	11.2	3.716	0.054
>7.5	21.2		
ABF2			
≤10.0	9.6	5.330	0.021
>10.0	21.7		
HbA1C			
≤7.5	14.5	1.24	0.265
>7.5	20.2		
SBP			
≤ 130	12.7	9.127	0.003
>130	30.4		
SBP			
≤ 80	13.9	5.223	0.022
>80	27.3		

Table 4: Independent binary logistic regression model taking CAD as a dependent variable in the model

Risk Factors	CAD OR (95%CI)	p-value
Age:		
≤50y		
>50y	2.16(1.05-4.44)	0.03
Gender:		
Male	1	
Female	1.17(0.583-2.362)	0.654
Exercise		
Yes	1	
No	3.46(1.62-7.39)	0.001
Residence:		
Urban	1	
Rural	2.09(1.02-4.29)	0.043
Schooling:		
Yes	1	
No	4.06 (1.84-8.95)	0.001
Duration:		
≤7.5y	1	
>7.5y	2.87(1.20-6.87)	0.018
FBG		
≤7.5	1	
>7.5	2.13(0.98-4.63)	0.054
ABF2		
≤10.0	1	
>10.0	2.60(1.13-5.99)	0.024
HbA1c:		
≤7.5	1	
>7.5	1.49(0.74-3.01)	0.267
SBP		
≤130	1	
>130	2.99(1.44-6.21)	0.003
DBP		
≤80	1	
>80	2.33(1.11-4.88)	0.025

Discussion:

Cardiovascular disease (CVD) is a leading cause of death in all around the world and one of the major problems for sustainable human development and also more burdens in low and middle income countries[11]. The most common cardiovascular disease is coronary artery disease (CAD) and the CVD, with diabetes is 2 to 4 times higher risk than in general population[11] and two-thirds will die from coronary heart disease in worldwide. This study emphasized the prevalence of CAD and quantified each specific risk whether or not contributing for developing CAD in Bangladeshi population. The specific risk factors included age, gender, physical exercise, residence, schooling, family history of diabetes, body mass index, duration of diabetes; blood pressure; lipid profile; and blood glucose were examined.

This study found that the prevalence of CAD was 17.2% and this result is consistent with Sayeed et al[12] who found that the prevalence of CAD was 18.6%. This result was also consistent with Agrawal RP et al[13] who found CAD in 780 out of 4067 (19.2%). Jurado J et al[14] also reported that the prevalence of CAD was 18.9% in a study from North Catalonia.

The prevalence of CAD increases with increasing age. Bowman K et al[15] have studied the follow-up data and discussed its applications to central adiposity and overweight in UK participants. The study found that the central adiposity and the overweight risk related to an aging process and it indicates that advanced age is a risk factor for CAD and our findings also consistent with this study. Again, the study findings also found that the female population had more affected by CAD than male participants, though the results didn't show significant and this result comparable with Gupta R et al[16]. Our study also found that rural subjects had significantly more chance to developed CAD than urban subjects. This finding suggested that despite increasing of hypertension in rural area[17] and the rural populations are more prone to develop CAD. Because of developmental changes like road communication, electrification, mechanized cultivation changes their lifestyle and it had greatly influenced the rural life.

The known modifiable risks of CAD are obesity, dyslipidemia, hyperglycemia, physical inactivity and hypertension. Different studies had not unequivocally proved these risk factors are associated with CAD. Despite the detrimental effects of obesity on coronary heart disease (CHD), obesity is found to be paradoxically associated with improved survival in secondary care of CHD and heart failure. In both CHD and heart failure, cardiorespiratory fitness (CRF) seems to significantly impact the relationship between adiposity and subsequent prognosis, and an obesity paradox is only present with low CRF. Emphasis should be placed on improving cardiorespiratory fitness(CRF), regardless of weight status. Intentional weight loss, particularly while maintaining FFM, should be encouraged in obese individuals as reported by De Shutter[18]. Another study have observed high CAD mortality among people with non-obese; and low mortality among the obese individuals[19]. In this study, we found no significant association between BMI and CAD. Likewise, dyslipidemia (high cholesterol, TG, LDL and HDL) were known risk for CAD[20,21] . On the contrary, our study findings did not show excess risk of dyslipidemia for CAD. Further study may explain, why the

obesity and dyslipidemia were not risk factors for CAD. Our study also revealed that physical inactivity has been identified as an important risk factor in the development of CAD, which was consistent with other published studies[22,23]. Regular physical activity is effective in the primary and secondary prevention of CAD; because exercise improves endothelial function and halts the progression of coronary stenosis and also contributes to enhanced myocardial perfusion. It is known that, high blood pressure is a major modifiable risk factor for CAD. The study also found that high blood pressure as a significant risk factor to develop CAD. The UKPDS found that tight blood pressure control in diabetic patients was associated with better outcomes than less tight control to reduce different types of complications with CAD[24] and our study finding also similar with this study. Usually high blood pressure puts added force against the artery walls. Over time, this extra pressure can damage the arteries, making them more vulnerable to the narrowing and buildup plaque which is associated with atherosclerosis and more likely it develop CAD. Some other risk variables such as family history of diabetes, smoking and HbA1c were expected to contribute to CAD, but not significant for CAD in this study. It is well established findings that hyperglycemia is also a major risk factor for cardiovascular patients with type 2 diabetes, and treatment of hyperglycemia to near-normal levels might reduce cardiovascular disease[25]. Our study also proved that increasing blood glucose as a risk factor for development of CAD. But our study couldn't prove significant association with the HbA1c results. May be they used to take regular treatment of diabetes to control or maintain near-normal the blood glucose level. Further prospective study may prove the results.

Again, this study found that it had significant association between CAD and educational status. Possibly, no/less educated patients may be less aware and less accessible to health care system & it may contribute to develop CAD. The association between duration of type 2 diabetes and the development of CAD is controversial. Some studies have noted an association[26], whereas others have not[27]. But in this study the long duration of diabetes has been found to be a significant risk factor for CAD.

Conclusion:

The study concluded that the prevalence of CAD in Type 2 diabetes was more common and comparable to other developed countries. The study proved that older age, physical inactivity, rural subjects, no schooling, long duration of diabetes, high blood pressure and high blood glucose were independent risk for CAD. Gender, Obesity and dyslipidemia had no effect on CAD in this study. May be they take maintain regular exercise, anti-lipid lowering treatment and as a results there is no significant relation.Further prospective study may be undertaken to confirm the role of these covariates. Therefore, the study concluded that lifestyle modification and tight blood pressure control with diabetes is key part to reduce CAD.

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