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Prevalence of Diabetes Mellitus and Associated Risk Factors among Adult Individuals in Selected Areas of Bangladesh

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Abstract Objective: To assess the prevalence of diabetes mellitus and its risk factors among individuals aged 18 years and above. Study design: cross-sectional. Methods: This study was conducted among 400 adults aged 18 to 93 years old from Dhaka, Mymensing, Sylhet and Khulna District in Bangladesh. A multistage sampling technique was used to select study participants. We carried out frequency tabulation, bivariate and multivariate regression analyses to achieve the study objective. Result: The prevalence of DM was 9.75%. Study participants with high waist circumference were 2.57 times more likely to be DM positive compared to those whose waist circumference was normal (OR = 2.57). Respondents who were overweight (OR = 2.587) and obese (OR = 4.17) were more at risk of having DM than those who had normal weight. Individuals with smoking habit were about 1.253 times more likely to have DM compared to participants who never smoked in their lifetime. Respondents who were inactive were 5.587 times at more risk of being DM positive than those were active. Female respondents were more (OR = 1.568) at risk of having DM than male respondents. Respondents aged 36-50 years old, 51-65 years old and 66-93 years old were 1.475 times, 2.136 times and 2.563 times more risk of having DM than 18-35 years old respondents. Conclusion: Health care system in Bangladesh urgently needs policy guidelines to monitor prevalence and associated factors regarding DM.

Keywords: *prevalence, diabetes mellitus, DM, associated risk factors, adult Individuals, Bangladesh*

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1. Introduction

Diabetes mellitus (DM) is a metabolism disorder happening from a defect in insulin action, insulin secretion, or both. Insulin deficiency, in turn, points to chronic hyperglycemia with irregularities of carbohydrate, protein metabolism, and fat [1]. It is one of the chronic non-communicable diseases which have appeared as a leading global public health problem. It is also known for vascular brain diseases, blindness, renal malfunction, and limb amputations [2]. As stated by the International Diabetes Federation (IDF) Atlas guideline report, there are 352 million adults with impaired glucose tolerance at present who are at significant risk of developing Diabetes in the upcoming days. In the year 2017, it was estimated that 425 million people of 20–79 years suffered from Diabetes Mellitus, and the number is expected to reach around 629 million by 2045. [3] In 2011, its global prevalence was approximately 8% and was supposed to rise to 10% by the year 2030. Almost 80% of Diabetes patients live in low- and middle-income countries. Notably, Asia and the eastern pacific region countries are affected severely. For example: in 2011, 9% of the total population of china (90 million adults) were Diabetes patients, followed by 61.3 million people from India and 8.4 million people from Bangladesh. [4] However, many governments and public health strategists still now headless of the prevalence of Diabetes and prediabetes, the possibility for future inflation in prevalence, and the severe complications associated with the disease. As a result, knowledge of the prevalence of Diabetes, prediabetes, and associated risk factors could boost awareness of the

disease and head to new policies and procedures for prevention and management.

Bangladesh, a country with 149.8 million people (according to 2011 data), according to a recent meta-analysis, the prevalence of Diabetes among adults had increased significantly. From 1995-2000, the prevalence was 4%, and from 2001-2005 it was 5%. But, from 2006 to 2010, the prevalence of the disease raised to 9% among Bangladeshi People. [5] Unfortunately, no nationally representative epidemiological analysis of the prevalence of Diabetes and its associated risk factors has been conducted in Bangladesh. Previous researches have been restricted to particular rural or urban regions or a specific gender or had a non-adequate sample size. Besides, no prior study has entirely estimated the impact of individual, domestic, and community factors on Diabetes mellitus. Therefore, the study's goals were to obtain a representative assessment of the prevalence of Diabetes patients in the risk group in Bangladesh and to point out individual, domestic, and community factors associated with the disease.

2. Methods

2.1. Study Setting

The study was conducted in Dhaka, Mymensing, Sylhet and Khulna District in Bangladesh.

2.2. Study Design, Study Period, and Size of the Sample

A community-based cross-sectional (prevalence) study was conducted from 1st January to 30th March 2018. The source population was individuals aged between 18 and 93 years and permanently living there. The sample size was calculated was determined to be 400.

2.3. Sampling Technique

This study was conducted among 400 adults aged 18-93 years who lived in Dhaka, Mymensing, Sylhet, and Khulna District for at least six months or more before the survey. Multistage sampling technique was applied; the primary sampling units, four districts were randomly chosen from a total of eight. The sample size was uniformly distributed to each of the selected regions. Lastly, a systematic random sampling technique was used to select households to be surveyed for data collection. From the selected households, qualified adults between 18 and 93 years old were identified, and if there were more than one adult in a household, one was chosen randomly.

2.4. Exclusion Criteria

(i) Peoples who were receiving any drug which may impact glucose metabolism (like B-Blockers, steroids, and thiazide diuretics) were clipped to avoid the risk of false-positive Diabetes mellitus or prediabetes. But the persons who were receiving antidiabetes mellitus drugs were not counted in this criteria.

(ii) Pregnant women were excluded from the analysis to evade the potential influence of pregnancy on laboratory and anthropometric parameters.

2.5. Data Collection Procedure and Measurement

Demographic and behavioral characteristics data were collected by learned personnel by a personal interview using a partially structured questionnaire. The field study team was comprised of scrutineers, nurses, laboratory technicians, and supervisors. The stepwise approach (three steps) of the World Health Organization (WHO) for non-communicable disease surveillance was employed to obtain the data [6].

2.6. Step 1: Demographic and Behavioral Characteristic Data

During this phase, demographic and behavioral risk factors were obtained by direct interviews using an interviewer-administered survey. Every participant was interviewed for age, gender, educational qualification, marital status, occupation, physical activity, history of high blood pressure and Diabetes, fruit and vegetable consumption, smoking habit, and alcohol consumption.

2.7. Step 2: Physical Measurements

The height and weight measurement required to measure body mass index, blood pressure, and waist circumference were assessed in this phase. Blood pressure (BP) was measured in a seated position utilizing a digital sphygmomanometer from the right arm. Two readings were obtained 5 minutes apart, and the average was recognized as the final blood pressure measurement. Systolic blood pressure of 120-139 and diastolic blood pressure 80-89 mmHg condition is characterized as Prehypertension. Hypertension is described as systolic blood pressure of more than or equal to 140 mmHg or diastolic blood pressure of more than or equal 90 mmHg. A transportable height and weight measurement scale was used to measure the height in straight standing position on a plane surface and the weight of the subjects dressing light outfits. After that, the body mass index was assessed by weight in kg (kilograms) divided by height in meters squared method. The BMI value of less than 18.5kg/m2 was considered underweight, 18.5- 22.99 kg/m2 was deemed to be healthy BMI, 23-27.49 kg/m2 was considered overweight, and subjects with ≥27.5kg/m2 BMI as obese. Waist circumference was taken following standard procedure (roughly midpoint between the top of the ilalic crest and the lower edge of the end palpable rib, using a plastic tape). According to the World Health Organization (WHO) guidance, Waist circumference values of>80 cm and >94 cm for women and men were regarded as high.

2.8. Step 3: Biochemical Measurements

The Accu-Chek Active method applies a capillary blood specimen, set to plasma serum standard, resulting in plasma glucose values. This analysis was instantly

completed for all participants, and the outcomes were filed in the questionnaire. Fasting capillary blood specimens were taken three times on diverse occasions (for three following days) from a single study subject, and glucose level measurement was conducted within fractions of seconds following specimen collection. After that, their mean was taken for investigation, which might have decreased the occurrence of strange results. The determination of Diabetes Mellitus was based on the American Diabetes Association (ADA) Diabetes mellitus classification standards with fasting blood glucose of more than or equal to 126mg/dl being counted as DM positive; impaired fasting glucose, fasting blood glucose less than or similar to 110 mg/dl to less than 126 mg/dl; normoglycemic, fasting blood glucose less than or equal to 61 mg/dl to less than 110mg/dl, and hypoglycemic, less than 61 mg/dl [7].

2.9. Data Analysis

The data were entered, cleaned, and analyzed utilizing the SPSS software package (version 23.0). A descriptive statistics approach was used to summarize the different characteristics of the study subjects. Bivariate and multivariate analyses were used to check the association between independent variables and the dependent variable. All independent variables with a value of ≤0.2 in the bivariate analysis were included in the multivariate binary logistic regression model to examine the independent influence of each variable on Diabetes. The magnitude of the correlation was estimated using the odds ratio (OR). The p-value<0.05 was acknowledged as statistically significant.

2.10. Consent to Participate

Informed verbal consent was collected from each study participant. Any data collected in each course of the study was retained confidential. Participants classified with low blood sugar, impaired fasting glucose (IFG), and Diabetes were referred to neighboring healthcare settings for farther investigation and management.

3. Results

A total of 400 valid observations were included in the analysis. The mean age of participants was 43.43±19.82 years. Two hundred forty-one (60.25%) of the participants were younger than 50 years old. 58.75% of the study participants were male. More than half (56.75%) of adults either attended primary education or did not participate in formal education. Two-thirds of them (68.5%) were married, while 86 (21.5%) were single. Concerning occupation, 140 (35%) adults were farmers, whereas 88 (22%) were housewives (Table 1).

3.1. Distribution of Adults' Behavioral Characteristics

From the total of participants responding, 173(43.25%) were smokers. Only Ten (2.5%) participants consumed alcohol over the last 30 days preceding the time of data collection. Three hundred six (76.5%) participants ate fruits two or fewer days in a week. Forty-seven (11.75%) participants ate vegetables for two or fewer days during regular weekdays. One hundred thirty-seven (34.25%) adults were not involved in adequate physical activity or physical inactivity (Table 2).

Table 1. Sociodemographic characteristics of adults in Bangladesh

Characteristics	Frequency	Percent
Sex		
Male	235	58.75
Female	165	41.25
Age		
18-35	115	28.75
36-50	126	31.5
51-65	74	18.5
66-93	85	21.25
Education		
HSC and above	101	13.5
SSC	119	29.75
Primary	154	38.5
No education	73	18.25
Marital status		
Married	274	68.5
Single	86	21.5
Divorced	23	5.75
Widowed	17	4.25
Districts		
Dhaka	100	25
Mymensing	100	25
Sylhet	100	25
Khulna	100	25
Occupation		
Housewife	88	22
Farmer	140	35
Private Job	72	18
Other†	100	25

Other†: including students (n=26), Unemployed (n=35), Business (n=18), and daily laborer (n=21).

Table 2. Distribution of adults' behavioral characteristics

Tobacco status	Frequency	Percentage
Ever smoking cigarette		
Yes	173	43.25
No	227	56.75
Current alcohol consumption		
Yes	10	2.5
No	390	97.5
Fruits consumption per week		
Two or fewer	306	76.5
Three to four	73	18.25
Five or more	21	5.25
Vegetable consumption per week		
Two or fewer	47	11.75
Three to four	82	20.5
Five or more	271	67.75
Total physical activities		
Active	263	65.75
Inactive	137	34.25

Other†: including students (n=26), Unemployed (n=35), Business (n=18), and daily laborer (n=21).

3.2. Physical and Biochemical Measurements

Table 3. Study populations' physical and biochemical measurement characteristics

Variables	Frequency	Percentage
Hypertension		
Yes	159	39.75
No	241	60.25
Waist circumference		
Normal	216	54
High	184	46
Body mass index		
Underweight	46	11.5
Normal	234	58.5
Overweight	93	23.25
Obese	27	6.75
Fasting blood glucose		
Diabetic	39	9.75
Prediabetic	46	11.5
Normoglycemic	305	76.25
Hypoglycemic	10	2.5

3.3. Prevalence of Diabetes Mellitus

The majority, 76.25% (305/400), of the study participants were normoglycemic, whilst 11.5% (46/400) of the respondents were prediabetics (Table 3) (Figure 1). The DM prevalence was found to be 9.75% (39 out of 400).

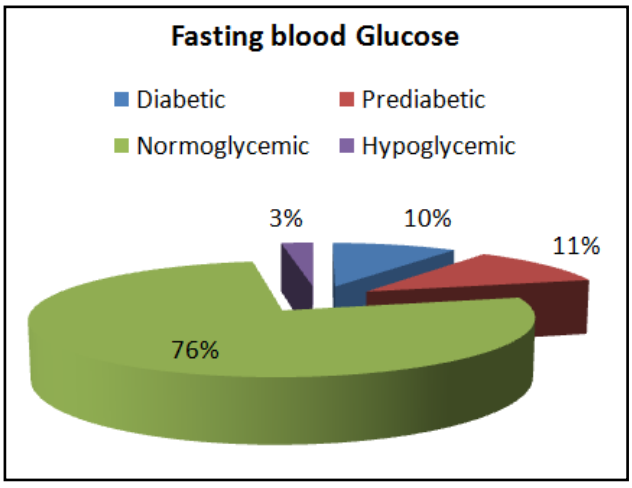

Figure 1. Prevalence of Diabetes and pre-diabetes

3.4. Factors Associated with Diabetes Mellitus

Study participants with high waist circumference were 2.57 times more likely to be DM positive than those whose waist circumference was normal (OR = 2.57). Regarding body mass index, being overweight and obesity was also independently associated with the prevalence of DM. Respondents who were overweight were 2.587 times at more risk of being DM positive than those with standard body mass index (OR = 2.587). Respondents who were obese were 4.17 times at more risk of being DM positive than those with normal body mass index (OR = 4.17). Similarly, individuals with smoking habits were about 1.253 times more likely to be DM positive compared to study subjects who never smoked in their lifetime (OR = 1.253). Inactive respondents were 5.587 times at more risk of being DM positive than those who were active (OR = 5.587). Female respondents who were 1.568 times at more risk of being DM positive than male respondents (OR = 1.568). The age of respondents was also independently associated with the prevalence of DM. Respondents aged 36-50 years old, 51-65 years old and 66-93 years old, were at least 1.475 times, 2.136 times, and 2.563 times respectively, at higher risk of being DM positive than 18-35 years aged respondents. (Table 4).

Table 4. Multivariable analysis of Diabetes mellitus associated factors

Variable	DM status		OR	P-value
	Yes (%)	No (%)		
Sex				
Male	19(8.09)	216(91.91)	1	0.043
Female	20(12.12)	145(87.88)	1.568	
Age				
18-35	7(6.08)	108(93.92)	1	
36-50	11(8.73)	115(91.27)	1.475	
51-65	9(12.16)	65(87.84)	2.136	0.0037
66-93	12(14.12)	73(85.88)	2.536	
Districts				
Dhaka	12(12)	88(88)	1	
Mymensing	10(10)	90(90)	0.815	
Sylhet	9(9)	91(91)	0.725	0.073
Khulna	8(8)	92(8)	0.638	
Occupation				
Housewife	7(7.95)	81(92.05)	0.993	
Farmer	13(9.28)	127(90.72)	1.17	0.0739
Private Job	11(15.27)	61(84.73)	2.07	
Other†	8(8)	92(92)	1	
Ever smoking cigarette				
Yes	19(10.98)	154(89.02)	1.253	
No	20(8.81)	207(91.19)	1	0.039
Current alcohol consumption				
Yes	1(10)	9(90)	1.029	
No	38(9.74)	352(90.26)	1	0.913
Total physical activities				
Active	14(5.38)	249(94.62)	1	
Inactive	25(18.25)	112(81.75)	5.587	0.0034
Nutritional Status				
Underweight	4(8.69)	42(91.31)	1.39	
Normal Weight	15(6.41)	219(93.59)	1	
Overweight	14(15.05)	79(84.95)	2.587	0.0431
Obese	6(22.22)	21(77.78)	4.17	
Hypertension				
Yes	13(8.17)	146(91.83)	0.736	
No	26(11.26)	215(88.74)	1	0.121
Waist Circumference				
Normal	13(6.02)	203(93.98)	1	
High	26(14.13)	158(85.87)	2.57	0.0427

4. Discussion

According to the study, the prevalence of Diabetes mellitus was found 9.75% (39 out of 400). According to IDF, the prevalence of Diabetes in Bangladesh was 6.3% in 2013, it was approximately 6.9% in 2017, but some studies were assessed to be 8.5% to 10%. The pre-diabetes

prevalence was found to be 11.5% in the present study, which is higher than the estimated 5–8% national prevalence of Bangladesh. This suggests that the DM prevalence in the study region may increase soon as there is a risk of progression of the prediabetic condition to the diabetic.

The present study has reported some established and hypothesized associated factors. This study evidenced that there was a significant relationship between Diabetes mellitus and smoking habits. The exact mechanism of why smoking enhances the chance of Diabetes and decays glucose homeostasis has not been fully clarified, but the available proof shows that the practice increases insulin resistance. Smoking has also farther been linked with the development of chronic pancreatitis and pancreatic cancer [8]. Expanded abdominal fat stores have been assumed to affect insulin action by releasing free fatty acids (FFA). Besides, fat cells emit indicating factors, for example, interleukin-6 (IL-6) and tumor necrosis factor-α (TNF-α), which are connected to the development of insulin resistance [9].

This study's main limitation is that Diabetes mellitus was diagnosed with a glucose meter from capillary blood. The process is not as accurate as plasma glucose estimation. Besides, study subjects did not track their exact fasting time in some cases, which might have influenced the overall DM prevalence. The study was not adequate to classify the different types of DM, and this is another shortcoming of the study.

5. Conclusion

The study showed a 9.75% prevalence of Diabetes mellitus, which was higher than the predicted national prevalence of 5-8% DM. This prevalence rate is an alarming indicator as it has been predicted that much of the global increase in DM is anticipated to be in Bangladesh. Body mass index, Waist circumferences (WC), smoking habits, hypertension, and physical activities were significantly associated with Diabetes. These determinants related to DM were probably modifiable. Therefore, targeting the prevention approach to such modifiable risk factors might decrease the prevalence of Diabetes mellitus in the study area.

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Ethical Consideration

This study was approved by Ethical Review Board of University of Dhaka. The researchers clarified the objective of this research and obtained informed consent from the respondents.

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Competing Interest

Authors declare to have no conflict of interest.

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