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PREVALENCE OF ABNORMAL GLYCEMIC AND LIPIDEMIC STATUS IN AN URBAN POPULATION OF BANGLADESH

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Abstract

Context: Undiagnosed cases of diabetes mellitus constitute a major proportion of diabetic patients in the developing countries due to lack of proper screening and primary care facilities. Generation of evidence on undiagnosed cases is highly important for the estimation of the true burden of this disease.

Objectives: The present study was undertaken to explore the proportion of undiagnosed diabetes and associated disorders in a middle aged Bangladeshi population living in the capital city of Bangladesh.

Materials and Methods: Under a cross-sectional observational design a group of 254 middle aged (35-60 yrs) subjects (146♂ and 108) were included in the study who previously were unaware about the existence of diabetes or its complications. A 2-sample OGTT was done and blood glucose was estimated by glucose-oxidase method and Serum total cholesterol, HDL and TG by enzymatic colorimetric (Cholesterol Oxidase /Peroxidase, CHOD-PAP) method. Glycemic and other abnormalities were diagnosed and classified as per WHO criteria.

Results: Out of the total 254 subjects 34 (15.1%) were found to have type 2 diabetes mellitus (T2DM) and 49 (19.29%) were prediabetics (24.5%-IFG, 75.5% -IGT and 20.4% had combined IFG-IGT). WHR (the indicator of central obesity) was present in higher proportions of diabetic (93.9%) and prediabetics (89.9%) compared to 76.0% control (λ^2=8.815; p=0.017). Male subjects had significantly higher central obesity compared to females both in the controls (t=3.929; p<0.0001) and in T2DM groups (t=2.608; p=0.015). Dyslipidemia (judged by triglyceride value) was present among 64.7% in T2DM, 40.8% in Prediabetes and 47.9% in the Controls). In Prediabetes group 80% males had dyslipidemia compared to 20% females (p=0.008).

Conclusion: Almost twice the proportion of reported diabetic and prediabetic cases in Bangladesh is still undiagnosed and a substantial proportion of these cases have generalized as well as central obesity and dyslipidemia.

Key words: Undiagnosed diabetes, Prediabetes, Obesity, Body Mass Index, Lipid abnormalities

Introduction

Undiagnosed diabetes may impose substantial public health implications because these subjects remain untreated and at risk for complications (Franse *et al.* 2001). Undiagnosed type 2 diabetes (T2DM) and impaired glucose regulation is reported to have substantial clinical importance (Harris *et al.* 2000, Wilson *et al.* 1991) and increase the risk of cardiovascular morbidity and mortality (Haffner *et al.* 1998; Unwin *et al.* 2002). Overt T2DM is preceded by two major asymptomatic indicators of imbalance in the metabolism of glucose: impaired glucose tolerance (IGT) and impaired fasting glucose (IFG) (ADA 2009). These two indicators, collectively labeled as prediabetes, are correlated but they may also appear separately (Valdez 2009). Similar to IFG and IGT, the early stages of T2DM are asymptomatic; consequently, people with the disease may go undiagnosed for prolonged periods. In the continuum of plasma glucose distributions (fasting or 2 hour), the escalation from prediabetes to T2DM is marked by a sharp increase in the risk of complications, which, in the long run, can seriously affect a variety of organs and tissues, such as eyes, kidneys, nerves, and blood vessels (large and small) (ADA 2009). Therefore, prediabetes and undiagnosed

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T2DM are conditions for which screening can be helpful in preventing major health problems in a sizable portion of the population.

Diabetes is a dangerous disease when left undiagnosed and untreated. The prevalence of diabetes (20-79 years) in South--East Asia in 2010 was 7.6% and predicted to be 9.1% in 2030 and in Bangladesh 6.1% in 2010 and predicted to be 7.4% in 2030 (Shaw *et al.* 2010). Asian Indians (like people from India, Pakistan, Bangladesh and Sri Lanka) have surprisingly high prevalence of type 2 diabetes compared to Caucasians. For such an easy disease to detect and to screen for, it is amazing the number of people whose diabetes goes undetected and so untreated. Considering the dangers of not controlling diabetes, it is scary how many have diabetes undiagnosed. The United States estimated to have an undiagnosed diabetes population of 2.7% of the entire adult population over the age of 20 and prevalence of undiagnosed diabetes was similar among white and black men (9.1%) (Franse *et al.* 2001). In Sardinian population, the prevalence of undiagnosed diabetes was 5.65% (5.20% and 6.15%, females and males, respectively) (Muntoni *et al.* 2008). The estimated proportion of diabetes that was undiagnosed ranged from 28% using HbA1c criteria in the 60- to 74-year age group to 43% based on oral glucose tolerance test criteria in the 75-year and older group in England (Hayes *et al.* 2012). In Japan the prevalence of undiagnosed diabetes among men and women was 6.4% and 3.2%, respectively (Bando *et al.* 2008). Generation of evidence on undiagnosed cases is highly important for the estimation of the true burden of diseases in a society. The present study was undertaken to explore the proportion of undiagnosed diabetes and associated disorders in a middle aged Bangladeshi population living in the capital city of Bangladesh.

Materials and Methods

Subjects, Anthropometric measurements and collection of blood samples: A total number of 254 (146♂ and 108♀) subjects (age 35-60 yrs) from Dhaka Metropolitan Area through personal contact between January to June 2011. The subjects did not have any diabetes check in last five years and were on sedentary life style. The volunteers were informed about the nature and purpose of the study and written consent obtained once they agreed to participate. Data were collected using a redesigned data collection sheet. Anthropometric measurements and blood pressure (BP) were recorded. Personal history, family history of diabetes and hypertension were also taken. Volunteer's height (m) and weight (kg), waist and hip circumference (cm) were taken following standard procedure. BP (average of two independent measurements) was recorded using barometric Sphygmomanometer.

Overnight fasting (8-10 h) blood was collected between 8:00 to 9:00 hours and, subjects were given glucose drink (75g glucose dissolved in 300 ml of water) and second blood sample was drawn 2 h later (2h-PG). Serum separated was preserved at -60^{o}C until biochemical analyses.

Biochemical methods: Glucose (by glucose-oxidase) and serum total cholesterol, triglyceride and HDL cholesterol was measured by enzymatic colorimetric method (Hitachi 704 Automatic Analyzer, Hitachi Ltd., Japan using reagents of RANDOX Laboratories Ltd., UK). Serum LDL cholesterol was determined using Friedwald formula (Friedewald *et al.* 1972). The method was not applied in case of level of triacylglycerol exceeds 400 mg/dL. Cut-off values for body mass index (BMI) (normal $\leq$22.9 kg/m^2; overweight 23-27.5 and Obese$\geq$ 27.5) and WHR (male-0.90 and female-0.80) were used as per WHO guidelines for Asian population (WHO 2004). Blood pressure was measured by using a standard mercury sphygmomanometer. Weight and height were measured according to standard protocol and body mass index (BMI) was calculated (Garabed Eknoyan 2008).

Statistical methods: Taking into account the multistage stratified cluster random sampling procedure, total and gender-specific prevalence (95% confidence intervals) of undiagnosed diabetes at the time of the study as well as prevalence of impaired fasting glucose (IFG), impaired glucose tolerance (IGT) and IFG/IGT were

calculated. Univariate comparisons between the 3 patient groups were performed by using the λ^2 test for categorical variables. Statistical significance was set at $p<0.05$ and all values were two-sided. Statistical analysis was performed by the Statistical Package for Social Sciences (SPSS) version 17.0 for Windows.

Results

Out of the total 254 subjects 34 (13.4%) were found to have T2DM and 49 (19.3%) had prediabetes. Among the prediabetes, 24.5% had IFG, 75.5% had IGT and 20.4% had combined IFG-IGT (Table 1). In males, the proportion of T2DM and prediabetes were 55.9% and 57.1% respectively and corresponding values in females were 44.1% and 42.9 % respectively (Table 2). Among the total subjects 1.57% subjects were underweight, 24.0% normal, 53.1% overweight and 21.7% obese. In case of male, proportion of overweight and obese in T2DM were 61.1% and 25.0% respectively and in prediabetes those were 57.1% and 59%. In females, the proportions were 38.9% and 75.0% in case of T2DM and 42.9% and 50.0% in case of prediabetes respectively (Table 3). Male subjects had significantly higher central obesity compared to females both in controls (t= 3.929; p<0.0001) and in T2DM groups (t=2.608; p=0.015) (Table 3). Dyslipidemia (judged by triglyceride value) was present among 64.7% in T2DM, 40.8% in prediabetes and 47.9% in the controls. Proportion of male and female subjects with dyslipidemia did not show a statistical difference in T2DM group and controls. In prediabetes group 80% males had dyslipidemia compared to 20% females (p=0.008) (Table 3).

Table 1. Proportion of diabetes and prediabetes among the total population

Variables	n (%)
Total participants	254
Normal glucose tolerance	171 (67.3)
Diabetes mellitus	34 (13.4)
Prediabetes	49 (19.3)
Impaired fasting glucose (IGF)	12 (24.5)
Impaired glucose tolerance (IGT)	37 (75.5)
IFG+IGT	10 (20.4)

Table 2. Gender, age, BMI, WHR and blood pressure of the study subjects

Variables	Control (n=171)	Prediabetes (n=49)	T2DM (n=34)
Male	99 (58%)	28 (57.1%)	19 (55.9%)
Female	72 (42%)	21 (42.9%)	15 (44.1%)
Age (yrs)	45.2 ± 7.1	46.0 ± 7.5	47.9 ± 8.9
BMI (Kg/m^2)	25.4 ± 3.6	25.3 ± 3.2	25.6 ± 3.6
WHR	0.92 ± 0.07	0.94 ± 0.06*	0.93 ± 0.03*
Systolic BP (mmHg)	119 ± 15	116 ± 14	128 ± 16*
Diastolic BP (mmHg)	78 ± 9	79 ± 10	81 ± 12

*p< 0.017, T2DM= type 2 diabetes mellitus, BMI= body mass index, WHR= waist hip ratio, BP= Blood pressure

Table 3. Distribution of subjects on the basis of obesity markers (BMI and WHR) and by gender

	Groups	BMI- n (%)			WHR- n (%)		Triglyceride- n (%)	
		Normal	Over weight	Obese	Normal	C-Obesity	Normal	Hyper
Male	Control(99)	57 (57.6)	38 (38.4)	4 (4)	12 (12)	87 (88)	48 (48.5)	51 (51.5)
	T2DM(19)	6 (31.6)	11 (58)	2 (10.4)	6 (31.6)	13 (68.4)	9 (47.4)	10 (52.6)
	Prediabetic(28)	8 (28.6)	16 (57.1)	4 (14.3)	8 (28.6)	20 (71.4)	12 (43)	16 (57)
Female	Control(72)	25 (34.7)	35 (48.6)	12 (16.7)	5(7)	67 (93)	41 (57)	37 (43)
	T2DM(15)	2 (13.3)	7 (46.7)	6 (40	2 (13.3)	13 (86.7)	3 (20)	12 (80)
	Prediabetic(21)	4 (19)	12 (57.1)	5 (23.9)	4 (19)	17 (81)	17 (81)	4 (19)

T2DM=Type 2 diabetes mellitus, C-Obesity= Central obesity, BMI (Kg/m^2) = body mass index, Cut-off value: Normal ≤22.9; Overweight 23-27.5 and Obese≥ 27.5). WHR= waist hip ratio, Cut-off value: Male Normal ≤0.90; Female ≤ 0.80, M/F= male/ female, **p<0.001, *p<0.015.

Discussion

Diabetes is a life threatening disease if it remains undiagnosed and untreated. However, much of diabetes remains undiagnosed (Rathmann *et al.* 2003, Joshy and Simmons 2006) and levels of hyperglycaemia below

the diagnostic threshold for diabetes, IGT and IFG are associated with an excess risk of cardiovascular disease (Unwin *et al.* 2002, Harati *et al.* 2009). Such levels of hyperglycemia are also at high risk of progressing to Type 2 diabetes. Numerous studies have shown that diabetes mellitus is not identified and consequently inadequately treated in a substantial proportion of the patients in the general population (Rojas-Rojas-Martínez *et al.* 2012). In our study, 15.1% were found to have undiagnosed T2DM, 24.5% had IFG, 75.5% had IGT and 20.4% had combined IFG-IGT (Table 1). In males, the proportion of T2DM and prediabetes were 55.9% and 57.1% respectively and corresponding values in females were in 44.1% and 42.9 % (Table 2) which are higher than Iranian population (Hadaegh *et al.* 2008). Rahman *et al.* (2007) observed the total prevalence of type 2 diabetes in an urbanizing rural community in Bangladesh as 8.5%, men showed higher prevalence (9.4%) compare to women (8.0%), whereas the overall prevalence of was 11.2% and IFG was 5.9% as recorded in urban area by Sayeed *et al.* (2007). The overall prevalence of DM was 16.7% with diagnosed DM being (10.7%) and newly diagnosed DM being (5.9%) of the Qatari population (Bener *et al.* 2009).

Clustering of pre-diabetes and diabetes is present in families of prediabetic subjects. So they should be taken as a major target for primary prevention of diabetes and prediabetes as like as first degree relatives of type 2 diabetic subjects (Shefin *et al*. 2011). Although there is increased awareness of diabetes in our population with improvement of education and access to medical care, but this was not sufficient to decrease the percent of undiagnosed cases. Undiagnosed T2DM is not milder than clinically detected diabetes (Rathmann *et al.* 2003). Hariss *et al.* (2000) in a review study reported that people with undiagnosed diabetes have substantial rates of risk factors for diabetes complications although they are not as hyperglycemic as are patients with diagnosed diabetes. In a rural population of Bangladesh Rahim *et al.* (2010) recorded the prevalence of IFG, IGT and newly detected T2DM were 1.3%, 2.0% and 7.0% respectively. IFG, IGT, IFG+IGT were more prevalent in females than males.

In our study, it was found that undiagnosed prediabetic and diabetic patients are of older age than normal population, which is supported by other study (Dong *et al.* 2005, Hadaegh *et al.* 2008, Nayak *et al.* 2011). We found that the total prevalence of diabetes was higher in male than female, a finding that is differ from a study in Iran (10% in women vs. 8.1% in men) (Esteghamati *et al.* 2008) and similar to data of the U.S (Harris *et al.* 1998, Geiss *et al.* 2006) and Australia (Dunstan *et al.* 2002). The higher prevalence of metabolic syndrome was found in our male population although hypertriglyceride and obese female were found more than male in case of T2DM (Table 3, 4). The higher prevalence of metabolic syndrome in our male may be the underlying cause for this sex difference (Azizi *et al.* 2003, Zabetian *et al.* 2007). Systolic blood pressure was significantly higher in diabetic subjects in comparison to normal subjects where as diastolic blood pressure did not show any significant difference among group (Table 2). This finding is similar to many other studies (Cushman 2010, Saadi *et al.* 2010, Joshi *et al.* 2012). The data from other authors showed a higher prevalence of overweight and other cardiovascular risk factors mainly in the group of undiagnosed diabetics (Meigs *et al.* 1998, Saydah *et al.* 2001, Tenenbaum *et al.* 2000). As the sample size was small so it is difficult to conclude on the prevalence of undiagnosed diabetes but this study will add some knowledge about the undiagnosed diabetes urban population of Bangladesh.

Conclusions

The data suggest that almost twice the proportion of reported diabetic and prediabetic cases in Bangladesh are still undiagnosed and a substantial proportion of these cases have generalized as well as central obesity and dyslipidemia. The proportion of undiagnosed cases can assume to be higher in rural areas due to lack of facilities and education. Thus, the true burden of undiagnosed diabetes in Bangladesh may be much higher and need further study and exploration considering these cases.

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