Original Article

Blood glucose and cholesterol levels in adult population of Bangladesh: Results from STEPS 2006 survey

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ABSTRACT

Background: A nationally representative survey was carried out to determine the distribution of blood glucose and cholesterol in adult population of Bangladesh in the absence of existing data.

Methods: The study adopted a multistage and geographically clustered sampling technique of households. A total of 2610 individuals (1444 men and 1166 women) aged 25–64 years were selected from rural and urban areas. Capillary blood glucose and total cholesterol levels were measured using an overnight fasting state.

Results: The mean age of the participants was 41 years [standard deviation (SD), 11 years]. Half of them (49%) were from urban areas. Half of them (51%) had primary or higher education. Mean glucose was 74 mg/dL (SD 23 mg/dL). Men had higher mean glucose levels (79 mg/dL) than women (67 mg/dL). Age-standardized prevalence of diabetes (blood glucose level ≥126 mg/dL and/or use of anti-diabetic medication) was 5.5%. In men, it was almost two-and-half times (7.6%) compared with women (2.8%). It was also double in urban areas (7.8%) compared with rural areas (3.4%). Mean cholesterol level among all participants was 167 mg/dL (SD 26 mg/dL). Men and women had almost similar levels (169 mg/dL versus 166 mg/dL, respectively). Prevalence of high cholesterol level (≥240 mg/dL) was very low (1.3%) in both men (2.2%) and women (0.5%). However, the prevalence of borderline high cholesterol was substantial (5.8%) in this sample.

Conclusion: The prevalence of high hypercholesterolemia is low, whereas there is a high prevalence of borderline high cholesterol and diabetes in the adult population of Bangladesh. This warrants population-based interventions to tackle this problem.

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1. Introduction

Major killer non-communicable diseases (NCDs) such as cardiovascular diseases, diabetes mellitus, chronic respiratory diseases, and some cancers have common amenable risk factors. Therefore, these NCDs can be prevented at first hand by controlling their risk factors.[1] These risk factors are mainly lifestyle-related and include tobacco consumption, unhealthy diet (fatty, salty, and sugary foods, and foods low in fruit and vegetables), low physical activity, and excessive use of alcohol.[2] Data on these risk factors are largely available because of simplicity of data collection by asking questions only. These lifestyle factors act through a few intervening factors such as obesity, high blood pressure, and high levels of blood glucose and lipids.[3] Obesity and blood pressure need physical measurements and they do not require much skill and investment in capital equipment. Therefore, data on these factors also are fairly available even in a developing country like Bangladesh.

The next group of intervening risk factors, however, requires biochemical examination of blood such as glucose and total cholesterol (TC) levels.[3] There is insufficiency of data on this group of variables. Some sporadic studies were carried out using small samples in communities in certain corners of Bangladesh.[4–6] Studies on blood glucose indicate an increasing trend of diabetes burden in Bangladesh[7] but cholesterol data are sparse. We reported two small-scale studies[5,6] from two different villages. Large differences were observed in the cholesterol levels between these two studies. Therefore, there is a need for population-based data on blood glucose and TC level because no such report is available. The present survey was carried out to have a nationally representative data on blood glucose and TC in adults from Bangladesh.

2. Methods

This survey was conducted as per the standardized approach devised by WHO known as STEPS (STEP wise Surveillance) for NCD risk factors in men and women aged 25–64 years.[3] The questionnaire was adapted from STEPS.

Ethical clearance was obtained from Bangladesh Medical Research Council (BMRC) and Declaration of Helsinki was followed throughout the study. Written (or thumb impression if unable to write) consent was obtained from the respondents in Bangla as per BMRC guidelines.

2.1. Sample selection

This study used a multistage, geographically clustered, probability-based sample of households, and then individuals. The questionnaire was filled up by interviewers and no proxy interview was allowed. Bangladesh is divided into seven administrative divisions. Out of those seven divisions, Dhaka division is most densely populated because the capital city of Dhaka is located in this division. More than one in ten people of Bangladesh live in Dhaka city alone. Therefore, sample from Dhaka's urban and peri-urban areas was considered mandatory. Out of the remaining six divisions, two (Chittagong and Rajshahi) were randomly selected for rural sample based on

the presence of member organizations of the Alliance for Community-based Surveillance of NCDs.[8]

Diabetes was defined as having blood glucose level ≥126 mg/dL[9] or current medication for diabetes. Borderline high and high cholesterol were defined as 200–239 mg/dL and ≥240 mg/dL of TC. Using the prevalence of diabetes (7.5%) for rural–urban combined population, 3% margin of error, and assuming a design effect of 2, the minimum required sample size was 592. This study aimed at giving prevalence data for four categories based on sex and urban–rural areas of residence. Therefore, a minimum of 2369 respondents was needed. Based on a response proportion of 0.8, our sample was inflated to 2961 and ultimately rounded to 3000. Proportionate sub-samples were selected from three divisions (Chittagong, Dhaka, and Rajshahi) to draw this sample of people with eligible ages.

In each area, the field team consisted of one physician and two enumerators. They underwent 3-day training before deployment in the field in the first half of 2006. Random selection of wards in urban areas (in addition to a small sample from a factory setting in peri-urban Dhaka) and unions in rural areas was carried out. In the next step, required number of households was identified in sequential order starting from the first one. Listing of households was carried out if necessary. Finally, one individual per household was recruited using Kish method.[10] People who stayed in the household the night before the day of survey were entered into the roster for identification using Kish table. Sample substitution was not allowed and no repeat call was carried out.

Information on drug treatment of diabetes was also collected. Those who were taking it for last 2 weeks were considered as a documented case of diabetes. WHO STEPS recommended equipment, Acutrend GC, was used to determine glucose and cholesterol by finger pricking without much pressing the fingers. The subjects were on overnight fasting status (8–12 h).[3]

2.2. Data analysis

Complex survey data analysis was performed to obtain population prevalence or mid-point estimates and their dispersions, as appropriate, for age and sex groups. Separate analyses for urban and rural areas were also carried out. Descriptive statistics was used for presenting all data. Prevalence rates were presented as percentages. Prevalence values were standardized for WHO world standard population.[11] All analyses were carried out using SPSS 17.0 version.

3. Results

A total of 2610 (87%) subjects participated. Among the respondents, 1444 (55%) were men (Table 1) with mean age of 41 [standard deviation (SD): 11 years]. Half of them (49%) were from urban areas as stipulated in the study design. Half (51%) of them had primary or higher level of schooling. One-tenth of men were farmers, one-third was laborers (industrial workers, agriculture, and daily laborers), one-tenth was having small business, and one-tenth had jobs in non-government sectors. Nine in ten women were homemakers (data not shown).

Table 1 – Background of the study subjects aged 25–64 years.			
	Both sex (n = 2610)	Men (n = 1444)	Women (n = 1166)
	Mean (standard deviation)		
Age, years	41.3 (11.3)	40.6 (11.1)	42.1 (11.4)
BMI, kg/m^2	21.3 (3.5)	20.9 (3.2)	21.8 (3.7)
Systolic blood pressure, mm Hg	116 (15)	117 (14)	117 (15)
Diastolic blood pressure, mm Hg	76 (10)	75 (10)	77 (10)
Fruit/vegetables servings/day, median (IQ range)[a]	2.7 (2.2–4.6)	3.0 (2.0–5.1)	2.5 (2.0–4.0)
	Number or percent		
Age groups, numbers			
25–34	774	468	306
35–44	738	434	304
45–54	593	291	302
55–64	505	251	254
Other variables, percent			
Urban residence	49.2	61.3	34.1
Primary and above education	51.5	62.9	37.0
Smoker	27.4	48.4	1.4
Smokeless tobacco users	28.6	24.1	34.2
Tobacco user in any form	49.1	60.3	35.3
Life time alcohol drinker, any amount	1.0	1.5	0.4
Medication for hypertension	5.1	4.7	5.6
Medication for diabetes	1.4	1.2	1.6
Low fruit/vegetable intake, <5 servings/day	77.1	72.9	82.3
Sedentary lifestyle[b]	35.2	24.7	48.2
Hypertension, BP ≥140/90 mmHg or medication	15.1	13.4	17.2
Overweight, BMI ≥25 kg/m^2	11.9	9.0	15.5

BMI, body mass index.
[a] IQ indicates inter-quartile range.
[b] Primary occupation that does not require moderate to vigorous physical activity.

3.1. Inquired (step 1) and measured (step 2) risk factors

Table 1 gives the distribution of relevant inquired and measured variables. Three-quarter (77.1%) of them had less than 5 servings of fruit/vegetables intake per day in a typical week. More than one-third (35.2%) of them had low physical activity level, i.e. non-engagement in moderate to severe physical activities. Half of them were tobacco users in any form. Twelve percent were overweight [body mass index (BMI) ≥ 25 kg/m^2]. One in twenty (5.1%) person was on medication for hypertension, whereas overall prevalence of hypertension was 15.1%.

3.2. Biochemical (step 3) risk factors

Mean glucose level was 74 mg/dL (79 in men and 67 in women) (Table 2). On history alone, the prevalence of diabetes was 1.4% (Table 1). In combination with capillary blood glucose level (≥126 mg/dL), it rose up to 5.5% (Table 3). As depicted in Fig. 1, the prevalence of diabetes was more than double in urban areas (7.8%) compared with rural areas (3.4%).

Average cholesterol level was 167 mg/dL (Table 2). Levels were similar in men (169 mg/dL) and women (166 mg/dL). Borderline high level of cholesterol was 5.6% (men 6.3%, women 5.0%) (Table 3). Prevalence of hypercholesterolemia (≥240 mg/dL) was 1.3% (men 2.2%, women 0.5%). We did not observe any prominent difference related to age (Table 3) or rural–urban residence locations in prevalence of hypercholesterolemia (Fig. 1).

4. Discussion

The current study is the first ever national STEPS survey to address blood glucose and TC levels. This survey reports a substantially high prevalence of diabetes in adults indicating

Table 2 – Fasting capillary blood glucose and total cholesterol levels in Bangladeshi men and women aged 25–64 years.						
	Both sex (n = 2610)		Men (n = 1444)		Women (n = 1166)	
	Mean	SD	Mean	SD	Mean	SD
Glucose						
25–34	72	19	78	18	63	15
35–44	75	23	80	23	69	19
45–54	74	27	81	32	67	20
55–64	74	25	79	30	70	18
25–64	74	23	79	25	67	18
Cholesterol						
25–34	164	32	168	41	161	20
35–44	168	24	168	25	168	22
45–54	167	24	171	25	163	22
55–64	171	21	170	22	172	21
25–64	167	26	169	30	166	22

To convert cholesterol and glucose values to mmol/L, multiply by 0.02586 and 0.05551, respectively.
SD, standard deviation.

Table 3 – Prevalence (%) of diabetes and hypercholesterolemia in Bangladeshi men and women aged 25–64 years.			
	Both sex (n = 2610)	Men (n = 1444)	Women (n = 1166)
Diabetes, blood glucose ≥126 mg/dL or medication			
25–34	4.0	6.0	1.0
35–44	5.4	7.6	2.3
45–54	6.1	9.6	2.6
55–64	7.5	8.0	7.1
25–64 (crude)	5.6	7.5	3.1
25–64 (age standardized)	5.5	7.6	2.8
Borderline high cholesterol, 200–239 mg/dL			
25–34	4.0	4.6	3.4
35–44	5.8	7.3	4.2
45–54	7.0	8.6	5.7
55–64	6.6	4.6	8.1
25–64 (crude)	5.8	6.3	5.3
25–64 (age standardized)	5.6	6.3	5.0
High cholesterol, ≥240 mg/dL			
25–34	1.0	1.7	0.4
35–44	1.4	1.9	0.8
45–54	1.7	3.3	0.4
55–64	1.3	2.3	0.5
25–64 (crude)	1.3	2.3	0.5
25–64 (age standardized)	1.3	2.2	0.5

an ongoing epidemic in Bangladesh. This poses a threat to other major NCDs such as heart diseases and stroke that are intimately linked to diabetes.

4.1. High blood glucose

About 1.4% people had documented diabetes. This is very low compared with our observed prevalence of 5.5%. This indicates that a large pool of people is out of detection services. There is a need for strengthening diabetes screening. Higher prevalence of diabetes in urban areas might be due to differences in physical activity levels and dietary factors. There are lines of evidences that the prevalence of diabetes is rising in Bangladesh, possibly because of recent substantial changes in lifestyle. This could reflect the effect of poorly planned urbanization that lacks in favorable environment for physical activity, unregulated

food industries promoting junk food, and exposure to stressful life in cities.[12] A recent study reported an increasing prevalence of diabetes from 2004 to 2009 in a Bangladeshi rural population.[13] The observed prevalence in 2009 was 7.9%, which is a little higher than ours, probably due to gradual influence of urbanization. Although the study site has been claimed as a rural area, by 2009, it had substantial urban characteristics. It is understandable that the prevalence in urban areas is higher than rural areas, as reported by our findings. Therefore, their prevalence data are not very different from our findings.

Similar to our study, a rural–urban difference in prevalence of diabetes has been observed in India also.[14] Among South Asian immigrants (that includes people of Bangladesh descent also) to the United Kingdom, the prevalence of diabetes is as high as 15–20%.[14] This is again more than double than what we observe in native people living in Bangladesh in urban areas of Bangladesh. This clear gradient in diabetes prevalence in rural through urban Bangladesh to the UK suggests an interaction between genetic predisposition and environmental influences, the so-called "thrifty gene" hypothesis.[14]

4.2. High blood cholesterol

Total cholesterol is the combination of high-density lipoprotein, low-density lipoprotein, and very low-density lipoprotein cholesterol fractions. Therefore, TC gives a composite picture of lipid levels in a population. We observed a little higher level of TC (167 mg/dL) when compared with a previous similar study carried out in 1996 (156 mg/dL) in a rural areas.[5] However, another study carried out in 2001 using a different cholesterol measurement method (enzymatic method using plasma) reported a mean level of 182 mg/dL.[6] Das et al.[15] measured plasma cholesterol using enzymatic method in a small sample of vegetarian and non-vegetarian adults living in
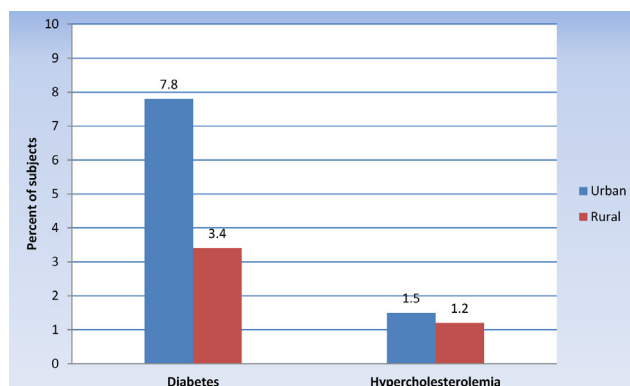
Fig. 1 – Prevalence (%) of diabetes and hypercholesterolemia in Bangladeshi adults of urban and rural areas.

rural Bangladesh, and reported a mean value of 172 mg/dL which is close to our current values. In employees of Bangladesh Secretariat, the mean TC was 170 mg/dL,[16] which is also close to our finding.

In a rural adult population of India, mean TC level was 194 mg/dL in 2005,[17] which is higher than the present study. However, in another Indian population without coronary artery diseases, the mean value was 172 mg/dL.[18] It is a little higher than what we have reported here, whereas it should be noted that such direct comparison may not be valid because of methodological differences among studies including age and sex composition of subjects.

Mean level of cholesterol in Bangladeshi emigrants to UK in general are higher than those living in Bangladesh.[19] High level of triglycerides has also been implicated to coronary heart disease in South Asian population.[20] It is relevant to note here that emigrant studies on South Asians observed that Bangladeshi people are in most disadvantageous position in terms of major cardiovascular risk factors compared with Pakistanis and Indians.[19]

Blood glucose and cholesterol measurements at several sites carried out by separate organizations are subject to inter-rater variability. A small portion of Dhaka urban sample came from a factory setting that may have influence on generalizability of our findings.

5.   Conclusion

Diabetes has become common in Bangladesh, especially in urban areas. Given that high blood glucose level and borderline high-cholesterol levels are common, population-based interventions employing primary health care system should be considered.

Conflicts of interest

The authors have none to declare.

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