Original Research Article

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Fasting blood glucose level and its association with sex, body mass index and blood pressure: a cross sectional study on a Bangladeshi public university students

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ABSTRACT

Background: In resource-limited countries like Bangladesh, there is a scarcity of epidemiological researches examining the relationship of blood glucose level with hypertension and BMI among the graduate level students. This research was therefore undertaken to evaluate fasting blood glucose levels of Mawlana Bhashani Science and Technology University students and to check its associations with sex, body mass index (BMI) and hypertension.

Methods: For the study, total 240 students (120 male and 120 female) were randomly selected. The demographic data of the study subjects were collected by interviewing the subjects with standardized questionnaires. Their fasting blood glucose levels were measured using portable blood glucose meter. The BMI and blood pressure of the subjects were also recorded following standard protocol. Finally the data were analyzed with SPSS software.

Results: The fasting blood glucose levels of the study subjects indicated that 0.4% of subjects were diabetic and, 5.4% of subjects were pre-diabetic. The blood glucose levels (mean \pm SE) of female subjects (4.88 \pm 0.07) were higher than that of the male (4.61 \pm 0.04) subjects. The mean blood glucose levels of hypertensive subjects (4.81 \pm 0.07 mmol/L) were higher than that of the normotensive counterpart (4.73 \pm 0.05 mmol/L). The fasting blood glucose levels shows significant positive associations with SBP (r=0.155, p<0.05) and DBP (r=0.149, p<0.05). The fasting blood glucose levels also showed a significant positive association with the BMI (r=0.193, p<0.01) of the subjects.

Conclusions: This study reveals the diabetic and hypertension status of the Bangladeshi graduate level students. The result of the study is very important in the context of public concern health of Bangladesh.

Keywords: Blood glucose level, Hypertension, Bangladesh, Diabetes, BMI

INTRODUCTION

Excessive blood sugar level beyond the body's utilization capacity could lead to serious life-long health consequences called diabetes. Diabetics are non-communicable diseases which have become global epidemics and cause significant mortality and morbidity worldwide. It also reduced quality of life, and imposes

huge social and economic impact on health care systems, households and nations as a whole. It affects large number of people of wide range of ethnic and economic levels in both developed and developing countries. Bangladesh, a developing country in South Asia, has been experiencing an epidemiologic transition from communicable diseases to non-communicable diseases. In recent years, rapid urbanization, increased life

expectancy, unhealthy diet, and lifestyle changes have led to an increase in the rate of non-communicable diseases including diabetes and hypertension in Bangladesh.³ Among the adults of age 20-79 years with diabetes in the top five south east asian countries, Bangladesh is in the second position.4 Association of fasting blood glucose level and blood pressure with different demographic variables has been consistently observed by several research groups worldwide.⁵ A number of population based studies conducted in Bangladesh have revealed an increasing prevalence of diabetes in both rural and urban populations. In 2010, an estimated 140 million people living in Asia had diabetes and globally 60% of the people with diabetes were of Asian population.⁶ From recent statistics it shows, by 2035 the number of people with diabetes in Bangladesh is expected to increase to 8.20 million.⁴ Body mass index (BMI) is a measure of body fat based on height and weight of an individual. An increase in BMI is generally associated with an increase in risk of metabolic diseases such as diabetes mellitus, hypertension. ^{7,8} A strong correlation has been established between a high BMI and the development of diabetes mellitus from a study of more than 7000 British men.⁹ Previous regional studies have demonstrated that Bangladeshis face high rates of metabolic syndrome, diabetes and hypertension, and that many are unaware of their condition or non-adherent with treatment. 10 There is a scarcity of epidemiological researches examining the relationship of blood glucose level with hypertension and BMI among the Bangladeshi graduate level students. Therefore the study was undertaken to evaluate the BMI, blood pressure, and fasting blood glucose level of the students of Mawlana Bhashani Science and Technology University and to check the association of blood sugar levels with BMI and hypertension.

METHODS

Ethical consideration

For the study, Institutional permission was taken from the Department of Biotechnology and Genetic Engineering of Mawlana Bhashani Science and Technology University, Bangladesh. The subjects who participated in this study have given their written approval and all sorts of confidentialities and rights of the study subjects were stringently maintained.

Selection of study subjects and collection of demographic data

This human population based cross-sectional epidemiological study was conducted from January 2016 to July 2016. For the study 240 students from all 15 Departments (BGE, FTNS, ESRM, BMB, PHARM, CPS, CSE, ICT, TE, ECON, BBA, PHY, CHEM, MATH and STAT) of Mawlana Bhashani Science and Technology University (MBSTU), Santosh Tangail 1902, Bangladesh were selected, among which 120 were male and 120 were female. The study participants from all departments were

selected by simple random sampling method. Apparently healthy students who had no previous record of chronic diseases like hepatic, heart, renal and respiratory diseases were selected as study participants. Pregnant or lactating female students were excluded from the study. Demographic information of the study individuals including age, sex, marital status, smoking etc. were collected using standardized questionnaires.

Determination of BMI

For the determination of body mass index (BMI), the measurement of the weight and height of the study subjects were done by weight measuring machine scale and height measuring machine scale. The BMI is calculated by dividing body weight (kg) by the square of height (m²). The normal range of BMI is 18.5-24.99. 11

Measurement of blood pressure of the study subjects

The standard protocol for measuring blood pressure recommended by the World Health Organization was used in this study. After study subjects had rested for 20 min or longer, both systolic and diastolic blood pressures (SBP and DBP) were measured three times with a mercury sphygmomanometer with subjects sitting. SBP and DBP were defined at the first fifth phase Korotkoff sounds, respectively. The average of three measurements was used for the analysis. Hypertension was defined as a SBP of \geq 130 mm Hg and a DBP of \geq 90 mm Hg on three repeated measurements. ¹²

Measurement of fasting blood glucose level of the study subjects

Fasting early morning blood glucose of the study subjects were measured using blood glucometer (Glucoleader Enhance, HMD biomedical, Taiwan) using blood glucose test strip (FIA biomed, Germany) as per the supplied manufacturers protocol. For the test a tiny volume of blood samples were collected by punching finger tips of the study subjects using sterile lancet (Medifine, China).We also collected some fasting blood samples (n=12) from them and measured blood glucose level clinically with bio-analyzer (Humalizer 3000) and found 5% variation from glucometer reading. Finally the fasting BGL were adjusted for all samples.

Data analysis

Statistical analyses for the study were performed using the Statistical Packages for Social Sciences (SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp) software. The mean age, BMI, SBP, DBP and fasting blood glucose level of the study subjects in male and female were analyzed. Pearson correlation coefficient tests were used to evaluate the correlations of BMI, SBP and DBP with fasting blood glucose levels. One way ANOVA was performed to compare the blood glucose

levels between hypertensive and normotensive study subjects and between male and female study subjects.

RESULTS

General characteristics of the study subjects

Table 1 shows the characteristics of the study subjects of Mawlana Bhashani Science and Technology University. Of the total 240 participants, 120 were male and 120

were female. The age range was 18-26 years. The average age of male was 21.57 ± 0.17 years and the average age of female was 21.90 ± 0.16 years respectively. All the study subjects were students. We collected data for smoking of the study subjects and found that 26.7% male subjects were smoker. No female study subjects were found to be smoker because generally Bangladeshi female students do not habited to smoke. The mean BMI of the study subjects in the study area were 21.55 ± 0.17 . The mean BGL of the study subjects in the study area were 4.75 ± 0.04 .

Table 1: General characteristics of the study subjects.

Parameters	All subjects	Male	Female
Total subjects (n)	240	120	120
Age (mean±SE)	21.73±0.11	21.57±0.17	21.90±0.16
Smoking [n, (%)]			
Yes	32 (13.3)	32 (26.7)	0.00
No	208 (86.7)	88 (73.3)	120 (100)
SBP (mean±SE; mmHg)	122.88±0.59	123.17±0.82	122.58±0.85
DBP (mean±SE; mmHg)	81.38±0.38	82±0.51	80.75±0.50
BMI ^b (mean±SE; kg/m ²)	21.55±0.17	21.79±0.23	21.31±0.25
Fasting blood glucose level (mean±SE; mmol/l)	4.75 ± 0.04	4.61±0.04	4.88±0.07

Data were presented as mean±SE, BMI^b= Body mass index, DBP= Diastolic blood pressure, SBP= Systolic blood pressure

Blood glucose profile of the study subjects

The fasting blood glucose levels of the study individuals were analyzed and the subjects were divided into non-diabetic, pre-diabetic and diabetic according to the definition set by the Global Diabetic Community in United Kingdom. According to the definition, the subjects having fasting blood glucose level >6.0 mmol/L called non-diabetic, the subjects having 6.1 mmol/L to under 7.0 mmol/L fasting blood glucose level called pre-diabetic, the subjects having fasting blood glucose level over 7.00 mmol/L fasting blood glucose level called diabetic. The result shows that 94.2% of study subjects were non-diabetic, 5.4% of study subjects were pre-diabetic and 0.4% of study subjects were diabetic patients (Figure 1).

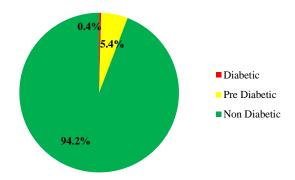


Figure 1: Fasting blood glucose profile of the study subjects.

Comparison of fasting blood glucose level in male and female study subjects

Figure 2 shows the comparison between fasting blood glucose level of the study subjects in male and female group. It was showed that the fasting blood glucose level (mean \pm SE) of female subjects (4.88 \pm 0.07) were higher than that of the male counterpart (4.61 \pm 0.04). Although the difference was not statistically significant.

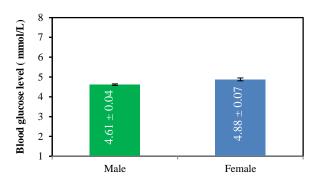


Figure 2: Comparison of fasting blood glucose level in male and female study subjects.

Comparison of fasting blood glucose levels in hypertensive and normotensive study subjects

According to the American Heart Association, the subject having DBP \geq 90 mmHg and SBP \geq 140 mmHg were termed into hypertensive. ¹⁴ The result showed that 17.5% of the study subjects were hypertensive. It was observed that the blood glucose (mean \pm SE) level of hypertensive subjects (4.81 \pm 0.07mmol/L) were higher than that of the

normotensive counterpart (4.73±0.05mmol/L) (Figure 3). Although the difference was not statistically significant.

	Table 2: Department wise	distribution of h	vpertensive sub	jects and their mean BGL.
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Department name	Normotensive number	Hypertensive number	Fasting blood glucose level (mean±SE)
ICT	11	5	4.44±0.564
TE	14	2	5.00±0.564
CSE	15	1	4.94±0.564
ESRM	14	2	4.94±0.564
BGE	13	3	4.94±0.564
FTNS	13	3	4.50±0.564
CPS	14	0	4.56±0.564
BMB	13	3	4.63±0.564
PHARM	12	4	4.50±0.564
BBA	13	3	4.75±0.564
ECON	14	2	5.00±0.564
MATH	13	3	4.56±0.564
STAT	13	3	4.44±0.564
PHY	14	4	4.38±0.564
CHEM	12	4	4.37±0.564
TOTAL	198	42	4.66±0.157

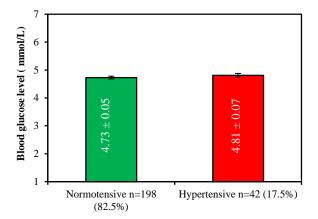


Figure 3: Fasting blood glucose level in hypertensive and normotensive subjects.

Department-wise distribution of hypertensive subjects and fasting blood glucose levels

Table 2 shows the distribution of hypertensive subjects were compared dividing the study subjects in 15 departments. The fasting blood glucose (mean±SE) levels are also representing departments with table.

Correlation between BMI and fasting blood glucose levels

Figure 4 shows the correlation between BMI and fasting blood glucose levels. A significant increase fasting blood glucose levels was observed with the increasing BMI (r=0.193, p<0.01).

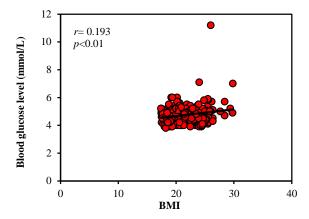


Figure 4: Correlation between BMI and fasting blood glucose levels. *r* and *p* values were from Pearson correlations coefficient test.

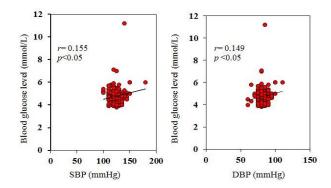


Figure 5: Correlation between SBP and DBP with fasting blood glucose levels. *r* and *p* values were from Pearson correlations coefficient test.

Correlation between blood pressure and fasting blood glucose levels

Figure 5 shows the correlation between SBP and DBP with fasting blood glucose levels. A significant increase fasting blood glucose levels was observed with the increasing SBP (r=0.155, p<0.05). Almost similar relation relationship was observed between fasting blood glucose levels and DBP (r=0.149, p<0.05).

DISCUSSION

Emerging evidences suggests that the prevalence of diabetes and hypertension is rising in Bangladesh, possibly because of recent substantial changes in lifestyle. 15-19 Our study demonstrated that 94.2% of study subjects were non-diabetic, 5.4% of study subjects were pre-diabetic and 0.4% of study subjects were diabetic (Figure 1). Sayeed et al 1995 conducted a study in rural Bangladesh and found the prevalence of type 2 diabetes was 2.1% (male 3.1% and female 1.3%). 20 Studies in the urban and peri-urban Indian population showed a strong association between diabetes and BMI and central obesity for both sexes however women showed an excess risk compared to men.^{21,22} Our study demonstrated that only very few individuals were diabetic but a considerable proportion of subjects were pre-diabetic. For the study all of our subjects were apparently healthy graduate students residing university dormitories within age range 18-26. Age have a profound effect on the prevalence of diabetes. Recent study in Hongkong, Gary TC Ko et al, 2006 found that blood glucose levels were progressively increase with age. In developing countries, the majority of people with diabetes are in the age range of 45–64 years. ²³ In the age range 18-26 as in our study, it is rarely anticipated to found diabetic patients but the percentage of pre-diabetic proportion as found in our study may be of note and these proportion is susceptible to develop diabetes is later age.

Diabetes was found to be associated with hypertension. The present study suggests that blood glucose levels in hypertensive subjects were higher than the normotensive counterpart (Figure 3). Also The SBP and DBP of the study subjects show significant positive correlation (Figure 5). Consistent results were also observed in similar studies in Bangladesh some population based studies also found that untreated high blood pressure has been linked to diabetes.²⁴ However, some studies also found the coexistence of hypertension and diabetes across different ethnic, racial, and social groups.²⁵ High blood pressure, or hypertension, is a condition that often affects people with type 2 diabetes. In our present study we found 17.5% of the study subjects were hypertensive. Kawasaki et al, 2003 reported that approximately 14% of the students at the annual regular health check at a certain university were hypertensive.²⁶

Overweight and obesity are common health conditions and their prevalence is increasing globally. Several epidemiological studies reported a significant association between BMI and blood glucose. 7,27

In this study, we also observed that the BMI was statistically significant with the fasting blood glucose level of the study subjects (Figure 4). So our study finding is consistent with the previously reported studies.

In this study we found that the fasting blood glucose levels (mean±SE) of female subject (4.88±0.07) were higher than that of the male counterpart (4.61 ± 0.04) although the difference was not statistically significant. Worldwide there are more women than men with diabetes, especially in developed countries.²³ In developing countries like Bangladesh women lead more sedentary life than male and physical activities has profound effect on blood glucose level. 28 Moreover, there are different hormonal and metabolic circumstances in male and female. According to American Diabetic Association, food intake, physical activity, disease condition, medication, stress hormonal condition, dehydration may also key contributory factors affecting individual's fasting blood glucose level.²⁹ Furthermore precise study will be required to take these considerations into account. Also, demographic trends suggest recruiting more study individuals to conclude a more precise association and correlation.

There are several limitations in our study that warrant further discussion. First, although we showed the association between BMI and fasting blood glucose level, there may be some others factors such as changes of lifestyle, physical inactivity or alcohol consumption that could influence the association in fasting blood glucose level. Second, this study was designed to be cross sectional, but not prospective. A cohort based study is needed in future to verify the relationship between fasting blood glucose level, hypertension and BMI. Third, our study individuals were limited and the age range is similar. Thus the results of the current study may not be generalizable to other study subjects and the study needs to be replicated in other institution.

CONCLUSION

The study demonstrated the hypertensive, diabetic and pre-diabetic profiles of Mawlana Bhashani Science and Technology University students. This result also demonstrated the association BMI and blood pressure with fasting blood sugar levels. The findings of this study are very much relevant to the public health concern of Bangladesh.

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Ethical approval: The study was approved by the

Institutional Ethics Committee

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