

Multivariate Analysis of the Causes of Type 2 Diabetes Mellitus in Urban and Rural Areas of Bangladesh

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Abstract

Background Type 2 Diabetes Mellitus has been a major concern for the people of Bangladesh where various factors are risky in this regard. That's why the study was designed in a way to assess the risk factors.

Materials and methods Sixty subjects played a part in the study of 30-90 years old, were branded into four varied groups. A number of factors including age, height, weight status, smoking habits, calorie intake, physical activity and past medical history were analyzed. Both BMI and FBG level were correlated.

Results BMI status advocates that obese subjects of Group-1 (80%) and Group-4 (66.67%) higher than 50% whereas group-2 (26.67%) and group-3 (46.67%) contains obese subjects below 50%. According to FBG level, Group-1 (average 16.876 mmol/L) and Group-4 (average 14.12 mmol/L) were in high risk than Group-2 (average 7.265 mmol/L) and Group-3 (10.03 mmol/L) subjects. 45% subjects had a family history of diabetes and about 50% male smokers were obese. 95% of subjects didn't have any physical exercise. The rate of new patients with no family history is increasing (48.33%).

Conclusion This study states individual correlation between BMI & FBG. Food calorie intake condition, data related to obesity and family history were also calculated.

Keywords:

Diabetes Mellitus, BMI, FBG, Family history, Calorie intake.

Introduction

Diabetes mellitus pronounces a metabolic sickness of multiple etiology symbolizing chronic hypoglycemia with instabilities of carbohydrate, fat, and protein metabolism occasioning from imperfections in insulin secretion, insulin action or both where body is incapable of regulating blood glucose levels resulting in too much glucose in the blood (WHO,1999). Nearly every organ system in the body can be la-di-da and exemplified as eye-blindness make possible end stage renal disease, lower extremity amputations and neuropathy. Diabetes has been designated as a modern epidemic, evolving rapidly in developing countries and also fourth or fifth leading cause of death in the most high-income countries (Mutlu et al., 2014). Diabetes caused 5.1 million deaths globally in 2013; that was a rate of one death every six seconds. Type 2 diabetes mellitus (T2DM) is one of the focal non-communicable chronic diseases accounting for 90-95 percent of all diabetic cases in adults throughout the world. It's usually happening in persons older than 30 years of age previously known as non-insulin dependent diabetes mellitus (NIDDM) or maturity-onset diabetes. It has recently been spotted in youth and young adults (Escott-Stump and Mahan, 2000). Type 2 diabetes can remain undetected (i.e. asymptomatic) for many years and the duration of Type 2 diabetes mellitus ranged from 10 years up to 16 years with a mean 13.17 ± 2.16 years (Hesham and Amna; 2014). Multiple genes are convoluted in the pathogenesis of diabetes in most patients but monogenic form is also found in a few patients. In the United States the pervasiveness of type 2 diabetes is 2% to 4% for Caucasians, 4% to 6% for African Americans and 10% to 15% for Mexican Americans but the incidence of obesity is rising at epidemic rates and improving these numbers (Christopher J. et.al; 2015). According to International Diabetes federation (IDF), some risk factors for type 2 diabetes mellitus are- family history of diabetes, overweight, unhealthy diet, physical inactivity, increasing age, high

blood pressure—140/90 or above, ethnicity, impaired glucose tolerance (IGT) and history of gestational diabetes. The American Diabetes Association (ADA) acclaimed that Type 2 diabetes should be calculated in adults carefully who is overweight or obese having one or more superfluous risk factors for diabetes. International Diabetes Federation predicted that nearly one in ten people globally will acquire diabetes by 2035 where the number of Africans with diabetes will be double. Nearly one out of every three people with diabetes universally is Chinese. It was appraised that 80% of people with diabetes live in low and middle income countries and the greatest number of people with diabetes is type 2 between 40 and 59 years of age (Scanlon et al., 2013). The US currently spends 36% of the total of diabetes spending on adults.

Bangladesh is one of the six countries of the IDF SEA (South East Asia) region where more than 72.1 million people with diabetes will rise to 123 million by 2035. 3.2 million people of Bangladesh with diabetes will be 11.1 million in 2030 (Wild et al., 2004). Therefore, this study was performed in various locations in Bangladesh with earnest attention to identify some risk factors associated with diabetes mellitus type 2 as well as the epidemic rate between urban & rural area so that the people of all classes become aware of this fatal disease.

Materials & Methods

Enlistment of study subjects with demographic and socio-economic data

With a view to performing this study a total number of 60 (sixty) subjects from rural and urban areas were drafted to accumulate their relevant clinical, medical, demographic and socioeconomic data such as age, weight, height, sex, educational status, and occupational status on a predesigned case record form during the period of November 2015 to February 2016. Patients with Type 1 diabetes, gestational diabetes (pregnant women) and cognitive impairments were excluded in this study. The subjects were classified with equal number into four groups, based on monthly expenditure and living area: low or group 1 (<10,000 Bangladeshi Taka (BDT, 1 USD = 84 BDT)), medium or group 2 (10,000–25,000 BDT), comparatively high or group 3 (25,000–40,000 BDT) and upper class or group 4 (above 40,000 BDT) where group 1 and group 2 study subjects were from rural area as well as group 3 and group 4 study subjects were from urban area. Patients taking oral diabetes medication, age greater than 30 years, willing to participate and being able to communicate were engaged in this survey.

Measurement of BMI (Kg/m²) and FBG

For determination of body mass index (BMI) of the subjects, weight and height was measured without shoes by using weight balance & appropriate scale (Detect-Medic, Detect scales INC, USA) respectively. Then BMI was calculated using following formula of $BMI = \text{Weight (kg)} / \text{Height (m}^2\text{)}$ and a classification from the Department of Health and Human Services, Lung and Blood Institute, National Institutes of Health and National Heart representing <18.5 is underweight, 18.5–24.9 is normal weight, 25–29.9 is overweight, 30–34.9 is obesity class I, 35–39.9 is obesity class II, >40 is obesity class III.

Fasting blood glucose (FBG) were measured using the portable glucometer (One Touch II, Life-scan, Milpitas, CA, USA) in whole blood obtained by finger prick in the middle finger— an approach that is widely used in resource-limited countries. Blood glucose measurements were adjusted to attain equivalent plasma glucose levels. Diabetes was diagnosed if FBG value was ≥ 7.0 mmol/L (WHO, 1999).

Average food calorie, smoking and past medical report observation

The unit of calorie measures the value of food energy intake. Every food item has its own calorie value different from another. Total calorie intake is derived from total consumption of food of subjects and presented on a per capita per day basis. In this study group-wise average food calorie was measured and compared between groups. Number of smokers was also surveyed to discern their effect on type 2 diabetes mellitus. To identify past family history of diabetes or other diseases associated during conduction of this survey past medical report of subjects were observed and high blood pressure was also measured.

Family history of subjects

The 60 subjects were divided into 4 groups to analyze their family history as a transparent tool of studying Type 2 Diabetes mellitus. The number of subjects carrying the disease for generations and the numbers who were the first cases for their family were taken into observation. Data were taken as the number of subjects whose disease inherited from parents (FP), from grandparents (FGP), from great grandparents (FGGP) and patients with no family history (NFH). (Fig. 6)

Results

Demographic status

In this study male (n=30) and female (n=30) were equally 50% with age variation from 30-90 years. Subjects of 30-40 years comprised of about 17% (n=5) male among total male subjects while 20% (n=6) female among all female subjects. 41-50 years old subjects were consisted of 25% (n=15) of total sample with 11.67% male (n=7) and 13.33% female (n=8). Comprising 30% (n=18) of the sample, 51-60 years age group included 26.67% (n=8) male among all male and 33.33% (n=10) female among all female. 61-70 years age group contained 16.67% (n=10) of total sample (n=60) with only 10% (n=6) male and 6.67% (n=4) female. Subjects above 71 years signified 10% (n=6) of the sample comprising of four male and two female. Demographic status of subjects is depicted in Figure 1.

BMI and FBG status

According to the BMI classifications from the Department of Health and Human Services, National Institutes of Health and National Heart, Lung and Blood Institute, measured BMI for subjects ranged from 18 to 36 kg/m² in which 55% (n=33) of subjects were considered at risk for type 2 diabetes due to obesity. In case of group 1 and group 2, 80% (n=12) and 26.67% (n=4) subjects were considered obese correspondingly where group 3 and group 4 included 46.67% (n=7) and 66.67% (n=10) obese subjects respectively (Figure 2).

To determine the blood glucose value, FBG test was then carried out among respective groups. The average FBG value of group 1, group 2, group 3 and group 4 subjects were 16.876 mmol/L, 7.265 mmol/L, 10.03 mmol/L and 14.12 mmol/L correspondingly. Table 2 represents the average FGB status of the subjects.

Average food calorie, smoking and past medical report observation

According to the calorie intake of subjects during breakfast, lunch and supper, average food calorie intake per day was calculated. At breakfast, average calorie uptake among group 1, group 2, group 3 and group 4 were 687.666 Kcal, 775.6 Kcal, 798 Kcal and 802.65 Kcal respectively. At lunch, average calorie uptake of 712.2 Kcal, 803 Kcal, 974.6 Kcal and 969.08 Kcal correspondingly represented group 1, group 2, group 3 and group 4 while at supper, the amounts were 753.22 Kcal, 847.77 Kcal, 835.02 Kcal and 887 Kcal for group 1, group 2, group 3 and group 4 respectively. It was also perceived that subjects consumed cereals more than 60% of total calorie intake.

Eleven male but no female subjects were smokers according to the report. Among the smokers most of them (n=9) were between 30-50 years old while only two subjects were between 51-70 years. It was also observed that about 45% (n=5) subjects among smokers were obese (four of them between 30-50 years old).

Disorders in subjects past medical history represented that twenty-four (40%) subjects were reported with a family history of diabetes, eighteen subjects (30%) were reported to have hypertension, eight (13.33%) with cancer, five (8.33%) with heart malfunction, four (6.67%) with asthma and only one having eye problem.

Family history of subjects

As compared to Group 1, the rests are quite phenomenal in attaining Type 2 Diabetes Mellitus with no family history (NFH) are 48.33%. Overall rate from parents (FP), from grandparents (FGP) and from great grandparents (FGGP) are 10%, 21.67% and 20% respectively.

Discussion

Assessing risk factors associated with Type 2 Diabetes Mellitus, this study was performed with surveying data including age, weight and height, income, habits of food and smoking, past medical history from the subjects and measuring high blood pressure, fasting blood glucose obesity and body mass index (BMI) from the collected data of height and weight. Collected data informed equal number of male (n=30) and female (n=30) subjects with varied income. Through BMI measurement, it was determined that 33 subjects (more than 50% of total subjects) were obese due to unusual food habits or having no physical exercise. As obesity is one of the well-known risk factor, these obese subjects were in risk for developing Type 2 DM. A similar result was observed by Steyn et.al (2004). Risk factor associated with Type 2 Diabetes found in inadequate fiber intake (less than 66%) among subjects (Tanya Christopherson, 2009). In our study we found inadequate energy uptake from meat, milk, fruits and other nutritious foods among the varied group of subjects but adequate amounts were achieved from cereals.

Due to obesity, impaired fasting blood glucose was found in children and adolescents in Germany and Sweden (Hagman et.al; 2013). Level of fasting blood glucose were higher (above 7.5) among obese subjects in this study. Among 33 obese people, it was observed from this study that 24 subjects (more than 75%) had a past history of diabetes where other 9 subjects represented hypertension (6 subjects), cancer (2 subjects) and asthma (only one subject). Bhowmik et.al (2013) stated that obesity is associated with hypertension and diabetes.

Smoking, overeating especially excessive intake of sugars and alcohol intake helps to occur type 2 diabetes mellitus (Ozougwu et.al, 2013). In this study, a minimum percentage of smoker subjects were included. Five obese smokers were found where six were not obese. Most of these obese subjects were in group 1 (12 subjects) and group 4(10 subjects) that meant these two groups were in high risk for developing Type 2 Diabetes Mellitus.

Family history is a big factor in case of Type 2 Diabetes Mellitus. In our research we have demonstrated that there are about 51.67% cases dominated by family history as the prime cause, in the same way Michael I. Goran and his co-workers (2003) found an outcome in their research that there is influence of positive family history (FH) of type 2 diabetes (T2D) on aspects of insulin resistance in prepubertal children. Metabolic malfunction is a regular issue for a type 2 diabetes patient as there is ill-regulation of various hormones. This condition actually may develop either hereditary factors or other factors of type 2 diabetes formation like BMI and FBS correlation, obesity, smoking, immune compromization, age, sex, environment, etc. These things got more impression through the findings of Dr. Mithun Das and the co-workers where they showed family history as a risk factor for a majority of chronic disease of public health significance including cardiovascular disease (CVD) and T2DM. The family history of specific diseases reflects the consequences of genetic susceptibility, shared environment and common behaviors. Family history has been recognized in clinical medicine as an important, non-modifiable, disease risk factor that when present might influence the probability of a suspected diagnosis. The risk-awareness and risk-reducing behavior are also associated with the family history study, as we also did it in the research.

Although HDL or triglyceride level could give better information, this study marked all the risk factors successfully and so, it provided awareness among varied groups of people in Bangladesh who were in risky condition for developing Type 2 Diabetes Mellitus.

Conclusion

Total calorie intake of the urban people (Group 3 and Group 4) is comparatively higher than the rural (Group 1 and Group 2) people (Fig. 1). In contrast, the amount of average fasting blood glucose (mmol/L) is higher than the urban people, but it also fluctuates phenomenally among the rural people (Fig. 2). Both males and females in the age group ranged 51-60 years are at high risk (Fig. 3). Obese subjects are more variable among the rural people (Fig. 4). In addition to these, there’s a positive correlation between BMI and FBS, as FBS is increased with the increase of BMI (Fig. 5). The rate of getting Type 2 Diabetes Mellitus is double for FGP than from parents (FP). The important fact is that, several remarkable cases have noticed without having any family history (Fig. 6). In summary, getting Diabetes Mellitus is not solely confined to the heredity barrier at recent time.

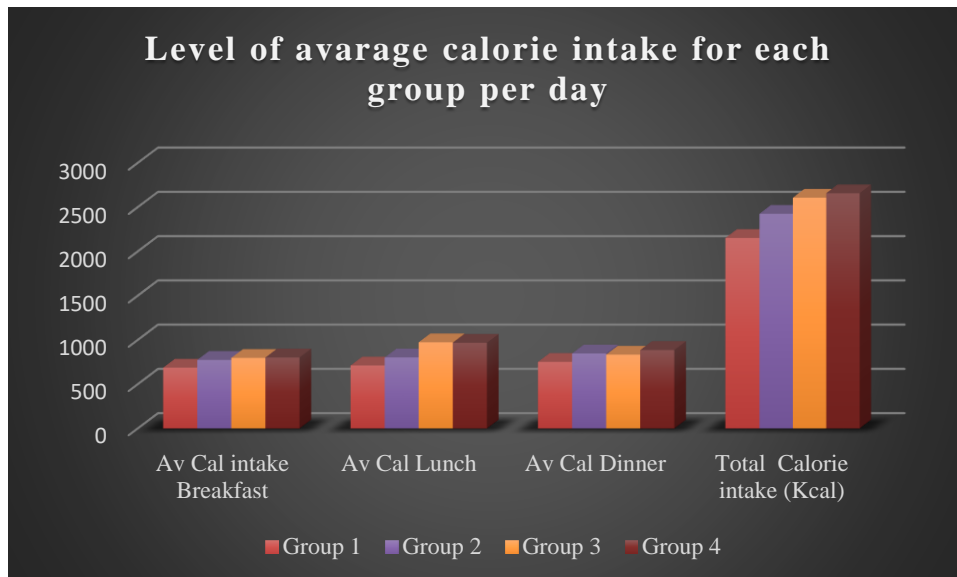


Fig.1. Average calorie intake (Kcal) of different groups at different times per day where legend-Blue one is breakfast, red one is lunch time, green one is dinner time. The total amount of calorie (Kcal) intake by arrange of people of interest at the right.

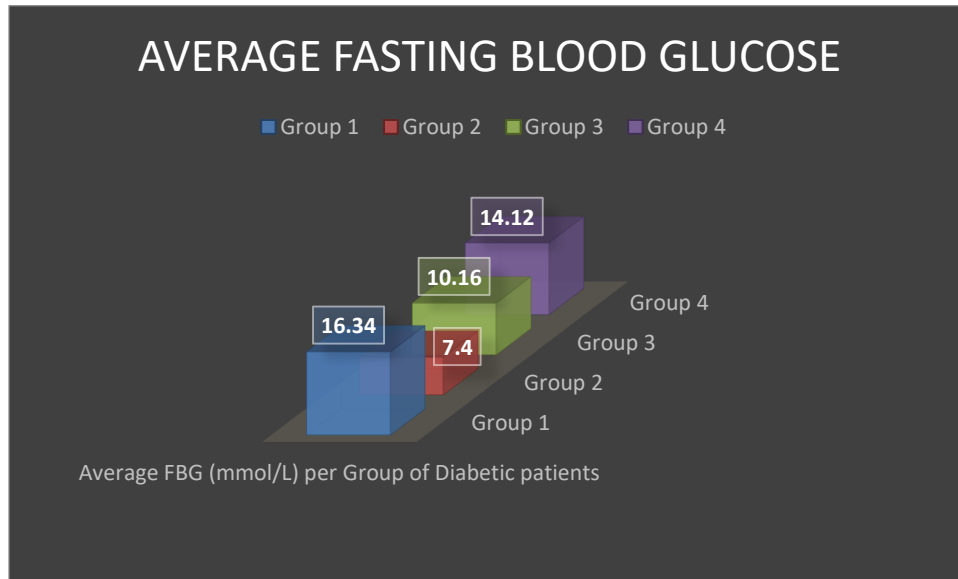


Fig.2. Average Fasting Blood Glucose (mmol/L) among different groups

Graphs

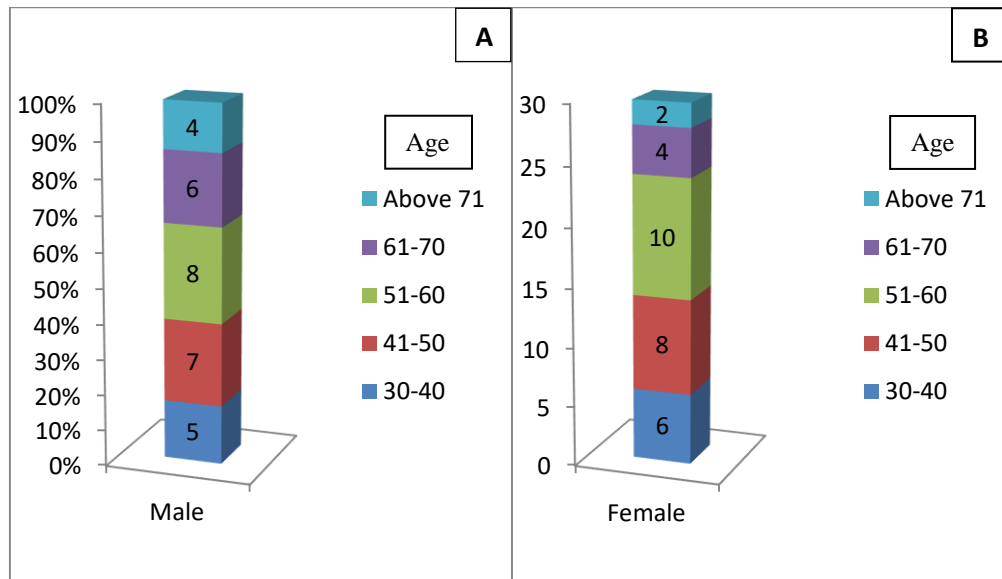


Fig. 3: Demographic status of A. Male (n=30) and B. Female (n=30) respondents.

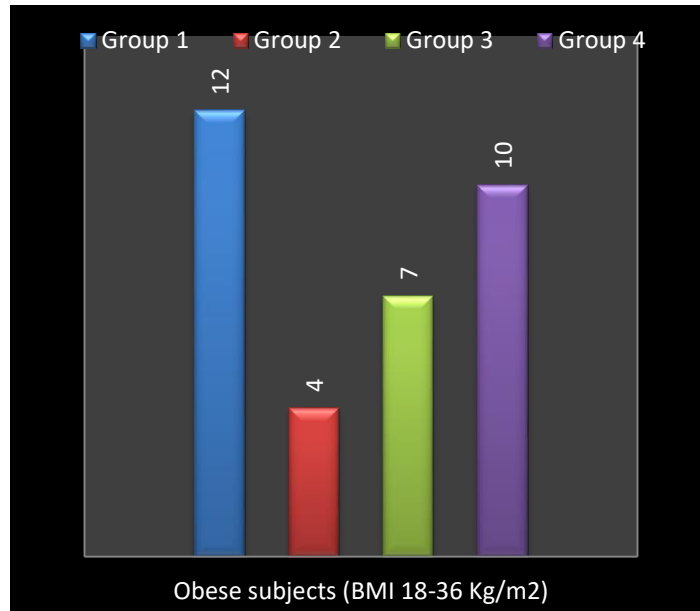


Fig. 4: Distribution of obese subjects in different groups.

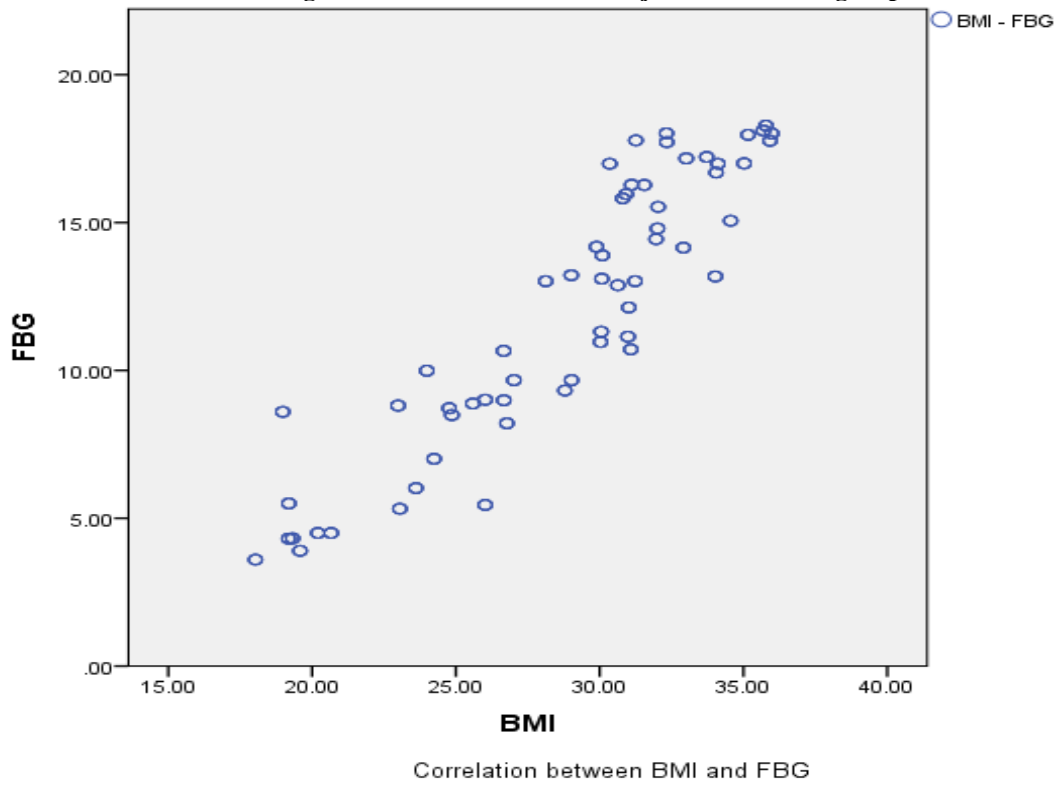


Fig. 5: A correlation between body mass index (BMI) and fasting blood glucose (FBG).

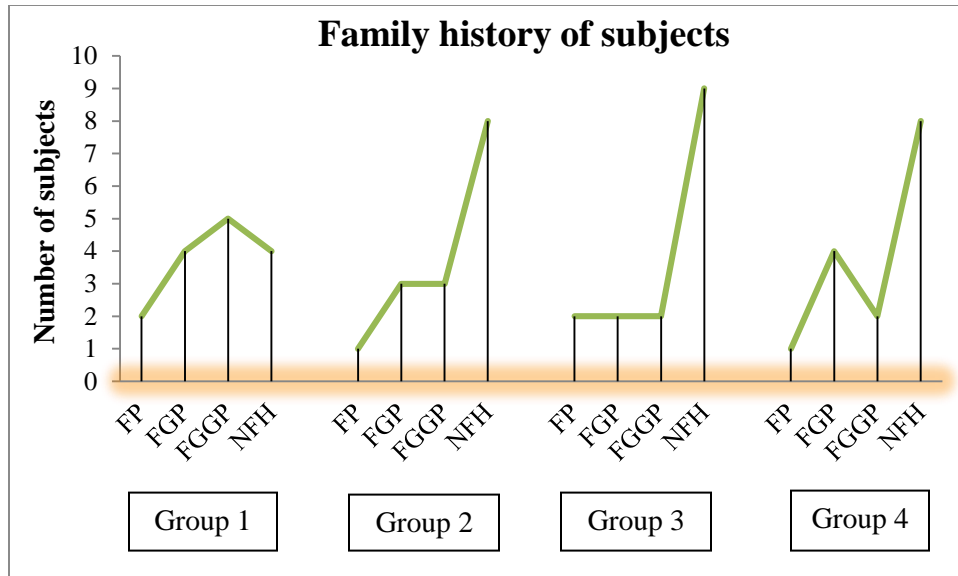


Fig. 6: The number of subjects per group carrying Type 2 Diabetes Mellitus with or without family history.

Abbreviations

BMI (Body Mass Index), FBG (Fasting Blood Glucose), T2DM (Type 2 Diabetes Mellitus), FP (From Parents), FGP (From Grand Parents), FGGP (From Great Grand Parents), NFH (No Family History).

Declaration

Ethics and consent

Ethical approval was granted by the Authority of Khulna Medical College (KMC), Khulna, Bangladesh. The data from reports and database of the program was obtained under the authorization of KMC.

Consent for publication

Not applicable.

Availability of data and materials

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Competing Interest:

This is to certify that the authors participating in this research article have no competing interest with others.

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Not applicable.

Authors' contributions

The selected subjects were motivated to study on themselves through the research via providing their detail in response to the analytical purposes with the combined approach of all the authors. The uploaded information were properly analyzed and revised by all the authors for publication.

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