Correlation Between Body Mass Index and Blood Glucose Levels Among Female Students of King Faisal University

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Abstract— The simple term "blood glucose" is surprisingly complex. Minor raises in blood glucose considerably increase the risk of diabetes mellitus development. Obesity and overweight is a recognized risk factor for developing type 2 diabetes. One unresolved question is, if there is a relation between body mass index (BMI) and blood glucose level (BGL) in female students of King Faisal University (KFU). This study examined the correlation between BMI and BGL amongst 125 randomly selected, consenting KFU female students who are apparently healthy. There is no significant correlation between BMI and BGL in subjects. College of medicine student subjects had significantly lower BGL compared with college of sciences and others. Number of sugar spoons in subjects' hot drink with body mass index is approaching significance with $p = 0.09$. High blood glucose levels in young females don't results from high BMI. Instead, they are associated with high sugar consumption. Awareness should be increase among the university students in order to reduce the prevalence of hyperglycemia and consequent pre-diabetes.

Index Terms— Blood glucose level, Body mass index, Diabetes, Hyperglycemia, Obesity, Overweight, Prediabetes.

1 Introduction

Diabetes is a chronic illness that needs endless health care and constant self-management, public health education and reliable psychosocial support to avoid acute complications and to shrink the risk of chronic complications (1). The highest prevalence of diabetes overall is anticipated to occur in the Middle East and North Africa due to rapid economic development, urbanization and changes in lifestyle patterns in the region. (2)
The simple phrase "blood glucose" is remarkably complex. Blood glucose can be highly variable, growing briskly after a carbohydrate meal then falling to the relatively steady fasting state (3). Minor raises in blood glucose considerably increase the risk of diabetes mellitus development (4). A study in England founded a significant association between an elevated BMI and diagnosis of type-2 diabetes mellitus from a study of about 7000 British men (12 years mean follow-up) (5). Moreover, a report by the Saudi Arabian Ministry of Health, published that nearly 0.9 million people were diagnosed DM in the year 1992, However this rate reached 2.5million people in 2010, signifying a 2.7 times rise in the incidence in less than two decades. (20) A cross-sectional study in 2009 carried out in KSA revealed that 30% of subjects were diagnosed with diabetes mellitus and correlating with the prevalence of body mass index of ≥25 amongst diabetics which was was 85.7% (P<.0001). (19)

Obesity and overweight is a recognized risk factor for developing type 2 diabetes, nevertheless, most obese individuals do not develop type 2 diabetes. Latest studies have recognized correlation between Body mass index and type 2 diabetes including pro-inflammatory cytokines (tumor necrosis factor and interleukin-6), insulin resistance, deranged fatty acid metabolism, and cellular processes such as mitochondrial dysfunction and endoplasmic reticulum stress (1).
It is impotent to elaborate the relationship between BMI and BGL in order to estimate the incidence of hyperglycemia level that is a risk factor for developing type 2 diabetes mellitus. Identifying risk factors is an essential step for prevention and health education as well as lowering the DM health burden. To date, no article has reviewed the relationship between BMI and BGL in female students of KFU.

2 Materials And Methods

This cross-sectional study was conducted at King Faisal University during April 2013. The study was approved by the ethical board of College of Medicine in King Faisal University. The target group was female students from all colleges of KFU in apparent good health. The sample included 125 girls with confidence level 95% and confidence interval of 8.74. Measured using online sample size calculator. The age group of the sample ranged from 18 to 26. A questionnaire was designed by the research team and tested using pilot test to be modified accordingly. A group of external undeclared respondents were chosen from different colleges of KFU and interviewed individually. The interview consisted of brief introduction about the aim of this study, handling the questionnaire and finally asking respondents to read it and answer out loud while a member of the team is recording notes. Finally, the research team reviewed all respondent's questionnaires and made minor adjustments. After obtaining the informed consent from subjects, the questionnaire was distributed. The age, the height, the weight, Random BGL and the college of the subjects were recorded. Random blood sugar was taken using glucometer and the weight and height was measured using a scale. Our exclusion criteria included invalid blood glucose test, absent weight and height information, and pregnancy. The BMI for each subject was calculated using the standard

formula i.e. weight in kilograms divided by height in square meters (6). All the variables including age, college, height, weight, BMI, BGL, diet, exercise and family history of diabetes from study group were organized and analyzed statistically using SPSS computer program. Person correlation coefficient was used to find the correlation between BGL and BMI. One-way ANOVA test was used to check the statistical significance of the changes in BMI and BG with respect to college and other factors. Chi-square test was used to find relation between body mass index categories and diet.

3 Result

Analysis of one hundred and ten (110) consented female KFU students' data was carried on and the achieved results are presented in Tables 1, 2, 3 and Graphs 1, 2.

First, BMI and BGL didn't show significate correlation in our subjects $p= 0.61$. However, graph 1 showed positive association.

As college changes, there is a corresponding change just in BGL but BMI changes diversely. College of medicine is statistically significantly different compared with college of Sciences and Others (Business administration, Computer and information technology, Art, Community Service and Pharmacy). The p value was ($p=0.04$ *and* $p=0.003$) respectively. Between the college of medicine and college of education there is a relationship approaching significance with $p = 0.09$. The college of medicine is not statistically significantly different in body mass index compared with others, $p>0.05$. In all, main relationship is significant between college and blood glucose in subjects.

As the intake of potato chips increases in subjects, the body mass index increases. This relationship is significant ($p=1.17$). Conversely, subjects with normal BMI favorite chocolates for snacks. The most fruit favorite snack are low BMI subjects.

Number of sugar spoons in subjects' hot drink with body mass index is approaching significance with $p=0.09$. Overall, for the 110 subjects, BMI and BGL showed no significant relationship.

College	N	BMI (Kg/M^2)	BGL (mmol/L)
Sciences	24	24.89 ± 6.27	123.75 ± 29.75
Education	22	27.33 ± 6.70	120.36 ± 28.97
Agriculture	16	26.40 ± 5.06	115.13 ± 18.84
Medicine	18	23.69 ± 5.46	107.06 ± 20.30
Others	26	27.67 ± 5.84	130.65 ± 24.92

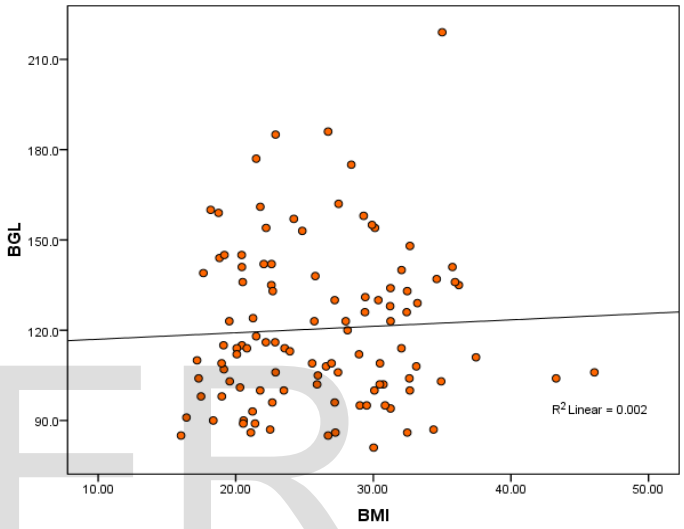
Table 1: Body Mass Index (BMI) and Blood Glucose Level (BGL) for female subjects in different colleges. Values are expressed as Mean ± SD for N subjects.

BMI Category	N	BGL (Moll/L)
Normal	51	120.28 ± 25.71
Overweight	23	120.87 ± 27.45
Obese	32	119.34 ± 26.57

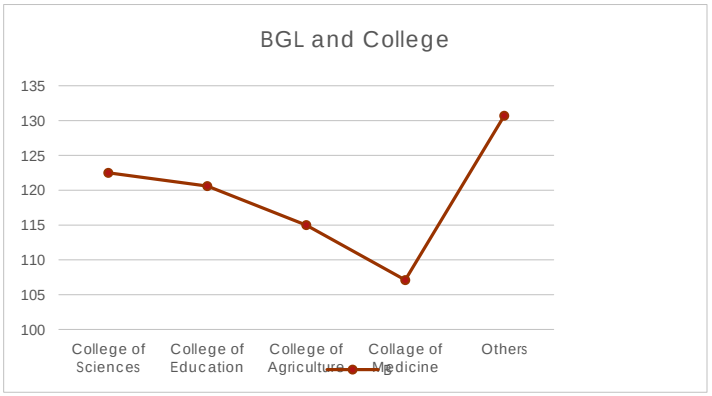
Table 2: Blood Glucose Levels (BGL) in different body mass index categories. Values are expressed as Mean ± SD for N subjects. BMI classification: 18.5-25.0: normal, 25-30.0: overweight, >30.0: obese.

BGL	1 ≥	2	≥3
Normal	18	28	35
Hyperglycemic	1	10	15

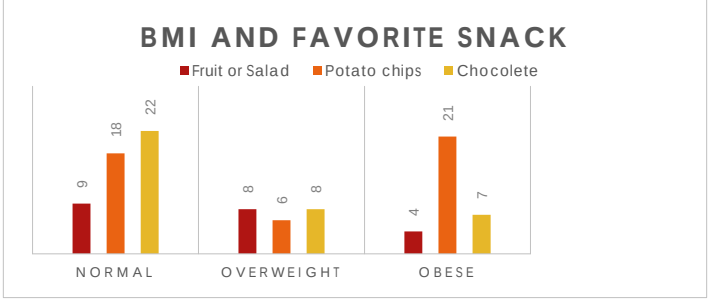
Table 3: Number of sugar spoons in hot beverages among different BGL categories.



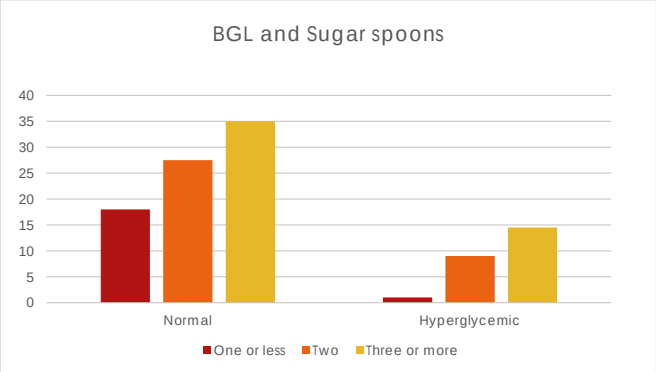
Graph 1: The correlation between BMI and BGL.



Graph 2: The correlation between BGL and college.



Graph 3: The correlation between BMI and favorite snack.



Graph 4: The correlation between BGL and number of sugar spoons.

4 Discussion

Present study was conducted to evaluate the risk of diabetes and prevalence of hyperglycemia in overweight and obese female students of KFU, based on assessment of family history of risk factors, diet, physical exercising and blood sugar levels in comparison with BMI.

Etiology of developing type 2 diabetes mulitas has many risk factors. However, the key modifiable and acquired risk factor in probably is obesity as found in multiple studies (7,8,9). A study by E. Skiros, et al. investigated a sample of men in Sweden with a normal BGL for development of type-2 diabetes mellitus revealed that the incidence of diabetes mellitus grew twenty-two times in subjects with elevated BMI compared to lower BMI subjects (8). Similarly, a prospective study exploring about 7000 men living in England (12.8 years' follow-up) recognized a solid significant association between high BMI and risk of developing type 2 diabetes. These interpretations are accepted because obesity is scientifically proven to induce insulin resistance (10,11).

Consequently, it is expected that BMI should correlate with blood glucose levels. This is, however, not always the case. A Scottish study has previously shown no significant correlation between random blood sugar levels and BMI (12). As well as our study which has shown that the correlation between BGL and BMI among female students of KFU was not statistically significant. The explanation for these findings could be that our sample was young in age. And age has a major role in development of diabetes, prediabetes, and hyperglycemia. Also, it might be that our sample size was not large enough to illustrate the correlation. Another factor that needs to be further explored is the racial factor as was suggested in a study involving Caucasian and African-American women (13).

Also, we found that hyperglycemia was more prevalent among students of sciences and other colleges as shown in graph 2. We think that is because of sedentary life style. The university have no gym for females at that time. Their students do have a long break in comparison to medical students. This time is usually spent in the cafeterias which mainly offer unhealthy junk food, rich in carbohydrates and fat. However, the lowest blood glucose levels were among medical students. We think that is because of their busy lifestyle between long lectures, labs, assignments, studying and researching. Also, in the university they have no free time or long breaks between lectures so they don't depend on the cafeteria food. Another possible explanation for the significant drop in BGL in medical students compared to science and others is psychological stress and even depression. According to H. Abdulghani in a recent cross sectional study conducted in Saudi Arabia, the stress in medical students was significantly more in females and in preclinical years (21). Also, a study by E. Eva in Bangladesh found that 54% of medical students are suffering from psychological stress especially due to academic load (22). Furthermore, the risk of developing depression in medical students, with CES-D ≥ 16, was 28.4 % and 39.0% in first and third years respectively with a significant increase in perceived stress (23). According to current literature, stress can induce hypoplasia as well as hyperphagia at equal rate of 40% while 20% experience no change in eating behavior (24, 25). However, this controversial relationship is suggested to be dependent on severity of stress. Where minor stress results in hyperphagia and major stress results in hypophagia (26). This finding explains the elevated BGL in students of science and other colleges in relation to medical students regarding the stress level of their academic requirements.

Furthermore, dietary habits have long been associated with the management and/or prevention of various metabolic disorders, such as insulin resistance, obesity, type 2 diabetes (14,15). However, our study showed no significant relation between the daily diet and snacks between meals with blood glucose levels. However, there was a significant relation between the number of sugar spoons consumed in hot beverages and the BGL as shown in table 3 and graph 4. High consumption of sugar-sweetened beverages has also been associated with a greater weight gain and with higher risk of type 2 diabetes (16). As an explanation of the insignificant relation between the diet and BGL, we can say that it can't be accurate to use a questionnaire to measure dietary habits. Subjects may not answer accurately or not understood properly. However, the statistics revealed that there is a relation between the snack and BMI as shown in graph 3.

Although it is scientifically proven that physical activity reduces the risk of type 2 diabetes (17), Our study has supported this information base by revealing inversely related association between physical activity and underlying asymptomatic diabetes or prediabetes. Furthermore, our finding suggests that the family history of diabetes had no relation to the random blood glucose level. Oppose to our findings, a cross-sectional study by R.D. Morris et al. of female members of a weight-control club, obesity showed a positive correlation with diagnosis of type 2 diabetes mellitus that is greater in individuals who had a family history of diabetes rather than in those who did not (18). This can be due to our relatively small and young sample.

A number of limitations were recognized by the research

team. First, some data was collected using a questionnaire. Also, the time used for data collection was short. And it was difficult to access some collages due to distance. Finally, the lack of experience of researcher team.

5 Conclusion

Based on this research findings, there is no significant relation between BMI and BGL in young female students of KFU. Also, there is no significant relation between BGL or BMI and diet, snack, exercise, or family history in our target group. This study found the relation between number of sugar spoons in hot beverages and BGL to be significant. People with high blood sugar but not diabetic are considered as pre-diabetic. Pre-diabetics are likely to develop Type 2 diabetes within 10 years. The study recommends pre-diabetics to modify their lifestyle by reducing junk food intake and sugar spoons consumption to one and a half or less per cup. Also, we recommend that all universities provide the facilities for a healthier lifestyle. These facilities include a gym or a playground for students, healthier meals and snack options and health education.

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