Relation of BMI with Blood Glucose Level amongst Healthy Students of Ayub Medical College, Abbottabad

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ABSTRACT

Background: Obesity is a global challenge all over the world. Body mass index is a good marker to measure the adiposity. Obesity is one of the important risk factors for type 2 diabetes mellitus. Normal random blood glucose levels are closely regulated in health with a normal range of 4.4-7.8mmol/l (79-140mg/dl), despite the varying demands of food, exercise and fasting. Many diabetic patients are obese and studies suggest a strong association between the two.

Objective: To find an association of BMI with blood glucose level in undergraduate healthy students of Ayub Medical College

Material and Methods: This cross-sectional study was carried out in 2018, capillary blood samples were collected from 152 students of Ayub Medical College Abbottabad to evaluate blood glucose level by Accu chek softclix[®] lancing device and Accu chek glucometer[®], BMI was calculated by the formula (weight in kg/ height in meters squared). Data was collected and analyzed by SPSS version 23.

Results: Total 152 (100%) healthy participants with 84 (55.3%) males and 68 (44.7%) females included in this study. Their ages were ranged from 18-25 with a mean age of 21.02 years (min 17 max 26) having a standard deviation of 1.75. By taking the correlation between two parameters i.e. body mass index and serum random blood glucose level by Pearson product of moment ($p=.214$, $r=101$) a non-significant result was found.

Conclusion: It is concluded that there is no significant association found between two parameters (BMI and serum BGL) in healthy young adults.

Keywords: Body mass index, diabetes mellitus, Blood glucose level, Insulin.

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INTRODUCTION

Obesity is one of the global and upcoming leading health challenge across the world. Mostly people of Pakistan are highly susceptible to hyperglycemia and diabetes mellitus (DM) with modest overweight, central obesity and also due to their decrease habits of exercise and physical activity level¹. As reported by Kelly, the obese adults were about 396 million and overweight were 937 million respectively worldwide². This figure is going to be doubled as compared to the past 20 years³.

Blood glucose level (BGL) is maintained and regulated within narrow limits. This system is very efficiently and finely regulated. As it is necessary to have continued and uninterrupted supply of glucose to the brain as it also utilizes ketone bodies to some extent in case of need, but the brain has an obligatory need for glucose. If we observe the postprandial regulation of BGL after meals, it is absorbed from our intestines and then get entered the blood. This raises the BGL and

causing stimulation of specific cells of pancreas i.e. islets of Langerhans whose function to secrete the specific hormone insulin. So the uptake of glucose by extrahepatic tissues (except brain) is totally dependent on insulin⁴. There occurred some disturbances in metabolic pathways of the body and decreased energy expenditure which results in obesity and excessive weight gain which drives elderly people to medical complications including hypertension, diabetes, cardiovascular disease and osteoarthritis⁵⁻⁷. Body mass index (BMI) is a good marker to measure the adiposity. It is defined as a "measure of body fat based on height and weight in adult men and women i.e. weight in kilograms divided by square of height taken in meters"⁸. Body mass is divided into four categories as underweight i.e. = 18.5, normal weight having a range of 18.5-24.9, overweight with range 25-29.9 and obese i.e. = 30⁹. Obesity is one of the important risk factors for type 2 DM, but further research is required that why every individual having obesity do not develop type 2 DM¹⁰. Normal BGL are closely regulated in health with a normal range of 3.5-8.0mmol/l (63-144mg/dl), despite the varying demands of food, exercise and fasting. The liver is the principal organ of glucose homeostasis, which basically involves in absorption, storage of glucose in the form of glycogen. In the process of gluconeogenesis in which the synthesis of glucose molecule takes place by combining 3-carbon molecules derived from the breakdown of

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muscle glycogen (lactate), fat(glycerol) and protein (Alanine) to be converted into a 6-carbon glucose molecule. Each day 200 g of glucose produced and utilized.90% of glucose derived from glycogen and remainder from renal gluconeogenesis¹¹. In fasting state, the action of insulin is regulation of glucose in the body and the counter-regulatory hormones are adrenaline, glucagon, growth hormone and cortisol which opposes the action of insulin causing less utilization and increased production of glucose¹². It is obvious from the literature that obesity has a role in the pathogenesis of DM, and to reach such conclusion, we aimed to find an association of BMI with BGL in undergraduate healthy students of Ayub Medical College, Abbottabad.

MATERIAL AND METHODS

A cross-sectional study carried out in biochemistry laboratory, Ayub Medical College Abbottabad from April-august 2018. Students of age group 18-25, both males and females of MBBS were included in the study. Total of 150 participants were included on convenient sampling. Written consent was obtained from each. A predesigned questionnaire was filled by students. The study received clearance from college ethical review committee.

Two parameters i.e. Random BGL and BMI were measured. Random BGL was taken by Accu-chek softclix[®] lancing device. Materials required for blood glucose testing were Accu chek active meter, lancing device, lancets, test strips. The pain-free collection of capillary blood from fingertips was taken from each subjects. The lancing device had eleven different penetration depths (0.5-5.5) so it was easy to adjust the

penetration. A sterilized new lancet was used for each and blood was drawn from the fingertip. 1-2 μ m of blood was put onto the test strip and after approximately 5 seconds, a reading of Random BGL was displayed on the glucometer in mg/dl.

Under standard protocols, venous blood was drawn from few students for cross-checking the results of Accu-chek softclix glucometer. Semi-Automatic Biochemistry Analyzer (BENCH-TOP-model URIT-810) was used in the same laboratory. Reading from both were compared and no significant difference was noted. Body mass index of the subjects was calculated by taking their heights in meter square and weight in kilogram by given formula.

$$\text{BMI} = \text{Wt. in kg} / \text{Ht in m}^2$$

Continuous variables were presented as mean, minimum-maximum and with standard deviation. Student T-test at 95% confidence was used to find any association of BMI and BGL. Data were analyzed by SPSS version 23 and presented in tables and figures as frequencies and percentages.

RESULTS

Out of 152 (100%) participants, 84 (55.3%) were males and 68 (44.7%) were females. Their ages were ranged from 18-25 with a mean age of 21.02 years (min 17 max 26) having a standard deviation of 1.75. Descriptive statistics of the study population are shown in table 1. BMI was categorized into four i.e. underweight (45.4%) normal BMI (46.7%), overweight (6.6%) and obese (1.3%) shown in table 2.

Table 1. Descriptive Statistics of BMI and BGL among students of Ayub Medical College Abbottabad.

Variables	Minimum	Maximum	Mean	Std. Deviation
Age	17	26	21.02	1.755
Weight(kg)	40.00	130.00	65.3046	14.27502
Height(m ²)	2.05	335.00	7.5055	36.19031
BMI	22.14	37.63	19.4861	4.17979
Blood glucose level(mg/dl)	66.00	154.00	98.9737	14.13040

Table 2 . Frequency of BMI Categories among students of Ayub Medical College Abbottabad.

BMI categories	Frequency	Per cent
Underweight	69	45.4
Normal BMI	71	46.7
Overweight	10	6.6
Obese	2	1.3
Total	152	100.0

Student T-test at 95% confidence interval was applied to both parameters i.e. serum BGL and BMI. A non-significance of the difference of mean ($p=0.208$) was found for the category; underweight (SEM= 1.69284) and normal BMI (SEM=1.60665). Similarly, p-values of 0.180 and 0.208 ensued for another group i.e. BGL and BMI category of normal BMI (SEM =1.60665) and overweight (SEM=4.36196). However, the p values of the third group between serum BGL and overweight BMI (SEM=4.36196) and obese BMI (SEM=3.50000) was significance 0.041 and 0.007 respectively. Table 3

By using the Pearson product of moment correlation, a coefficient of correlation “r” of two variables (serum BGL and BMI) resulted in a p-value of $r < 0.001$ indicating that the correlation is significant. The random BGL level taken on y-axis and BMI on the x-axis. The correlation is shown by the scatter diagram. The correlation was found to be 0, ($p=.214$, $r=-.101$) which is non-significant. Figure 1

Figure 1: linear correlation and significance of BMI and serum BGL among students of Ayub Medical College Abbottabad.

Table 3. Student T-test applied to categories of BMI and serum BGL among students of Ayub Medical College Abbottabad.

BMI Category	N	Mean of BGL $\pm$ S.Dev (mg/dl)	SEM	t	df	sig	95% CI of difference Lower upper
Under weight-- Normal BMI	69	101.97 $\pm$ 14.06181	1.69284	1.354	79	.180	-2.91851 15.32414
	71	96.80 $\pm$ 13.53790	1.60665	1.334	11.58	.208	-3.96613 16.371
<i>Normal BMI--Over weight</i>	71	96.80 $\pm$ 13.53790	1.60665	2.216	138	.208	.5590 9.780
	10	90.60 $\pm$ 13.79372	4.36196	2.214	137.38	.208	.55320 9.783
Over weight-- Obese	10	90.60 $\pm$ 13.79372	4.36196	-2.341	10	.041	-46.640 1.15394
	2	114.50 $\pm$ 4.94975	3.50000	-4.274	5.141	.007	-38.158 -9.64153

DISCUSSION

BMI is internationally accepted as a standard tool to classify obesity¹³. The study conducted by Agrawal *et al.*, in his prospective study including 150 subjects of age 20-70 years of age from PMCH, Chabad and RIMS, Ranchi including both males and females. They concluded that BMI and FBG are positively correlated and the subjects are at risk of obesity and other related conditions. As their mean BMI was in the range of $25.58 \pm 4.77 \text{ kg/m}^2$. This was higher in females as compared to males. FBG, SBP and DBP showing significance with increasing BMI ($p=0.001$, $p=0.001$ and $p=0.0001$ respectively).

There is also a positive correlation between FBG and BMI ($r=0.751$ $p=0.001$)¹. Another study was done by Sepp E *et al.*, also determine the positive correlation of BGL with BMI and reduced the proportion of cultivable bacteroids which is taking place in the gut microbiota of elderly people. The correlation of BGL and BMI was found to be $r=0.402$, $p=0.014$ ¹⁴. In a study done by Kyriazanos *et al.*, in which the data suggest obesity along with *Helicobacter pylori* infection induces an enhanced and quick response to hormone insulin which leads to decreased FBG levels, among HP-positive obese individuals as compared to HP-positive lean and thin persons¹⁵. the study conducted by Onyesom *et al.*, in which older females in Nigerian undergraduates are at risk of increased BMI and associated abnormalities in blood glucose homeostasis. This study investigated the relationship and positive correlation between BGL and BMI.

Among 253 Nigerian undergraduates having good health and with a mean age of 22.65 ± 5.52 years. This is indicating a positive but weak correlation between BGL and BMI among male subjects ($r=0.43$ $n=151$ and $p=0.05$) and females showed strong significance ($r=0.53$, $n=102$, and $p=0.05$)¹⁶. The data given by Cheng *et al.*, which again shows the positive relationship between BMI and plasma glucose concentration during iatrogenic hypoglycemia in subjects having type 2 diabetes mellitus. The subjects enrolled were of above 20 years of age, having T2DM, who has documented $\geq 70 \text{ mg/dl}$ plasma glucose level. People having lower BMI harbored decreased plasma glucose concentration during iatrogenic hypoglycemia as compared to those individuals having high BMI ($30.1 \pm 9.6 \text{ mg/dl}$ vs $38.4 \pm 12.3 \text{ mg/dl}$, $p=0.001$). Subjects having lowered BMI might have

compromised defense against iatrogenic hypoglycemia due to decreased release and secretion of antagonist hormones and functional disability¹.

In Shimizu *et al.*, study, relating the BMI and triglyceride to HDL ratio in relation to diabetes (Nagasaki islands study). There is a significant inverse relationship between low TG-HDL diabetes and body mass index and having a positive association between BMI and high TG-HDL diabetes¹. In an observational study done by Pavithra *et al.*, in 2018, indicating a strong positive association between BMI and random BGL but they clearly put stress on detection and importance of early obesity¹. A study carried out by Farooq *et al.*, in 2017 in which they basically determine the association between BMI and serum glucose in undergraduate students. The age group taken was 17-23. Mean age of subjects was 18.57 ± 0.99 years, mean glucose level was $126.23 \pm 25.26 \text{ mg/dl}$ and BMI was 24.65 ± 6.196 . By applying the Pearson correlation test, the level of serum glucose becomes higher with increasing BMI. The correlation was found to be significant ($r=0.625$, $p=0.000$)²⁰. Similarly, a researcher found 0.88% prevalence of pre-diabetic cases in early age group (<25 years) and Waseem M *et al.*, contradict these results but found higher level of plasma glucose level in medical students with positive Diabetes family history^{21,22}.

In our study we found a correlation between BMI and serum random BGL by Pearson product of moment by SPSS 23 which was found to be .214 ($r=101$). The p-value indicates no coefficient of correlation between two parameters so significant was found to be non-correlated in young adults of age 18-25 among students of Ayub Medical College Abbottabad.

CONCLUSION

It is concluded that there is no significant association found between two parameters (BMI and serum BGL). In other words, no direct effect of BMI is noted over BGL, yet increasing BMI (overweight, obesity) resulted in increasing BGL. This is very important because Normal BMI has no effect on BGL. Hyperglycemia can be controlled by keeping the BMI normal in young adults, as obesity is one of the most important risk factors for diabetes mellitus. Obesity is increasing in our young adults due to decreased physical activities, stressful life and bad eating habits.

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