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Original Research Article

Mean Blood Glucose Level and Basal Metabolic Index of Adult Residents of a Semi-Urban Community in Rivers State, Nigeria

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Abstract: This study was carried out on an adult population in Semi urban communities of Rivers State, Nigeria. The aim of the study is to determine if any relationship exist between blood glucose level and basal metabolic index**.** The subjects were randomly selected among the population and those who met the inclusion criteria were recruited and used for the study. They were apparently healthy subjects with no known history of a metabolic or any other form of chronic diseases. The sample size included a total of 168 subjects [108 males and 60 females] aged between 18 to 55 years. Clinical history and clinical examination methods were employed for sample/data collection. The height (m) and weight (kg) were measured using a stadiometer. The basal metabolic index (BMI) was calculated using the formula: (weight (kg) / height (m^2). Random blood glucose (mg/dl) was obtained using a glucometer. The Statistical Program for Social Sciences (SPSS version 21.0) was used for the analysis. The significance of differences between and among group means was tested using analysis of variance (ANOVA) and multiple group means were compared using the post hoc test. To determine the link between variables, Pearson correlation analysis was used. Statistical significance was defined as a P- value of less than 0.05. In females, there was non-significant very low positive correlation between the blood glucose and the BMI. In addition, the mean level of glucose in blood for the different BMI categories did not show any significant difference when compared to normal BMI. In males, the mean blood glucose levels for all groups including overweight and obesed were not statistically significant when compared to the normal BMI. A Pearson correlation between blood glucose level and BMI indicated a non-significant markedly low positive correlation. In conclusion, it was discovered that there was a positive correlation between BMI and blood glucose levels in adult males and females in this study.

Keywords: Blood glucose, obesed, overweight, BMI, positive correlation.

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INTRODUCTION

The body mass index is an important tool used in categorizing individual's weight and height In health and disease conditions (Price *et al.*, 2013). The body mass index is considered a determinant of general adiposity. It measures and defines adiposity and body composition in adults and children, and it is a good indicator of body fatness (Frontini *et al.*, 2001). The body mass index (BMI) is calculated by dividing the weight in kilograms by the square of the height in meters (kg/m^2) (Hu, 2008). A person is considered underweight if his or her BMI is less than 18.5; normal weight if his or her BMI is between 18.5 and 24.9; overweight if his or her BMI is between 25 and 29.9; and obese if his or her BMI is greater than 30 (WHO, 1997). The International Task Force on Obesity has decided that BMI is the best feasible method for defining and screening for overweight or obesity (Dietz & Robinson, 1998; Himes & Dietz, 1994; Zuguo *et al.*, 2002). As a result, BMI is used in the categorization of persons as overweight, normal weight, or underweight. A high BMI is a well-known risk factor for ischemic heart disease, stroke, and cancer (Whitlock *et al.*, 2009). Furthermore, there has been a link between BMI and blood glucose.

The measure of glucose concentrated in the blood of humans or other animals is glycaemia, often known as blood sugar level, blood sugar concentration, or blood glucose level. As part of metabolic homeostasis, the body tightly regulates blood glucose levels (Wasserman, 2009). Glucose is stored as glycogen in skeletal muscle and liver cells; blood glucose is maintained at a steady level in fasting persons at the expense of glycogen stores in the liver and skeletal muscle (Wasserman, 2009).Modifications to insulin, glucagon, epinephrine, and cortisol are made to keep blood glucose steady. When blood sugar levels are too high, insulin promotes the storage of extra glucose in the muscles. When blood glucose levels are

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too low, glucagon signals the tissue to create more glucose. In the event of a "fight or flight" response, epinephrine prepares the muscles and breathing system for activity. In situations of high stress, cortisol provides nourishment to the body (Lehninger *et al.*, 2017).

In the etiology of type 2 diabetes, obesity is one of the most important modifiable risk factors. The exact process through which fat causes insulin resistance is unknown. Adipocytes secrete a variety of biological products (leptin, TNF- alfa, free fatty acids, resistin, and adiponectin) that influence insulin secretion, insulin action, and body weight, as well as contributing to insulin resistance (Steppan *et al.*, 2001).

Glucose is used to make fatty acids, which are the building blocks of body fat. An increase in blood glucose levels causes an increase in BMI, which leads to increased lipid production and, as a result, increased weight (Nelson & Cox, 2005). Insulin, which is released by beta cells in the pancreas' islets of Langerhans, acts on specific cell receptors in insulin-sensitive cells, resulting in increased glucose uptake into the cell (Henriksson, 1995). Insulin resistance increases when BMI rises, resulting in higher blood glucose levels in the body. As BMI increases, insulin resistance also increases which leads to increased blood glucose level .Because BMI is linked to body weight, it stands to reason that BMI would be linked to blood glucose levels. An excessive persistent increase in blood glucose concentration has been associated with several chronic conditions including heart disease. Pulmonary infections, including chronic bronchitis (in non- smokers), bronchiectasis, and lung abscess have been attributed to impaired phagocytic function induced by hyperglycaemia (Cooper *et al.*, 1990)

Understanding the association between BMI and blood glucose level has elicited so much interest among researchers and has led to many studies but it has remained poorly understood possibly as a result of interactions with other factors which has the tendency to influence blood glucose level. In the present study, we raise the hypothesis that BMI has a positive correlation with blood glucose level in the total population of study. Secondly, BMI has a positive correlation with blood glucose level in the female population. Furthermore, BMI has a positive correlation with blood glucose level in the male population. The aim of this study is to determine mean blood glucose level of different BMI categories and to ascertain if any relationship exists between BMI and blood glucose level in the population under study.

METHODOLOGY

This is a descriptive research (Cross sectional) carried out among residents of Igwuruta and Chokocho; Semi urban neighbouring communities in Rivers State, Nigeria to investigate the relationship between BMI and blood glucose level using some anthropometric measurements such as weight and height. Study participants for the research work were drawn in no particular order, that is, participants were selected using simple random sampling, A sample size of 168 subjects (108 males and 60 females) aged between 18 to 55 years was used. Only apparently healthy persons who reside in the study area were included in the study. Clinical history taking and examinations enabled us to identify and exclude those who are known diabetics, or suffering from diseases like liver disease, cardiac disease, respiratory disease, renal disease or any other acute or chronic diseases as well as those suffering from AIDS, thyroid disorder or psychiatric illness. Pregnant women were also excluded from the study.

The rationale for the study and the procedures was properly explained to the subjects. Age and sex of each subject were recorded. The height (m) and weight (kg) used to calculate BMI were measured using a stadiometer. Weight was recorded to nearest 0.5 kg and height was measured in standard standing position without shoes while keeping shoulders in erect position and recorded to two decimal places (in meters).. BMI was calculated using the formula; weight (kg)/ height (m^2). The subjects with different BMI were categorized into Normal (18.5-24.9 kg/m^2), Overweight (25.0-29.9 kg/m^2) and Obesed ($\geq$ 30.0 kg/m^2).

Blood glucose (Random blood) level was obtained using a glucometer in mg/dl.

STATISTICAL ANALYSIS

The statistical program for social sciences (SPSS version 21.0) was used for the analysis. The differences between and among group means was tested using analysis of variance (ANOVA), and multiple group means were compared using the post hoc test. To determine the link between variables, Pearson correlation analysis was used. Statistical significance was defined as a P-value of less than 0.05.

RESULTS

The result for the study is presented in tables 1-6.

Table 1: Mean Blood Glucose Levels of Total population of subjects with different BMI

BMI Categories	N	RBS (mg/dl)	Relative Change (%)	Level of Significance
Normal	56	125.84.±4.98	0	_
Overweight	56	127.80±3.71	1.56	0.77
Obesed	56	128.84±5.19	2.38	0.65
Total	168	127.49±2.69	0	-

Values are presented as mean±SEM

Table 2: Correlation between blood glucose levels and Body Mass Index of total population

		BG	BMI
BG	Pearson Correlation	1	.053
	Sig. (2-tailed)		.493
	N	168	168
BMI	Pearson Correlation	.053	1
	Sig. (2-tailed)	.493	
	N	168	168

BG=Blood glucose level; BMI=Basal metabolic index.

Table 3: Mean Blood Glucose Level of Females with different BMI

BMI Categories	N	BG (mg/dl)	Relative Change (%)	Level of Significance
Normal	20	121.20±6.25	0	_
Overweight	20	126.60±6.05	4.46	0.54
Obesed	20	127.05±6.29	4.83	0.51

Values are presented as mean±SEM. BG=Blood glucose level.

Table 4: Correlation between blood glucose level and Body Mass Index of Females

		BG	BMI
BG	Pearson Correlation	1	.131
	Sig. (2-tailed)		.320
	N	60	60
BMI	Pearson Correlation	.131	1
	Sig. (2-tailed)	.320	
	N	60	60

BG=Blood glucose level; BMI=Basal metabolic index.

Table 5: Mean Blood Glucose Level of Males with different BMI

BMI Categories	N	BG (mg/dl)	Relative Change (%)	Level of Significance
Normal	36	128.42±6.96	0	_
Overweight	36	128.47±4.76	0.04	1.00
Obesed	36	129.83±7.34	1.10	0.88

Values are presented as mean±SEM. BG=Blood glucose level.

Table 6: Correlation between blood glucose level and Body Mass Index of Males

		BG	BMI
BG	Pearson Correlation	1	.034
	Sig. (2-tailed)		.730
	N	108	108
BMI	Pearson Correlation	.034	1
	Sig. (2-tailed)	.730	
	N	108	108

BG=Blood glucose level; BMI=Basal metabolic index.

DISCUSSION

The mean blood glucose levels of various BMI categories were measured among residents of Semi urban community in Rivers State, Nigeria. The determination of the blood glucose level in this population is a good way of detecting any potential risk to the development of certain chronic conditions associated with impaired glucose metabolism especially when it is considered in relation to whether the individual's weight is in healthy proportion to his height. The total (both female and male) means blood glucose level was found to be 127.49±2.69. The mean

blood glucose level for the total subjects with normal BMI, overweight and obesed were 125.84.±4.98mg/dl; 127.80±3.71mg/dl and 128.84±5.19mg/dl respectively (table 1). There were no statistically significant ($p<0.05$) differences between total mean blood glucose levels of overweight and obesed subjects compared to that of the normal subjects. A correlation between blood glucose level and BMI of the total population was found to be markedly low positive but non-statistically significant ($r=.053$, $p<0.05$) (table 2). This indicates that, although these variables tend to increase in response to one another, the outcome of the relationship is negligible**.**

The mean blood glucose level for female subjects with normal BMI in this study was 121.20±6.25mg/dl. The mean blood glucose level for overweight and obesed female subjects are 126.60±6.05mg/dl and 127.05±6.29mg/dl with a percentage mean difference of 4.46% and 4.83% respectively, relative to control. Although, these differences showed an increase in mean blood glucose in those with abnormal BMI, they were not statistically significant (table 3). A correlation of blood glucose level and BMI of females in this study also showed a very low positive but non-statistically significant ($r=.131$, $p<0.05$) relationship (table 4). The mean blood glucose level for males with normal BMI is 128.42±6.96mg/dl and means blood glucose level in overweight males is 128.47±4.76mg/dl. Obesed males had a mean blood glucose level of 129.83±7.34mg/dl (table 5). The correlation of blood glucose level and BMI of males also showed a markedly low positive and non-statistically significant ($r=.034$, $p<0.05$) relationship (table 6). The mean blood glucose values for females, shown in table-3 were lower than that for males for both the normal BMI and the overweight and obesed subjects. In other words, the average blood glucose values obtained in males were higher than that obtained in females. The findings in this study confirm previously indicated positive correlation existing between blood glucose and BMI. (Agrawal *et al.,* 2017).In our study, these observations were not statistically significant which may be as a result of the weakness of the association or sample size used in the present study.

The mean glucose levels for the overweight and obesed in total population, females and males were not statistically significant ($p<0.05$) when compared to mean glucose level in the normal BMI category. This finding in our study is in agreement with reports of Janghorbain *et al.,* (1991) who showed no statistically significant relationship between random blood sugar levels and BMI. In a similar perspective, Gupta and Bansal (2020) determined that a rise in BMI raises the risk of diabetes and prediabetes. They further demonstrated that this risk is larger in overweight or obese people which also agrees with reports of Sepp *et al.,* (2014) and Huffman *et al.,* (2007), who found that a rise in BMI is linked to higher blood glucose levels and diabetes. These findings are consistent with the positive correlations between blood glucose level and BMI observed in the present study suggesting that a rise in one variable would be associated with a rise in the other variable. The exact mechanism through which obesity causes increase in blood glucose level leading to increased risk of developing several chronic conditions has been unclear because of interactions with other risk factors such as heredity and genetics. However, obesity is considered to be one of the most important modifiable risk factor for the development of conditions such as type-2 diabetes mellitus (Kahn, 1994). Thus, maintaining BMI within normal range may reduce risk of developing abnormal glucose hoemostasis and improve quality of life.

CONCLUSION

A positive correlation exists between random blood glucose level and BMI in male and female subjects. Mean blood glucose values obtained in overweight and obesed male and female subjects were not significantly ($p<0.05$) different compared to those with normal BMI. Maintaining a normal BMI may enhance glucose homoestasis which is essential for optimal physiological function and physical well-being as obesity may act as an effective risk factor for the development of type 2 diabetes.

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