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Assessment of Fasting Blood Glucose Level of Undergraduates in Abeokuta Ogun State Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Author NSS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. All authors were involved in the research. All authors read and approved the final manuscript.

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ABSTRACT

Objectives: Impaired Fasting Glucose (IFG) is a condition where Fasting Blood Glucose (FBG) is above normal but not high enough to be considered diabetic. Impaired fasting glucose is linked with many co-morbid diseases such as obesity, dyslipidemia and hypertension. The study assessed the prevalence of impaired fasting glucose concentration among undergraduates in Ogun state South-West Nigeria.
Materials and Methods: A purposive sampling technique was used to select three hundred undergraduate students willing and ready participant. A pretested structured questionnaire was used to obtain the socio-economic information of the undergraduates. Fasting blood glucose, weight, height and blood pressure were determined using glucometer, weighing scale, height meter and sphygmomanometer respectively.

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Results: The result of the study showed that the prevalence of IFG among undergraduate in South West Nigeria was 11.0% (n=33) of total participants. A higher prevalence of impaired fasting glucose (IFG) was found with females than males. Body mass index of the subject reviewed that (11.0%, n=33) were underweight, (61.0%, n=183) had normal weight, (27.3%, n=82) were overweight and (0.7%, n=2) were obese.
Conclusion: In conclusion, some of the participants had abnormal FBG (11%, n=33). Nutritional program/workshop should be organized by the institutions to enable undergraduates make a healthy, responsible lifestyle choices and consume a well-balanced diet.

Keywords: Blood glucose level; obesity; hypertension; fasting.

1. INTRODUCTION

Impaired fasting glucose (IFG) is a condition where fasting blood glucose (FBG) is above normal but not high enough to be considered diabetic. This condition is also known as pre-diabetes and is categorized with a FBG level of 100-125 mg/dl [1]. Over the past decades there has been a drastic increase in type 2 diabetes mellitus (T2DM) in children and adolescents [2].

There is rising incidence of noncommunicable diseases like diabetes, hypertension, and coronary heart diseases globally [1–3]. Increased risk of impaired glucose tolerance, insulin resistance, and type 2 diabetes (T2DM) has been found to be associated with obesity in adolescents [4]. The risk factors for developing T2DM include family history of T2DM in first- or second-degree relative, belonging to certain ethnic groups (i.e., Native American, African American, Hispanic, Japanese, or other Asian/Pacific Islanders), or having signs associated with insulin resistance (hypertension, dyslipidemia, acanthosis nigricans, or polycystic ovarian syndrome) [5-7]. Similarly other endogenous populations, for instance, in Canada, Australia, Russia, and Latin America, may share similar genetic predispositions [8].

Beck-Nielsen and Groop [9] proposed a three-stage model for the development of T2DM. Stage 1 includes fasting hyperinsulinemia with normal or slightly increased blood glucose, especially mild fasting hyperglycemia. Stage 2 is characterized by prediabetic glucose intolerance with insulin resistance, and Stage 3 is the development of classical symptomatic or non symptomatic T`2DM with more persistent hyperglycemia present. Many of the macrovascular changes associated with diabetes and related to cardiovascular disease (CVD) begin in Stages 1 and 2, well before overt diagnosis [10].

Young people are dependent population and development of diabetes mellitus or other noncommunicable diseases will pose a burden to parents and society at large, hence the need to assess the FBG of status of the young adults in speedily changing communities. This will help in early discovery and expectantly the control of the prediabetic phase through education and lifestyle modification.

Data on FBG among Nigerian young adults are scarce, hence the need for the present study especially in Abeokuta Ogun state developing state capital in Nigeria with changes in lifestyle associated with urbanization.

2. RESEARCH METHODOLOGY

2.1 Subjects/Participants

A purposive sampling technique was used to select three hundred undergraduate students between the ages of 18-25 years in South-West Nigeria. A pretested questionnaire was used to obtain the socio-economic information of the undergraduates. Participants were asked about medical history, current medication and detailed history before sampling collection.

FBG was measured after an overnight fast. Capillary blood sample was collected for FBG measurement using Accu-Chek Active glucometer, after the thumb or index finger had been cleaned with wet (water) cotton wool. Data was entered and analyzed using SPSS 21 (SPSS Inc., Chicago, USA). Subjects were grouped based on their age, gender, family history of obesity and diabetes, and fasting blood glucose (FBG). Cross tabulation and tests for association with chi square were done and

values less than 0.05 were regarded as significant.

2.2 Anthropometric Measures

Height and weight for each participant were obtained to determine Body Mass Index (BMI), as stated by the Center of Disease Control.

2.3 Anthropometric Measurement (Weight Measurement)

2.3.1 Weight measurement

The subject weight was measured using a bathroom weighing scale. The scale placed on flat surface and the subject was made to stand upright on its bare footed with minimum clothing's. The reading was done in duplicate to the nearest 0.1 kg and the average weight was constantly checked for accuracy.

2.3.2 Height measurement

A height meter was used to measure the subject height. The subject was made to stand erect on the base placed without shoes, socks head tie, in order to give the accurate distance between the size of the feet and the crown of the head. As the subject was looking straight ahead, the headpiece was sliced down to the head crown and the height was taken was to the nearest 0.1 cm and repeated to obtain the highest value.

2.3.3 Body mass index

This was determined by dividing the weight of each subject 1 kilometer by the square of the height in meters.

$$\text{BMI} = \frac{\text{weight(kg)}}{(\text{height})\ (\text{m}^2)}$$

2.3.4 Anthropometric measurement

The anthropometric data obtained is used to determine the body mass index (BMI). The body mass index BMI was calculated using the weight and height data of the subject as shown below.

$$\text{BMI} = \frac{\text{weight(kg)}}{\text{Height}(\text{m}^2)}$$

The subject, will be classified using the WHO classification (11)

Under weight (<18.5) kg/m^2
Normal weight (18.5-26.9) kg/m^2
Over weight (25.0-29.9) kg/m^2
Obesity Grade (30.0-34.9) kg/m^2
Obesity Grade II (35.0-39.9) kg/^{2}
Obesity Grade III (Extreme) (>/40.0) kg/m^2

Furthermore, BMI below 18.4 kg/m^2 were classified according to the degree of energy defined as shown below.

17.0-18.4 kg/m^2=chronic energy deficiency (CED) grade I

16.0-16.9 kg/m^2=CED Grade II

3. DATA ANALYSIS

Data were analyzed using SPSS software version 21 (SSPS Inc, Somers, NY, June 2009). Variables were grouped for data analysis. Fasting blood glucose was classified as under <60 mg/dl, normal concentration with 60-100 mg/dl and increased fasting blood glucose as >100 mg/dl.

4. RESULTS

Body mass index was categorized as underweight with <18.5 kg/m^2, normal with 18.5-24.99 kg/m^2, overweight was set as 25.0-30 kg/m^2 while obese was set >30.0 kg/m^2, waist circumference was grouped as (<35 inches) normal, (35.0-40) inches increased waist circumference and (>40.0 inches) abnormal. The variables grouping was chosen on the basis of disease risks associated with waist circumference by gender. Blood pressure was categorized as under with <100/60 mmHg, normal 100/60-120/80 mmHg while high blood pressure was set at >120/80 mmHg.

Descriptive statistics were used to compare demographic variables. Correlation statistics were used to describe the relationship between fasting blood glucose and anthropometric variables. Cross tab statistics displayed the relationship between fasting blood glucose and self-reported questionnaire responses. The statistical significance levels were set at $p < 0.05$.

5. DISCUSSION

5.1 Socio-Demographic Characteristics of Respondent

The socio-demographic characteristics of the respondents are presented in Table 1 of the 300 respondents, 38.3% (n=115) were males and 61.7% (n=185) were females with an average

age of 21.44±2.07 years. The respondents were classified according to their state with 39.3% (n=118) from Ogun state, 10.7% (n=32) from Osun state, 9.0% (n=27) from Ondo state, 7.0% (n=21) from Ekiti state, 29.7% (n=89) from Lagos state and 4.3% (n=13) from Oyo state Nigeria.

The respondent was classified according to the institution attended with 5.7% (n=17) from university and 98.3% (n=283) from polytechnic. According to the marital status of the respondents, 1.7% (n=5) were married while 98.3% (n=295) was still single. Few 0.7% (n=2) of the respondents were not full-time student while 99.3% (298) were full time students. Only 4.7% (n=14) of the respondents had a family history of diabetes with 51.8% (n=153) having in-depth knowledge of diabetes while 49.0% (n=147) of the total respondents having no in-depth knowledge of diabetes. Eighty seven percent (87%) (n=261) live off campus while 7.7% (n=23) live in their parent/guardian home. Results showed that 1% (n=3) reported being asthmatic while the rest of the respondents reported having no medical problem.

The anthropometric measures of the respondents are presented in Table 2. It represents the mean and standard weight (kg), height (m^2), body mass index (BMI kg/m^2), waist circumference (inches), fasting blood glucose (mmdl), systolic and diastolic measures (mmHg).

Table 3 shows the mean and standard deviation of the anthropometric measures. Table 4 indicated that the respondents with increased fasting blood glucose are 11.0% (n=33) which is less than the percentage of the respondent with normal FBG. Table indicated that respondent with normal BMI is high in percentage (61.0%) than respondent that are over-weight (27.3%).

Table 3 shows that 89.0% of the total respondents had a waist circumference below 35 which is higher than the percentage of respondents with increased (7.3%) and abnormal waist circumference (3.3%)

Table 4 represents the frequency and percent of the respondents. Respondents with under/normal BP had a higher percentage than respondent with high BP. It indicated that 33 respondents had increased FBG consisting of 12 males and 21 females.

Table 5 shows that there is no relationship between fasting blood glucose and state of the respondents. Of those with increased FBG, 10 (30.3%) are from Ogun, 5 (15.2%) from Osun, 2 (6.1%) from Ondo, 5 (15.2%) from Ekiti, 7 (21.1%) from Lagos and 4 (12.1%) from Oyo.

Table 6 reveals that 27.3% (n=82) of the respondents were considered over-weight/obese when classified by BMI (>25.0 kg/m^2). Results shows that 75.8% (n=25) with an elevated FBG were classified as over-weight illustrating that respondents are more likely to have a high FBG if they are overweight/obese.

Table 7 shows that 60.6% (n=22) of the respondents with increased FBG prefer fast foods to homemade meals because it is readily available without stress and it is delicious.

Table 8 shows the relationships between fasting blood glucose FBG and Anthropometric variables. The results show that sex has a negative correlation on BMI (p=0.806). Age has no correlation with the anthropometric variables and FBG.

The result shows that in-depth knowledge has a significant correlation with BMI (p=0.024), negative correlation with height (p=0.002) and no correlation with FBG. Hours spent engaging in sedentary activity has no significant correlation with FBG (p=0.977) and a significant correlation with height (p=0.017).

Table 1. Socioeconomic characteristic of the respondents

Variables	Frequency	Percentage %
Male	115	38.3
Female	185	61.7
Total	300	100.0
Age		
18-21 year	167	55.7
22-25 year	133	44.3
Total	300	10

Table 2. Anthropometric measures of the respondents

Variables	N	Mean±SD
Weight (kg)	300	57.34 ± 8.56
Height (m^2)	300	1.61 ± 0.116
BMI (kg/m^2)	300	22.20 ± 3.40
Waist Circumference (cm)	300	28.34 ± 6.16
FBG (mdL) (mmol/L)	300	87.75 ± 12.44
Systolic (mmHg)	300	111.51 ± 6.74
Diastolic (mmHg)	300	72.07 ± 7.42

Table 3. Fasting blood glucose of the respondents

Variables	Frequency	Percentage %
<60 Under	0	0.0
(60-100) Normal	267	89.0
(101-125) Increased fasting blood glucose	33	11.0
TOTAL	**300**	**100.0**

Table 4. Body mass index (BMI)

Variables (kg/m^2)	Frequency	Percentage %
<18.5 Under-Weight	33	11.0
18.5-24.99 Normal	183	61.0
25-30 Over-Weight	82	27.3
>30 Obese	2	7
TOTAL	**300**	**100.0**

Table 5. Waist circumference of the respondents

Variables (inches)	Frequency	Percentage %
<35 Normal	268	89.0
35-40 High Risk	22	7.3
>40 Abnormal Waist	10	3.3
TOTAL	**300**	**99.7**

Table 6. Blood pressure of the respondents

Variables (inches)	Frequency	Percentage %
<100/60 Under	0	0.0
(100/60-120/80) Normal	275	91.7
>120/80 High BP	25	8.3
TOTAL	**300**	**99.7**

Table 7. Fasting blood glucose and fast food to homemade cross tabulation

Variable (MMDL)	Fast food to home made		
	YES	NO	Total
FBG < 60	0	0	0
60-100	140	127	267
>100	20	13	33
Total	160	140	300

Table 8. Correlations between fasting blood glucose and anthropometric variables

		BMI	FGB	WC	Height	Weight	BP
Sex	Pearson correlation	.193	.014	-.062	-.507	-.174	-.010
	Sig. (2-tailed)	.001	.806	.286	.000	.002	.859
N		300	300	300	300	300	300
AGE	Pearson correlation	-.043	.064	.024	-.059	-.075	.075
N	Sig. (2-tailed)	.455	.270	.681	.309	.194	.192
		300	300	300	300	300	300
In depth	Pearson correlation	.130	.004	-.040	-.176	-.001	.018
Knowledge	Sig. (2-tailed)	.024	.950	.493	.002	.984	.755
of Diabetes	N	300	300	300	300	300	300

Table 9 also shows that exercise/physical activity has a significant correlation with BMI (p=0.046) with no correlation with FBG. Days engaging in exercise have a significant correlation with waist circumference (p=0.031). Fruits and vegetables per week would either affect the BMI and weight positively or negatively.

Table 9 also shows that foods have a significant correlation on BMI (p=0.012) and a negative correlation on weight (p=0.008) and no significant correlation on FBG (p=0.421).

The incidence of chronic disease is elevated with an increase in body mass index (BMI) [12] reported an increase in weight and body fat percentages in college freshman. Because of this in body weight, BMI as also increased. This study correlates to the present study that 27.3% were over-weight according to BMI of 25-30 kg/m^2 and 0.7% was obese according to BMI >30 kg/m^2. This number is greater than the 1995 National College Health Risk Behavior Survey (NCHRBS) [13]. As 20.5% of 4,609 undergraduates student were classified as overweight. Given the time difference, this increased percentage can be correlated to the dramatic increase in an overweight younger population.

The results of this study support the notion that undergraduate need to monitor lifestyle choices to decrease their risk of chronic disease. Similar to this study found that in a college population, 16.2% were overweight and those with increased fitness levels had lower blood glucose [2].

Increased waist circumference is associated with obesity-related diseases, such as Type 2 diabetes, hypertension and coronary heart disease. By monitoring an individual's waist circumference, they will be able to access their own risk for these diseases. Type 2 diabetes is linearly related to obesity and measuring waist circumference I an indicator of obesity [14] reported an increase in waist circumference as a major risk factor Type 2 diabetes in people aged 30-64 years with impaired fasting glucose. However, the result of the present study indicated that only 7.3% had a waist circumference between 35-40 inches and only 3.3 had a waist circumference >40 inches, all aged 18-25 years. This could be due to the younger age group of the present study compared to [15]. This low percentage may also be due to 61.0% (n=183) of the participants having a normal BMI. By monitoring waist circumference, students can evaluate their health risk.

Table 9. Correlations between fasting blood glucose and anthropometric variables

	Pearson correlation	.377	-.029	-.013	1	.439	.035
Height	Sig. (2-tailed)	.000	.618	.829		.000	.552
	N	300	300	300	300	300	300
	Pearson correlation	.537	.388	.323	.439	1	.342
Weight	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000
	N	300	300	300	300	300	300
Blood	Pearson correlation	.247	.549	.572	.035	.342	1
Pressure	Sig. (2-tailed)	.000	.000	.000	.552	.000	
	N	300	300	300	300	300	300

***Correlation is significant at the 0.01 level (2 tailed); *Correlation is significant at the 0.05 level (2 tailed)*

Many of the nation's college students have been placing their health at risk through lifestyle choices. Being physically fit can contribute to a healthy body weight composition. Therefore, it is important to encourage both healthy weight and physical activity throughout life which play an important role in risks associated with an increased incidence of chronic disease. The result of this present study indicated the need for early intervention to help undergraduates be aware of diabetes and engage in healthy choices to prevent them from developing diabetes.

Among the participants with normal fasting blood glucose (FBG), 89.0% (n=267) participated in four or more days of physical activity per week and those with an increased FBG, 11.0% (n=33) participated in less than four days of physical activity per week. This suggests that healthy lifestyle choices may see an increase in risk factors.

Institution atmosphere promotes changes in many aspects of an undergraduate's life. If students are not participating in physical activity or sports it correlates to a higher FBG and therefore increased risk of chronic disease. One study reviewed data at a university student health centre to indicate that 30-35% of these students were classified as overweight. It is suggested that institutions implement new programs or improve existing programs to increase student awareness of healthy lifestyles.

6. CONCLUSION

In conclusion, the majority of the participants had a normal FBG (89%, n=267) while 11.0% (n=33) of the participants had increased fasting blood glucose. Body mass index of the subject reviewed that (11.0% n=33) were underweight, (61.0% n=183) had normal weight. (27.3%, n=82) were overweight and (0.7%, n=183) were obese.

7. RECOMMENDATION

Undergraduates should be more enlightened on FBG and risks involved in having increased FBG such as increased BMI, high blood pressure, waist circumference above normal by giving nutritional education to the undergraduates.

Nutritional programme/workshop should be organized by the institution to enable undergraduates make a healthy, responsible lifestyle choices and consume a well-balanced diet.

CONSENT

Participants were assessed from selected institutions in Ogun state South-West Nigeria. Each participant gave their consent and co-operation for the study and the purpose of the study was explained to the subject.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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