

Research Article**Correlation of Adiposity with Fasting Blood Glucose in Young Individuals**Nazia Farah¹, M. Syamala Devi^{2*}, Asish Kumar Patnaik³¹ Assistant Professor, Department of Physiology, ACSR Government Medical College, Nellore, Andhra Pradesh, India² Associate Professor, Department of Physiology, Andhra Medical College, Visakhapatnam, Andhra Pradesh, India³ House Surgeon, GSL Medical College, Rajahmundry, Andhra Pradesh, India***Corresponding author**

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Abstract: India is undergoing rapid epidemiological transition with increased urbanization and socio-economic development. It has resulted in a dramatic change in lifestyles that consist of low physical activity, fat-rich diet, sugar and salt coupled with higher mental stress leading to the increased incidence diseases like type 2 Diabetes Mellitus (DM), hypertension, dyslipidemia, obesity and ischemic heart diseases. The association between these conditions is so close that many experts have considered that obesity and type 2 DM to be different ends of the same spectrum. The study aimed to assess the effectiveness of BMI, and WC in predicting high levels of fasting blood glucose (FBG). The study was conducted in the Department of Physiology, GSL Medical College, Rajahmundry, Andhra Pradesh. A total of 77 medical students aged between 18 and 22 years participated. The subjects were divided into three groups based on BMI as control group, overweight group and obese group and designated as Group I, group IIa and group IIb respectively. BMI and WC were determined using standard equipments. FBG was measured by glucose oxidase-peroxidase method using reagent kits. Correlations between the anthropometric parameters and FBG were estimated by the Pearson's correlation coefficient method. FBG levels in overweight (85.12 ± 9.52) and obese group (87.6 ± 8.66) were significantly higher than control group (80.95 ± 5.87). The results of the present study revealed that FBG was highly significantly positively correlated ($r=0.399$, $p<0.01$) with BMI and significantly positively correlated with WC ($r=0.293$, $p<0.05$). We have therefore shown in the present study that the best anthropometric predictor of FBG and thus metabolic status in young adults is the BMI.

Keywords: Fasting Blood Glucose (FBG), Body Mass Index (BMI), Obesity, Waist Circumference (WC).

INTRODUCTION

Worldwide at least 2.8 million people die each year as a result of being overweight or obese, and an estimated 35.8 million (2.3%) of global Disability-adjusted Life Years (DALY) are caused by overweight or obesity. Overweight and obesity lead to adverse metabolic effects on blood pressure, cholesterol, triglycerides and insulin resistance. Risks of coronary heart disease, ischemic stroke and type 2 diabetes mellitus increase steadily with increasing body mass index (BMI), a measure of weight relative to height.

The prevalence of overweight and obesity were highest in the WHO regions of the Americas (62% for overweight in both sexes, and 26% for obesity) and lowest in the WHO Region for South East Asia (14% overweight in both sexes and 3% for obesity). In all WHO regions women were more likely to be obese than men. In the WHO regions for Africa, Eastern Mediterranean and South East Asia, women had roughly double the obesity prevalence compared to men [1].

Impaired fasting glucose (IFG) is a frequent glycemic disorder in the general population and is considered as a pre-diabetic state [2]. IFG has been receiving increased attention in recent years, not only because it is an intermediary stage in the development of diabetes and cardiovascular diseases (CVDs) [3-5], but also because it is associated with increased risk of all-cause death and CVD mortality [6]. IFG has thus come to be considered as a potential indicator of preventive importance for diabetes and CVDs [7]. IFG was defined in 1997 by the American Diabetes Association as a means of classifying individuals who had fasting glucose levels between normal and diabetes [8]. It was meant to be analogous to Impaired Glucose Tolerance (IGT) as an intermediate metabolic state between normal and diabetes, but based on the Fasting Plasma Glucose (FPG). The original FPG range (110–125 mg/dl) was changed in 2003 to 100–125 mg/dl so that the population risk of developing diabetes with IFG would be similar to that with IGT [9]. Because different populations have diverse patterns of relationships

between IFG and obesity and lipid markers, it is important to investigate the characteristics of associations between IFG and other related risk factors in the Indian population. In addition, because IFG is the early stage of diabetes and cardiovascular diseases, identifying preventable risk factors associated with IFG at an early stage is very important in prevention and control of these diseases. Therefore, this study aimed at establishing the relationship between fasting blood glucose and parameters of obesity.

METHODOLOGY

The present study was conducted in the Department of Physiology, GSL Medical College, Rajahmundry, and Andhra Pradesh. Permission of the Institutional Ethical Committee was obtained before undertaking the study. The study was conducted on young and healthy adult medical students aged between 18 and 22 years who were willing to participate in the study. The total sample size of 77 students was divided into three groups categorized on the basis of Body Mass Index (BMI). The first group being the control group designated as Group-I, the second group is over-weight group designated as Group-IIa, and the third group was obese group designated as Group-IIb. This categorization was done based on WHO classification

of obesity based on BMI. Obesity indices measured were BMI, WC, WHpR (waist to hip ratio) using standard protocol. FBG was measured by glucose oxidase-peroxidase method using reagent kits. FBG and anthropometric data are reported as mean ± standard deviation (mean ± SD). Correlations between the anthropometric parameters and FBG were estimated by the Pearson’s correlation coefficient method.

Fifty six obese and overweight and twenty one non-obese volunteers comprising of both boys and girls aged between 18 and 22 years were selected based on predefined exclusion and inclusion criteria. All the participants were interviewed by trained interviewers using standard questionnaires to obtain information on demographic data, smoking, alcohol drinking, and family history of diabetes and CVDs in first-degree relatives like parents and siblings. Height and weight were measured to within 0.05 cm and 0.05 kg respectively. BMI (kg/m²) was used as an indicator of overall adiposity. WC, a validated estimate of abdominal adiposity (central obesity), was measured to within 0.5 cm. They were classified as overweight, obese and normal according to obesity classification based on Body Mass Index (BMI).

Table 1: WHO classification of obesity based on BMI

BMI	Weight Status
Below 18.5	Underweight
18.5 – 24.9	Normal
25.0 – 29.9	Overweight
30.0 and Above	Obese

The purpose of the study was explained to all the participants. Pulse rate and blood pressure were measured using the Omron T8 Automatic Blood Pressure instrument.

Inclusion Criteria

- Healthy young adults aged between 18 and 22 years.

Exclusion Criteria

- Subjects with history of cardiopulmonary disease.
- Chronically ill.
- Prolonged Medication.
- History of any major surgery (cardiac, pulmonary, abdominal) related to study.

BMI was calculated using Quetelet’s index where the value is derived from mass and height i.e. kg/m². The waist circumference is the minimum circumference between the costal margin and iliac crest measured in horizontal plane, with the subject standing upright. The cut off point for central obesity was defined as 90 cm for male participants and 80 cm for female participants. W/H Ratio (Waist-Hip

Circumference ratio) Hip circumference is the maximum circumference in the horizontal plane, measured over the buttocks. The ratio of the WC to the hip circumference provides an index of proportion of intra-abdominal fat. The cut off point for central obesity was waist to hip ratio more than 0.95 for men and 0.85 for women.

Fasting blood glucose was measured by glucose oxidase-peroxidase method using reagent kits by automated analyzer. A 5 ml blood sample was collected from each subject after fasting more than 10 hours. The coagulated blood was then centrifuged at 3,000 rpm for 10 min. The serum was used to measure glucose levels.

Informed consent was sought and obtained from the subjects and the study was approved by the Faculty’s Research and Ethics Committee.

RESULTS

It was observed that fasting blood glucose levels in overweight (85.12 ± 9.52) and obese group (87.6 ± 8.66) were significantly higher than control group (80.95 ± 5.87).

Table 2: Mean fasting blood glucose level in all groups.

Parameter	Group I (n=26)	GroupIIa (n=30)	Group IIb (n=21)
BMI Kg/M ²	18.5-24.9	25.0-29.9)	>30.0
FBS mg/dl	80.95 ± 5.87	85.12 ± 9.52	87.6 ± 8.66

Table 3: Mean fasting blood glucose level in male and female groups.

Parameter	Male (n=43)	Female (n=34)	p value
BMI Kg/M ²	24.7± 6.3	26.8±5.6	
FBG in mg/dl	79.95± 6.87	86.12±7.52	0.014*

p value < 0.05 significant *Significant

Table 4: Correlation between FBG level and BMI in each group

Groups	BMI Kg/m ²	FBG mg/dl	r	p value
I (n=26)	18.50–24.99	80.95 ± 5.87	0.076	0.407
IIa(n=30)	25-29.99	85.12 ± 9.52	0.088	0.38
IIb (n= 21)	≥ 30	87.6 ± 8.66	0.24	0.010*

p value < 0.05 significant *Significant

Table 5: Correlation of FBG level with BMI and WC

		r	p value	R ²
FBS	BMI	0.399	0.001	0.159
	WC	0.293	0.023	0.09

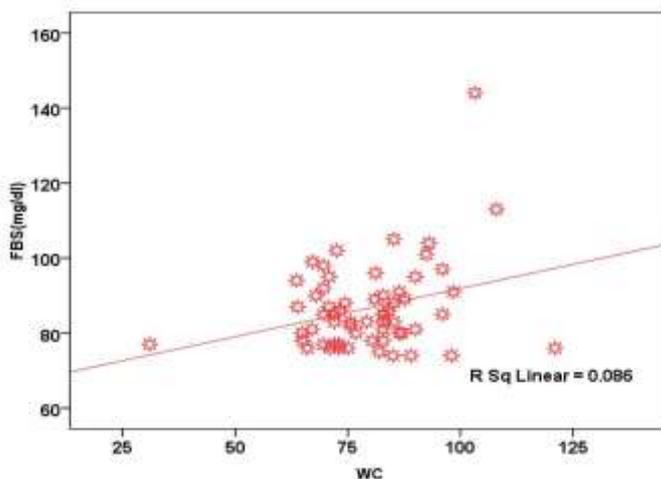


Fig. 1: Correlation of WC and FBG levels

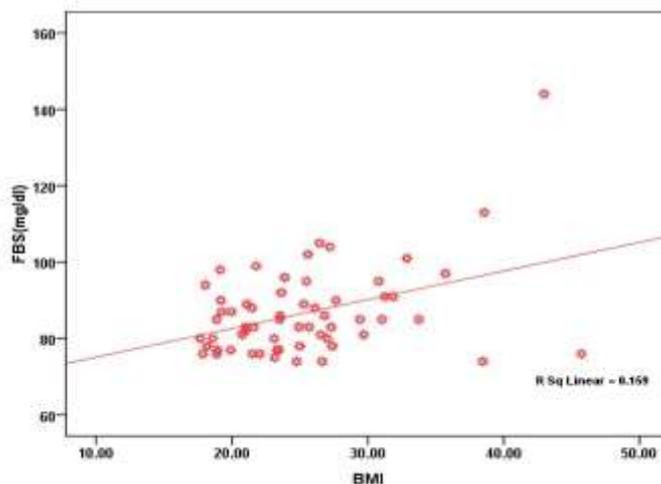


Fig. 2: Correlation between FBG level and BMI

DISCUSSION

The link between obesity and type 2 DM is explained in the following way. As body weight increases, insulin resistance increases i.e. there is decreased ability of insulin not only to move glucose into fat cell and muscle cell but also to shut off glucose release from the liver [10]. Various circulating chemicals like leptin, adiponectin, resistin, TNF α produced by adipocytes (mainly abdominal) modulate insulin secretion and insulin action which may contribute to insulin resistance [11]. This means that fat depots are not inert lumps but are actually endocrine tissues.

The transition from the early metabolic abnormalities like IFG and IGT that precede diabetes, to actual onset of diabetes may take many years. However, current estimates indicate that most individuals (perhaps up to 70%) with these pre-diabetic states eventually develop diabetes [12-15]. During the pre-diabetic state, the risk of a CVD event is modestly increased [16].

A strong correlation has been established between a high BMI and the development of type-2 DM from a study of more than 7000 British men (mean followup of 12 years) [17]. These observations were expected as obesity is known to induce insulin resistance due to decrease in insulin-sensitive receptors as the weight increases [18]. Insulin is known to facilitate the uptake of glucose through the specialised membrane of the insulin-sensitive cells which invariably results in an increase in blood glucose level due to delayed glucose uptake [19]. In different Asian populations, WC and WHR positively correlate with and are best predictors of FBG and type 2 DM [20]. In a recent study in healthy post-pubescent female Nigerians (16-23 years), FBG best positively and significantly correlated with BMI ($r=0.15$; $P<0.05$). This showed that relative to other indices of body mass and obesity (WC, HC, WHR, and WHtR), BMI best predicted FBG in this young female Nigerian population [21].

In our study FBG significantly and best correlated with BMI ($r=0.399$; $p = 0.001$). This showed that relative to WC ($r=0.293$; $p = 0.023$) of body mass and obesity, BMI best predicted FBG in the sample of young adults. However, in this study, the positive association between FBG and WC ($r=0.293$) is significant ($P=0.023$), and is weaker than the significant relationship between FBG and BMI. We have therefore shown in the present study that the best anthropometric predictor of FBG and thus, metabolic status, in young adults is the BMI, and this anthropometric index is positively and significantly associated with WC. Thus weight gain and increased IFG correlates well and supports our study of higher percentage of IFG incidence with increased BMI.

The strong association between diabetes and obesity suggests that our first priority is maintenance of healthy weight and obesity prevention. All individuals who are overweight or obese, regardless of their blood glucose value, should be intensively counseled to exercise and lose weight. In addition, interventions at the community level, such as changes in school-based meals and exercise programmes, community infrastructure changes conducive to increasing exercise frequency, and legislation that promotes a healthy lifestyle, are required. General public does not recognise the connection between overweight and obesity with diabetes; so greater efforts for educating the obese and overweight are needed.

For all of these reasons, lifestyle modification therapy emphasising modest weight loss (5–10% of body wt) and moderate-intensity physical activity (30 min daily) is the treatment of choice for individuals with IFG/IGT. While it is likely that the population enrolled in the clinical trials may not exactly mirror the general population, it seems very likely that lifestyle modification would benefit all people with IFG/IGT.

A more difficult issue is whether drug therapy is warranted to prevent or delay diabetes in individuals with IFG/IGT. Although several drugs successfully slowed progression to diabetes, there are many issues that need to be considered before medications can be recommended.

Metformin was the first drug shown to be effective [22]. Although its effectiveness was about half that achieved with lifestyle modification (31 vs. 58%), substantially greater benefit was seen in a subset of younger and obese individuals. The drug is inexpensive and has a long history of use showing virtually no long-term serious side effects and only a low prevalence (5–10%) of modest side effects, such as nausea and gastrointestinal disturbances.

CONCLUSION

Weight gain and increased FBG correlates well and supports our study of higher percentage of FBG incidence with increased BMI. It is very important to note that people with impaired fasting glucose can change their life style to delay the onset of diabetes. General public does not recognise the connection between overweight and obesity with diabetes so greater efforts for educating the obese and overweight are needed.

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