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ORIGINAL ARTICLE

A Study Of Body Mass Index In Healthy Individuals And Its Relationship With Fasting Blood Sugar

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ABSTRACT

Background and objectives: Obesity is a global epidemic and is on the rise. It is defined as a body mass index (BMI) which is equal to or more than 30. It is one of the modifiable risk factors of type 2 diabetes. This study was undertaken to assess the association between BMI and fasting blood sugar (FBS) and also to verify whether BMI increases with age. **Subjects and Methods:** This prospective study included 400 healthy adult individuals who met the inclusion criteria. Fasting blood samples were collected to measure FBS by the glucose oxidase method. Thirty individuals were excluded from the study, as their blood glucose levels were in the diabetic range. **Results:** Among 370 individuals, a positive correlation was observed (Pearson's correlation coefficient r = + 0.26) between BMI and FBS. There was a stepwise increase in the magnitude of BMI with an increase in age in decades. Although the increase in mean FBS was observed with age, a statistically significant (p = 0.00093) increase in mean FBS was observed only in the 4th decade of life. **Interpretation and conclusions:** The observed positive correlation between BMI and FBS reiterates the diabetogenic effect of adipose tissue and emphasizes the importance of the maintenance of normal BMI to prevent the early onset of diabetes.

Key words: Obesity, Body mass index, Fasting blood sugar.

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Introduction

Body mass index (BMI) is a good measure of general adiposity. It is defined as the weight in kilograms, divided by the square of the height in meters (kg/m^2).[1] A person can be categorized as underweight if his/her BMI is ≤18.5, as normal weight if his/her BMI is in the range of 18.5–24.9, as overweight if his/her BMI is between 25 to 29.9 and as obese if his/her BMI is ≥30.[2] A raised BMI value is an established risk factor for ischaemic heart disease, stroke and carcinomas.[3]

Obesity is one of the most important modifiable risk factors in the pathogenesis of type 2 diabetes. The mechanism by which obesity induces insulin resistance is poorly understood. Adipocytes secrete a number of biological products (leptin, TNF-alfa, free fatty acids, resistin, and adiponectin) that modulate insulin secretion, insulin action and body weight and may contribute to insulin resistance.[4] A positive correlation is

assumed to exist between BMI and fasting blood sugar (FBS) levels.

Global epidemic obesity - "globesity" - is rapidly becoming a major public health problem in the world and is on the rise. In many populations, the average BMI has been rising by a few percent per decade, thus fuelling the concern about the effects of increased adiposity on health.[5]

This study was undertaken to determine the correlation between FBS and BMI in an adult healthy Indian population and also to check whether BMI increases with age.

Methods

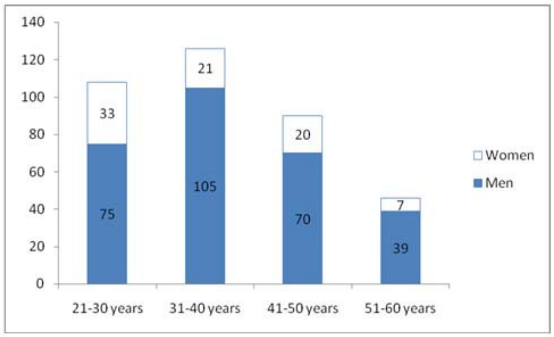
This prospective study was conducted at Sri Chamarajendra Hospital, a teaching hospital which is affiliated to the Hassan Institute of Medical Sciences, during May – August 2010.

After obtaining permission from the Institutional Ethical Committee, normal healthy individuals attending the hospital for routine health check-up were included in the study. Paediatric, pregnant, psychiatric and diabetic subjects were excluded from the study. The study group included 400 persons of the age group of 21-60 years. After obtaining the informed consent, the age, sex, height and weight of the subjects were recorded. Weight was recorded to nearest 0.5 kg and height was recorded to nearest 0.5 cm. Fasting (8-12 hours of overnight fasting) venous blood samples were collected by venipuncture of the median cubital vein in a vacutainer and were centrifuged to separate the plasma. Fasting plasma glucose levels were estimated by the Glucose oxidase method by using an ERBA-Transasia fully automated analyser.

The BMI for each subject was calculated by using the standard formula i.e., weight in kilograms divided by height in square meters.[1] All the variables including age, sex, height, weight, BMI and FBS from study group were tabulated and analysed statistically. Pearson's correlation coefficient was used to find the correlation between FBS and BMI. Student's t-test was used to check the statistical significance of the changes in BMI and FBS with respect to age.

Results:

Four hundred apparently healthy subjects who met the inclusion and the exclusion criteria were included in the study. Thirty members were excluded from the study population as their fasting blood glucose levels were in the diabetic range. Of the 370 members, 289 (78.1%) were men and 81 (21.9%) were women. The study included subjects who were in the age group of 21 to 60 years. The mean age of the male subjects was 37.98 ± 10.51 years and the mean age of the female subjects was 36.4 ± 10.11 years.



[Table/Fig 1]: Age and sex distribution of study population

The mean FBS of the study population was 90.70 ± 10.71 mg/dl and the mean BMI was 25.1 ± 3.38. The Pearson's correlation coefficient between FBS and BMI of the study population was positive (r = + 0.26).

[Table/Fig 2]: Mean BMI and mean FBS of different age groups

Age groups	Mean BMI	Mean FBS (mg/dl)
21-30 years	22.27	87.27
31-40 years	26.00	90.87
41-50 years	26.33	92.24
51-60 years	27.10	92.26

There was a stepwise increase in the magnitude of BMI, with an increase in age in decades. Although an increase in the mean FBS was observed over decades, a statistically significant increase in mean FBS was observed ($p = 0.00093$) only in the 4th decade of life i.e., as the age group increased from the 3rd to the 4th decade of life.

Discussion

In the present study, BMI showed a positive correlation with FBS (Pearson's correlation coefficient r = + 0.26). A positive correlation between BMI and blood sugar was also reported by other studies.[6],[7] Ethnicity affects the association between obesity and diabetes and that probably explains the different levels of association between obesity and blood glucose levels which are observed in various studies.[8]

The mean BMI of different age groups showed an increasing trend over the decades and an increase in mean BMI was found to be more marked from the 3rd to the 4th decade. The prevalence of obesity, as measured by BMI, is high in many countries all over the world and is rising. It is mainly attributed to the changing lifestyles and dietary habits.[5],[9]

Mean FBS increased with increasing age and with increasing BMI. Significant increase in mean FBS was observed during the 4th decade of life.

The mechanism by which obesity induces insulin resistance is poorly understood, but a number of mechanisms have been suspected to be involved. Obesity causes peripheral resistance to insulin-mediated glucose uptake and may also decrease the sensitivity of the beta-cells to glucose.[10] These changes are largely reversed by weight loss, leading to a fall in blood glucose concentrations towards normal levels. Weight gain precedes the onset of diabetes; conversely, weight loss is associated with a decreased risk of type 2 diabetes. [11],[12]

The administration of resistin, an adipocyte derived hormone, decreases while the neutralization of resistin increases insulin-mediated glucose uptake by the adipocytes. Thus, resistin may be a hormone that links obesity to diabetes.[4] Leptin is produced by adipocytes and is secreted in proportion to the adipocyte mass. It signals the hypothalamus about the quantity of stored fat. Studies in humans and animals have shown that leptin is associated with obesity and insulin resistance.[13] The deficiency of adiponectin, an adipocyte-derived hormone, plays a role in the development of insulin resistance and subsequently, type 2 diabetes.[14]

Retinol-binding protein 4, free fatty acids, tumour necrosis factor-alpha, plasminogen activator inhibitor 1, interleukin-1 beta, uncoupling protein 2 and obestatin are also implicated in the adipose tissue induced pathogenesis of type 2 diabetes.[15]

BMI is a good measure of adiposity; however, the relationship between actual body fat and BMI differs between ethnic groups, and as a consequence, the cut off points for the overweight status and obesity based on BMI, will have to be ethnicity specific.[16]

Summary and conclusion:

The observed positive correlation between BMI and FBS reiterates the effect of adipose tissue in impairing blood glucose regulation and emphasizes the importance of the maintenance of normal BMI.

The effects of increasing obesity, as indicated by an increase in BMI over the decades in a population can be disastrous, as it can lead to enormous health costs. Hence, awareness needs to be created in children right from the school age, as well as amongst the parents of these children, in order to have an appreciable impact in preventing or delaying the onset of type-2 diabetes in later life.

Limitations of the study:

Our study did not take into account the other indices of obesity like waist hip ratio and abdominal circumference.

Recommendations:

We recommend that further studies must be carried out on a larger sample size with the measurement of waist hip ratio and abdominal circumference as comparative indicators.

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