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Original Article

Diabetogenesity of adiposity: When to intervene?

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ABSTRACT:
Objective: Obesity is one of the modifiable risk factors of type 2 diabetes mellitus. Adiposity causes insulin resistance and diabetes by various mechanisms. This study was undertaken to determine diabetogenic effect of adiposity in relation to age for identification of vulnerable age groups.
Methods: This prospective study included 370 healthy adult non-diabetic individuals. Height and weight were recorded to calculate body mass index (BMI). Fasting blood sugar (FBS) was estimated by glucose oxidase method.
Results: A stepwise increase in magnitude of BMI was observed with increase of age in decades. Although increase in mean FBS was observed with age, statistically significant ($p = 0.00093$) increase in mean FBS was observed only in 4^{th} decade of life. Positive correlation was observed (Pearson's correlation coefficient $r = + 0.26$) between BMI and FBS.
Conclusion: With increasing age, BMI and FBS increase, especially during 4th decade of life. This emphasizes the need to target the vulnerable age group (30-40 years) for creating awareness about maintenance of ideal body weight to prevent early onset of type 2 diabetes. Positive correlation between BMI and FBS reiterates diabetogenic effect of adipose tissue and emphasizes importance of maintenance of normal BMI.

Keywords: Obesity; Adiposity; Body Mass Index; Blood glucose.

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1. INTRODUCTION

Obesity is one of the most important modifiable risk factors in pathogenesis of type 2 diabetes. The mechanism by which adipose tissue induces insulin resistance is poorly understood. Adipocytes secrete a number of biologic products that modulate insulin secretion, insulin action, and may contribute to the insulin resistance (1).

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) (2). A person can be categorized underweight if BMI is $\geqslant$18.5, normal weight if BMI is in range of 18.5 - 24.9, overweight if BMI is 25 to 29.9, and obese if BMI is $\leqslant$30 (3). A positive correlation is assumed to exist between BMI and fasting blood sugar (FBS) levels. Raised BMI is an established risk factor for ischemic heart disease, stroke, and carcinomas (4).

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

This study was undertaken to determine the diabetogenic effect of adiposity in various age groups for identification of vulnerable age group. Study also checked whether any association existed between FBS and BMI in adult healthy Indian population.

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2. MATERIAL AND METHODS

This prospective study was conducted in District hospital, a teaching hospital affiliated to Hassan Institute of Medical Sciences, at Hassan, Karnataka state, India, during May – August 2010.

After obtaining permission from 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. Study group included 400 persons in age group of 21-60 years. After obtaining the informed consent, person's age, sex, height and weight 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 sample was collected by venupuncture of median cubital vein in a vacutainer and centrifuged to separate plasma. Fasting plasma glucose level was estimated by Glucose oxidase method using ERBA-Transasia fully automated analyser.

BMI for each subject was calculated using the standard formula i.e., weight in kilograms divided by height in meters squared. All the variables, age, sex, height, weight, BMI, and FBS from study group were tabulated according to age groups of 10 year intervals and analysed statistically. Student's t-test was used to check the statistical significance of changes in BMI and FBS in relation to age. Pearson's correlation coefficient was used to find correlation between FBS and BMI.

3. RESULTS

400 apparently healthy subjects who met inclusion and exclusion criteria were included in the study. 30 members were excluded from the study population as their fasting blood glucose levels were in diabetic range after estimation of FBS. Of the 370 members, 289 (78%) were men and 81 (22%) were women. Study included subjects in the age group of 21 to 60 years. Mean age of male subjects was 37.98 ± 10.51 years and mean age of female subjects was 36.4 ± 10.11 years. Age and sex distribution of study population is illustrated in figure 1.

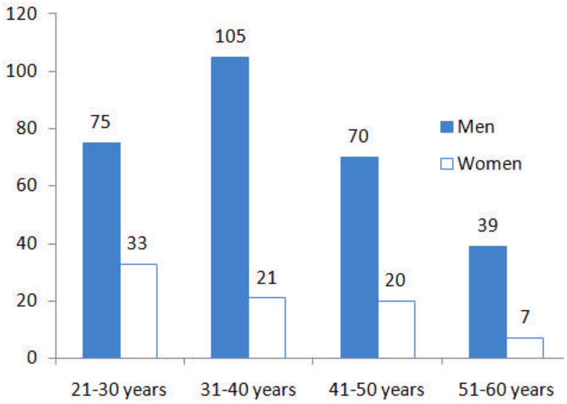

Figure 1. Age and sex distribution of study population

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

Mean FBS of study population was 90.70 ± 10.71 mg/dl and mean BMI was 25.1 ± 3.38. Pearson's correlation coefficient between FBS and BMI of the study population was positive (r = + 0.26). Mean BMI and mean FBS of different age groups is depicted in table 1.

Table 1. 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

4. DISCUSSIONS

In the present study, mean BMI of different age groups showed an increasing trend over the decades and increase in mean BMI was more marked from 3rd to 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 changing lifestyles and dietary habits (5, 6).

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

BMI measures adiposity while increasing FBS measures diabetogenecity. Both mean BMI and mean FBS levels showed a marked increase in persons of 4th decade (30-40 years) compared to persons of 3rd decade (20-30 years). This indicates that especially in 4th decade of life people are vulnerable for the accumulation of more body fat paving way for insulin resistance and onset of diabetes.

BMI showed a positive correlation with FBS (Pearson's correlation coefficient r = + 0.26). A positive correlation between BMI and blood sugar was also noted by other studies (7, 8).

Ethnicity affects the association between obesity and diabetes (9) and calls for similar studies on various ethnic groups to know their vulnerable age groups.

The mechanism by which adiposity induces insulin resistance is poorly understood, but a number of mechanisms may be involved. Adipose tissue 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 toward normal. Weight gain precedes the onset of diabetes; conversely, weight loss is associated with a decreased risk of type 2 diabetes (11, 12).

Administration of Resistin, an adipocyte derived hormone, decreases while neutralization of resistin increases insulin-mediated glucose uptake by adipocytes. Thus, resistin may be a hormone that links obesity to diabetes (1). Leptin is produced by adipocytes and is secreted in proportion to 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). Deficiency of adiponectin, an adipocyte-derived hormone, plays a role in the development of insulin resistance and subsequent type 2 diabetes (14).

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

5. CONCLUSION

With increasing age, BMI and FBS increase, especially during 4th decade of life. This study emphasizes the need to target the vulnerable age group (30-40 years) for creating awareness about maintenance of ideal body weight to prevent early onset of type 2 diabetes. Effects of increasing obesity in a population can be disastrous, as it can lead to enormous health costs. Intervention at right time and targeting people of right age for health education and lifestyle modification can minimize the health costs, lessen the burden of disease and can improve the quality of life. The observed positive correlation between BMI and FBS reiterates the effect of adipose tissue in impairing blood glucose regulation and emphasizes importance of maintenance of normal BMI. Our study did not take into account of other indices of obesity like, ethnicity, waist hip ratio and abdominal circumference. We recommend that further studies be carried out on a larger sample size and be multi centric with measurement of waist hip ratio and abdominal circumference as comparative indicators of adiposity.

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