

Association between Body Mass Index and Percent body fat among healthy women in India

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Abstract

The aim of this study was to determine the relationship between body mass index (BMI) and body fat percentage of healthy women's from urban areas in Baghpat district. A total of 2000 women categorized in four age groups 20-30, 31-40, 41-50 and 51-60 years were examined. In this study examined adolescents were divided into four groups. Overweight and obesity are defined as abnormal or excessive fat accumulation in the body that may impair health. During the last few decades, the prevalence of obesity has increased and has become a considerable global health hazard. Excessive body fat is associated with increased metabolic risk, and its' measurement is important in implementing curative and preventive health measures. The purpose of this study was to compare and quantify the relationship between BMI and %BF for women.

Key words: - Body mass index, percent body fat, obesity, overweight

Introduction

Biologic aging is a process involving changes that influence the body's total functional capacity. Body composition is an important aspect of health related to nutritional status. Numerous studies have indicated that biologic aging is associated with a number of adverse changes in body composition. With advancing age, the body's fat-free tissue weight decreases whereas fat tissue weight increases (Komiya et al, 1992).

Fat is the most changeable and important components of the body. The total body fat contains the combination of two fat components that are storage fat and essential fat. Throughout the central nervous system, lungs, liver, spleen, heart, Fat in the marrow of bones, kidneys, intestine and muscle is called essential fat which is necessary for normal body functioning whereas the fat which is accumulated in adipose tissue is called storage fat (Das and Roy, 2010). Furthermore reduction in muscle mass leads to a reduction or stability in body weight. It may be masked by an increase in body fat mass as a result of aging. The body fat accumulation is usually located at trunk area and visceral sites of the body. This fat is closely linked with an increased risk of cardiovascular diseases, chronic disorders and disabilities (Milanovic et al, 2011).

During the last few decades, the prevalence of obesity has increased and has become a considerable global health hazard. Excessive body fat is associated with increased metabolic risk, and its measurement is important in implementing curative and preventive health measures. Direct measurement of body fat requires sophisticated equipment and is time consuming; it is also difficult in epidemiological studies. Body Mass Index is used as a useful population-level measure of overweight and obesity. It is used as the same for both sexes and for all ages of adults. The relationship between body mass index and body fat percentage has been studied in various ethnic groups to estimate the capacity of body mass index to predict adiposity (Ranasinghe et al, 2013).

Overweight and obesity are usually defined as the abnormal or excessive fat accumulation that may impair health. Obesity is defined as the accumulation of excess body fat to the extent that it may have adverse effects on health. It is crucial to determine a threshold of body fat that is associated with potential harm to an individual's health (Chan et al, 2010).

MATERIALS AND METHODS

1. Subjects

The present study was conducted in the urban areas Baghpat district (Uttar Pradesh). For the study 2000 women age between 20 to 60 years were selected. All 2000 individuals were from four age groups and these age groups were 21 to 30 years (group 1), (group 2) 31 to 40 years, 41 to 50 years (group 3) and 51-60 years (group 4). Sample selection was done in such way so that each category should have at least 500 samples for making even sample distribution in all groups. Information on about age, occupation and educational status was obtained from all subjects with the help of a questionnaire.

All anthropometric measurements were taken by using internationally accepted standard protocols (Lohman et al., 1988).

2. Study variables

Weight: The body weight was taken with an electronic weighing machine, asking the subject to stand on it bare foot with an erect posture and light apparel. The weighing machine was calibrated time to time with a known standard weight. No deduction was made for the weight of light apparel while taking the final reading. Body weight was measured to nearest 0.1 kg.

Height: Height was measured to the nearest 0.5 cm on stadiometer. Subjects stood with their scapula, buttocks and heels resting against a back wall of stadiometer, the neck was held in a natural non stretched position, the heels were touching each other, the toe tips formed a 45° angle and the head were held straight with the inferior orbital border in the same horizontal plane as the external auditive conduct (Frankfort's plane).

Body mass index: "BMI was calculated by dividing body weight (kg) by height². Individuals were considered under nourished if their BMI was less than 18.5, normal from 18.5 to 24.9 and overweight if =

25 . BMI: Weight (kg) / Height (m²) (WHO, 1995). The following cutoff points were used: Under nutrition: BMI < 18.5, Normal: BMI: 18.5-24.9, Overweight: BMI > 25.0, 30.0–34.9 Obesity I, 35.0–39.9 Obesity II and 40.0 (and above) Obesity III.”

Percent body fat

Body density was calculated according to Durnin and Womersley formula, which was in turn used to estimate the per cent body fat.

Body density = 1.1369-(0.0598×log sum of 4 SFTs)

% PBF = (554.8/density) – 500.4

RESULTS DISCUSION

Table 1: Body mass index and percent body fat of female in various age groups

Variables	20-30years (group 1) mean±sd	31-40years (group 2) mean±sd	41-50 years (group 3) mean±sd	51-60years (group 4) mean±sd	t-test					
					1 vs.2	1vs.3	1vs.4	2vs3	2vs.4	3vs.4
BMI (kg/m ²)	23±3.43	25.85±3.25	26.00±3.62	25.59±3.47	13.4*	13.48*	11.83*	.670 ^{ns}	1.250 ^{ns}	1.834 ^{ns}
PBF (%)	43.25±2.15	45.32±1.85	45.23±2.02	45.25±2.012	16.29*	16.46*	15.19*	.861 ^{ns}	.559 ^{ns}	1.363 ^{ns}

Body mass index-

High BMI is an indicator of fat accumulation in the body. Body mass index [BMI, weight kg/height m² is presently the most often used and widely satisfactory methods of distribution of body weight and classification of medical risk. BMI is a useful determinant of adiposity in early and middle-aged adults. Body mass index is positively and independently associated with morbidity and mortality from hypertension, cardiovascular disease, type II diabetes mellitus, and other chronic diseases (Chindu et al, 2013).

“BMI was calculated by dividing body weight (kg) by height² (m²).The following cut-off points were used: Under nutrition: BMI < 18.5, Normal: BMI: 18.5-24.9, Overweight: BMI > 25.0, 30.0–34.9 Obesity I, 35.0–39.9 Obesity II and 40.0 (and above) Obesity III” (WHO).

Mean BMI of group 1 (20-30 years) was 23±3.43, it was significantly lower than the other three groups and was normal. Mean BMI of age groups 30-40, 41-50 and 51-60 years were 25.85±3.25, 26.00±3.62 and 25.59±3.47 respectively and not significantly different from each other. After analyzing BMI, in age group

21-30 years number it was found that 70% (n-355) adult women had normal BMI, numbers of under nourished adult women were (24)4.8%, (119)23.8% women were in the category of obesity 1, and (3)0.6% females were in obesity 2 category.

Body fat percentage (BFP) –body fat includes essential body fat and storage body fat. Essential body fat is necessary to maintain life and reproductive functions. The percentage of essential body fat for women is greater than that for men, due to the demands of childbearing and other hormonal functions. Storage body fat consists of fat accumulation in adipose tissue, part of which protects internal organs in the chest and abdomen. (https://en.wikipedia.org/wiki/Body_fat_percentage).

High percent body fat is the true indicator of obesity. According to WHO a person having Percent body fat >30 is called obese. Mean Percent body fat of age group (20-30 years) was $43.25 \pm 2.15\%$. It was significantly lower than the mean body weight of age group 2 (30-40 years), group 3(41-50 years), group 4 (51-60 years) where mean body weight were 45.32 ± 1.85 , 45.23 ± 2.02 , $45.25 \pm 2.012\%$ respectively. Although mean percent body fat of each age group was higher than 30%. But the mean Percent body fat of age group 20-30 years was significantly lower than the other three groups. Although there was no significant difference was observed between the Percent body fat other three groups. Because of all women having more than 30 of % body fat, are all in the category of obese.

Table 2: Percentage of Body mass index level in women of various age groups.

	20-30 years	31-40 years	41-50 years	51-60 years
Under weight	4.8%(24)	4.4% (22)	4.8% (24)	-
Normal	71% (355)	45.4% (227)	46.6% (233)	45.2% (226)
Overweight	-	36.2%(181)	35.2%(176)	36.4% (182)
Obesity1	23.8% (119)	11.4% (57)	11.6% (58)	11% (55)
Obesity2	0.6% (3)	2.6% (13)	1.8% (9)	2.6%(13)
Obesity3	-	-	-	4.8% (24)

In age group 31-40 years 45.4% (227) women had normal BMI. 4.4% (22) women were under nourished, numbers of overweight adult women were 36.2% (181), 11.4% (57) women were in the obesity 1 and 2.6% (13) women found to be obesity 2 categories. In age group (41-50 years) numbers of normal adult women were 46.6% (233) , numbers of under nourished adult women were 4.8% (24), numbers of overweight adult women were 35.2% (176), 11.6 (58) women were in obesity 1 and 1.8% (9) women were in obesity 2 category. In age group (51-60 years) numbers of normal adult women were 45.2% (226), numbers of

overweight adult women were 36.4% (182), 11% (55) women were in obesity 1 category, 2.6 % (13) women were found to be obesity 2 and 4.8% (24) were in obesity 3 categories.

Height and weight are the two most easily obtained anthropometric measures and have been used extensively in screening and monitoring programs because abnormal weights categories (underweight, overweight and obesity) have been considered as risk factors for various diseases (Chindu et al, 2013).

In this category 20-50 years less than 30% women were under weight and 51-60 years no one was found in this category. In the category of 20-30 years, in all subjects; it was seen that about 24.4% of the women were in the category of obese. In the category of 31-40 years, about half of the women's were obese and overweight. In the category of 41-50 years about 49% of women were in the category of overweight and obesity and 51 -60 years were 55% respectively. So it is seen that most of the subjects are in normal state in the year of 20-30 years but above this group (31-40 years, 41-50 years and 51-60 years) about half of the women were found to be overweight or obese.

Traditionally, body mass index have been the preferred indicator by which to assess body size and composition, and to diagnose underweight and overweight. However, waist circumference, waist-hip ratio and waist-height ratio are alternative measures that reflect abdominal adiposity and have been recommended as being superior to body mass index in predicting CVD risk. Basically, this is based on the justification that increased visceral adipose tissue which is linked with a range of metabolic abnormalities, including decreased glucose tolerance and insulin sensitivity, and adverse lipid profiles, which are risk factors for type 2 diabetes and CVD. As women body weight increase changes in body mass index also occur and these changes affect the human health. These changes are direct correlated with different health problems. Higher body mass index has found to be associated with increased reporting of headaches, back pain, hypertension, asthma, irregular monthly periods, and difficulty in sleeping (Varte et al, 2013).

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