Assessment of Obesity from Body Mass Index and Percent Body Fat among Adult Females of Amritsar, Punjab

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ABSTRACT: The present cross-sectional study was carried out to find out the prevalence of obesity assessed with the help of Body Mass Index (BMI) criteria and Percent Body Fat (PBF) estimated by Bio-electrical Impedance Analysis (BIA) among adult females of Amritsar. A total of 172 adult females (30-50 years) were contacted personally at their residence. Height and weight measurements were taken using standard methodology. Percent body fat of each individual was measured by using, body fat analyzer (BODYSTAT-1500). BMI was calculated with the help of BMI criteria of WHO ('98 and 2000). The overall prevalence of obesity in adult females was found to be 23.26% and 56.40% by using BMI criteria of WHO ('98 and 2000); respectively, and 60.47% from PBF estimated by using bio-electrical impedance analysis.

INTRODUCTION

Worldwide, obesity has been recognized as one of the most important public health problem (WHO, 2000; Ejike and Ijeh, 2012; Anjos, 2013). The prevalence of obesity is increasing in developed and developing countries in children, adolescents and adults (Haslam and James,2005; Lobstein *et al*. 2004; Sidik and Rampal, 2009).

The rising prevalence of overweight and obesity warrants the need for accurate method of assessment of obesity. Currently, there are many measures for diagnosing obesity at population level but most frequently used diagnostic tool in the current classification system of obesity is Body Mass Index (BMI). It was confirmed by various scientists (Valtallie *et al*., 2090; Schutz *et al*., 2002; Kyle *et al*., 2003; Kyle *et al*., 2004; Romero-Coral *et al*., 2008; Liu *et al*., 2013), that the use of BMI as a measure obesity can introduce misclassification problem because it does not provide information about the respective contributions of fat mass and fat free mass to body weight. However, it is difficult to accurately measure body fat mass, because this requires the use of sophisticated technologies that are not readily available. Several techniques have been used to assess body fat such as magnetic resonance imaging (MRI); dual energy x-ray absorptiometry (DXA); computer tomography (CT) and densitometry. However, these methods are difficult and expensive for epidemiological study and not feasible to conduct in the field because they require large specialized equipment when compared to bio-electrical impedance analysis (BIA). The use of BIA for determining percent body fat (PBF) is widely accepted as safe, rapid, low cost and reliable method by various scientists (Tsui *et al*., '98; Singh *et al*., '99; Willet *et al*., 2006; Kobayashi *et al*., 2006; Rana and Sidhu,

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2012). Very few studies are available in literature in which obesity was assessed with the help of PBF. Therefore, in the present study an attempt has been made to assess the prevalence of obesity by using BMI criteria of WHO ('98 and 2000) and percent body fat (PBF) criteria.

MATERIALS AND METHODS

The present cross-sectional study was undertaken to assess the prevalence of overweight and obesity among 172 urban adult females (age 30-50yrs) of Amritsar, Punjab. All the subjects were apparently healthy, without any signs and symptoms of physical deformities, only those who gave informed written consent were included in this study. Pregnant females were excluded from the study. Each subject was contacted personally at her residence. The Institutional Ethical Review Committee had approved the study protocol. To avoid circadian variation study was conducted between 10 am to 12 noon. Two anthropometric measurements (height and weight) were taken according to protocols recommended by Weiner and Lowrie ('81). Percent body fat was estimated by bio-electrical impedance analysis (BIA) technique using BODYSTAT-1500 (UK, Model). BIA involves passage of a weak alternating current across the extremities. As mentioned in instructions of the equipment, right hand and foot was selected for the experiment. BIA is based upon the principle that electric current flows through body at different rates depending upon its composition. BIA varies under different conditions so to accurately measure its values, subjects were asked to follow pre-requisite guidelines: i) no tea, coffee or food or even exercise within 4 hours before the test, ii) no intake of water at least for 2 hours before conducting examination. During the examination two pairs of electrodes one at right wrist hand and other at right foot were placed. Subject's data including gender, age, height, weight physical activity was entered into BODYSTAT's software and results were recorded.

For the assessment of overweight and obesity two variables i.e. BMI and PBF were used in the present sample. BMI was calculated from measured values of height and weight for each subject. In general, BMI= weight (kg)/ height^2 (m^2). For the assessment of overweight and obesity following BMI criteria of WHO ('98 and 2000) were used:

WHO ('98)		WHO (2000)	
<18.5	Underweight	<18.5	Underweight
18.5-24.9	Normal	18.5-22.9	Normal
≥25.0	Overweight/ Obese	23.0-24.9	Overweight
25.0-29.9	Overweight	25.0-29.9	Obese I
≥30.0	Obese	30.0	Obese II

Similarly, second approach of PBF was used for assessment of overweight and obesity by using criteria suggested by Gomez-Ambrosi *et al*. (2012) i.e. subjects having body fat <35% were categorized as non-obese and those having ≥ 35% as obese.

For statistical analysis of data, entire data was entered into the computer using MS_EXCEL program. The analysis of data was done using statistical package for Social Sciences for windows version 16.0 (SPSS Inc., and Chicago IL) and mean, standard deviation was calculated. To find out statistical significance of results Chi-square test was used and a p-value < 0.05 was considered statistically significant.

RESULTS

Table 1 shows the basic characteristics of the studied sample. It is apparent from this table that there is wide variation in minimum and maximum values of all the studied variables among Amritsar females.

TABLE 1

Basic characteristics of the urban adult female sample of Amritsar

Variables	Mean	SD	Minimum value	Maximum value
Age (yrs.)	39.91	6.61	30.00	50.00
Height (cm)	154.69	6.00	135.10	168.50
Weight (kg)	62.53	12.94	40.00	106.00
BMI (kg/m^2)	26.13	5.30	15.30	44.70
PBF	36.74	5.76	22.70	50.90

In the present study two approaches i.e. BMI and PBF assessed by BIA were used for the estimation of prevalence of obesity. The overall prevalence of obesity among Amritsar females was 23.26% according to WHO ('98) criteria and 56.40% according to WHO (2000) criteria of BMI (Table 2).

TABLE 2

Number and percentage prevalence of underweight, normal, overweight and obese females according to BMI criteria of WHO ('98) and WHO (2000)

	Underweight	Normal	Overweight	Obese
WHO, '98	5.81(10)*	37.79(65)	33.14(57)	23.26(40)
WHO, 2000	5.81(10)	25.58(44)	12.21(21)	56.40(97)

*Figures in parenthesis indicate absolute frequency

This shows that WHO (2000) criteria identified about 33.14% more females as obese as compared to WHO ('98) criteria and this difference was statistically significant (χ^2=38.040*, DF=1, p<0.0001). The prevalence of obesity in terms of number of people was almost more than double according to WHO (2000) classification than WHO ('98). Therefore, the changed perception about the use of BMI criteria has drawn a drastic situation of obesity, among the females in this study. On the other hand, the prevalence of obesity using PBF criteria was 60.47% (Table 3). PBF criteria had identified slightly more number of obese subjects (4.07%) than BMI criteria of WHO (2000) but the difference between the two criteria was statistically non-significant (χ^2 = 0.431, DF=1, p= 0.5116).

TABLE 3

Number and percentage prevalence of obesity using Percent Body Fat criteria (Gomez-Ambrosi et al., 2012)

Total number of subjects	Non-obese		Obese	
	No.	%	No.	%
172	68	39.53	104	60.47

On the other hand, Table 4 shows the discrepancy in percentage prevalence between BMI criteria of WHO ('98) and PBF criteria which was quite high (-37.21%) and the difference was statistically significant (χ^2 = 47.408*, DF=1, p<0.0001). This proves that PBF and BMI criteria of WHO ('98) had a wide difference in prediction of obesity while PBF and BMI criteria of WHO (2000) criteria are closely correlated in detecting obesity prevalence in Amritsar females. Hence, it can be concluded from these results that WHO ('98) criteria of BMI under-estimates prevalence of obesity when compared to WHO (2000) and PBF criteria.

TABLE 4

Discrepancy in prevalence of obesity diagnosed by BMI criteria of WHO, '98 and 2000 with PBF

PBF (60.47%)	BMI criteria of WHO ('98)	BMI criteria of WHO (2000)
	Percentage discrepancy	
	-37.21	-4.07

DISCUSSION

Obesity in India has reached epidemic proportions in the 21st century and is following a trend of other developing countries that are steadily becoming more obese (Kaur, 2014). The findings of present study indicate that the prevalence rate of obesity for the two sets of BMI criteria of WHO, used in this study was 23.26% according to WHO ('98) and 56.40% according to WHO (2000) criteria and 60.47% according to PBF criteria. The major finding of this study is the wide discrepancy (-37.21%) in the prevalence of obesity as diagnosed by PBF with BMI criteria of WHO ('98) but this discrepancy is quite less (-4.07%) while using BMI criteria WHO (2000). This shows that BMI criteria of WHO ('98) significantly under-estimates the prevalence of obesity than WHO (2000) and PBF criteria. It is also evident from literature (WHO, 2000) that BMI criteria of WHO ('98) is not appropriate for assessment of obesity for Asian populations. Present results make further addition to this information. Therefore, future studies are required for assessment of obesity, using both BMI criteria of WHO (2000) and PBF.

The results of the present study were compared with the adult females of different regions of India to facilitate a relative evaluation of obesity prevalence. Table 5 presents the prevalence of obesity in females reported in various studies in India. However, the extent of overweight and obesity reported in these studies is not strictly

comparable because of the variation in criteria of BMI used, the variation in age, and socio-economic status of subjects, their life style and periodic dissimilarities. The prevalence of obesity in the present study was found to be very close to the females of New Delhi (66.7%) as reported by Mishra *et al.* (2003). According to NFHS-3 (2006) in India, 29.6% of females have BMI less than 18.5 indicating under-nutrition and 15.3% are overweight and obese. It is

TABLE 5

Prevalence of obesity in females reported in various studies conducted in India

Area/City	Age-group	Cut-off points of BMI (kg/m^2)/PBF	Number of subjects	Percentage prevalence	Investigator
Ahmadabad	30-60	≥25-30 >30	200	16.5 22.0	Saboo *et al*., 2014
Bhopal,Central India	>20	>30	177	26.55	Nahar *et al*., 2012
Jammu (rural)	>20	>30	1135	Ow=11.63 Ob=3.35	Raina and Jaswal, 2009
Amritsar	20-25	PBF	150	36	Rana and Sidhu, ('12)
Tirupati town, Andhra Pradesh	20-70	>30	772	4.40 1.15	Reddy *et al*., 2012
N-W-S	35-69	>30	4177	20	Daniel *et al*., 2011
North India	15-39	>30	2015	14.3	Gupta and Gupta, 2009
Punjabi females	15-49	>30	3681	37.50	NFHS-3, 2006
Hindu Bengali, Kolkata	20-50	25-29.9 >30	850	37.24 17.45	Bhadra *et al*., 2005
Punjabis (urban and rural areas)	>20	25-29.9 >30	900 800	22.77 21.11	Sidhu *et al*., 2005
New Delhi	15-58	≥25	60	66.7	Mishra *et al*., 2003
Amritsar	30-50	≥25 ≥35 (PBF)	172	56.40 60.47	Present study

apparent from this report that Punjab, Kerala and Goa have high prevalence of obese females. Out of various states of India; Punjab comes at rank one with 37.5% females being overweight and obese. The overall prevalence of obesity in Amritsar females was about two times more than obesity prevalence reported by NFHS-3 (2006). Rana and Sidhu (2012) studied Amritsar young adult females (20-25 years) and reported the prevalence of obesity as 36% according to PBF which is quite less than the present sample. Saboo *et al*. (2014) studied Ahmadabad females and reported very less prevalence of overweight: 16.5% and obesity: 22%. Bhadra *et al*. (2009) worked on Kolkata, (West Bengal) Hindu females and observed the prevalence of overweight and obese as 37.24% and 17.45% respectively using WHO (2000) criteria which is again less than Amritsar females. This proves that prevalence of obesity is quite higher in Amritsar females. If the present trend continues, the situation can get worse even within a decade and obesity can emerge as a single most important health problem.

CONCLUSION

The prevalence of overweight and obesity in the current study was quite higher (BMI criteria of WHO,'98: 23.26%; WHO, 2000: 56.40%; PBF: 60.47%) than the reported prevalence in general females of India and Punjab. The obesity prevalence among females of Amritsar is comparable to the obesity prevalence reported in developed countries. This proves that the prevalence figures are alarming among females of Amritsar. If the present trends of overweight and obesity continue, then the Punjabi population may experience in the next decade a high prevalence of adulthood obesity similar to the developed countries. The prevention and control of this problem must claim priority attention because obesity is the mother of various non-communicable diseases in adult life. The purpose of assessing obesity is to identify within each population, the proportion of people with a high risk of an undesirable health state that warrants a public health intervention.

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