Assessment of Obesity using various Anthropometric Variables among Young Adult Females of Amritsar (Punjab)

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ABSTRACT
Obesity is a widespread and growing problem in developed and developing countries with significant medical, psychosocial and economic consequences. Prevalence of obesity has increased substantially in the last two or three decades worldwide. The prevalence statistics shows that obesity pandemic is penetrating even in the developing nations like India. In the present study an attempt has been made to report the prevalence of obesity on the basis of various anthropometric variables among young adult Jat-Sikh females of Punjab, ranging in age from 18-25 years. For the assessment of obesity, height, weight, waist circumference and hip circumference were taken on 150 young adult females. The prevalence of obesity was calculated according to Body Mass Index (BMI), Waist Circumference (WC), Waist-Hip-Ratio (WHR) and Waist-Stature-Ratio (WSR). The observations revealed that the prevalence of undernutrition, overweight and obesity according to BMI in young adult females was 21.3%, 20% and 10.7%, respectively. The prevalence of abdominal obesity according to the WC, WHR and WSR was 34%, 57% and 37%, respectively. The results of the comparative analysis showed that absolute prevalence of obesity vary according to the parameter used.

Keywords: *Obesity, Body Mass Index, Waist Circumference, Waist-Hip-Ratio, Waist-Stature Ratio, Young adults, Amritsar*

INTRODUCTION

Obesity is defined as a disease in which excess body fat has accumulated such that health may be adversely affected (Kopelman, 2000). It is a consequence of an energy imbalance where energy intake has exceeded over a considerable period. Obesity now-a-days has become the biggest health problems, which not only affects a person physically but psychologically also and has become an epidemic in many parts of the world. Available studies (Mokdad *et al.,* 2000; Popkin, 2002; McLaren, 2007; Musaiger, 2011) in developed and developing countries indicate that

obesity has reached at an alarming level among both children and adults. According to global estimates by WHO (2005) there were about 1.6 billion overweight person aged 15 years and above and 400 million were obese among them. The revision of definition of obesity to adjust for racial differences by WHO has resulted in higher prevalence of 1.7 billion people classified as overweight. The WHO further project that by 2015, approximately 2-3 billion adult will be overweight and more than 700 million will be obese (WHO, 2006).

During the last three-four decades, the greatest increase in obesity has been observed in populations that have been undergoing demographic transition, nutrition transition and socioeconomic transition. India, especially Punjab is a unique example of these transitions because it has undergone changes at a much faster rate than the other states of India. It is most likely, that the high consumption of food rich in fat and calories and sedentary lifestyle have played an important role in the rise of obesity. Based on the NFHS (2007) survey about 37.5% females are obese in Punjab, making Punjab the heaviest state of India.

The growing prevalence of obesity is increasingly recognized as one of the most important risk factors for the development of hypertension, type-II diabetes and lipid abnormalities, which are known to be independent risk factor for cardiovascular diseases (WHO, 2000; Marinou *et al*., 2010). Therefore, appropriate precautionary measures to prevent further progression of the problem into an epidemic are needed.

Majority of the studies in the developed and developing countries used body mass index (BMI), with a few of them using waist circumference (WC), waist hip ratio (WHR) and waist stature ratio (WSR) to measure obesity. There are numerous studies worldwide that have dealt with obesity and its consequences (WHO, 2000). However, in the Indian context, very limited information is available. Considering the economic burden and importance of overweight and obesity, documenting the patterns and trends in overweight and obesity in different Indian populations are of paramount importance. Till date there is no reliable estimate of the frequency of overweight/obesity among Jat-Sikh females of Punjab. This research paper aimed to highlight the prevalence of overweight and obesity in young adult Jat-Sikh females of Amritsar (Punjab) because females have more body fat which is presumably required in their child bearing process. The subjects included in this study were Jat-Sikh which forms the significant proportion of Punjabi population and lead a sedentary lifestyle.

MATERIAL AND METHODS

This cross-sectional study was conducted on 150 young adult Jat-Sikh female students of Guru Nanak Dev University, Amritsar (Punjab), ranging in age from 18-25 years and belonging to middle socioeconomic status. A written consent was obtained from the subjects after explaining the objectives as well as the methodology of the study. The study was approved by the ethics committee of Guru Nanak Dev University.

Information about age and socioeconomic status was collected from each subject in the pre-designed questionnaire. Four anthropometric measurements (height, weight, waist circumference, hip circumference) were taken on each individual using standard anthropometric methodology (Weiner and Lourie, 1981). The height was measured without shoes, using stadiometer with the subject standing in the eye-ear plane. The weight of the subject was measured in kilograms by making her stand on a weighing machine in minimal clothing. Height (cm) and weight (kilogram) were measured to the nearest 0.1 cm and 0.5 kg, respectively. The body mass index (BMI) was calculated using the formula, BMI=weight (kg)/height (m^2). Waist circumference was measured at the midpoint between the inferior margin of the last rib and the top of the iliac crest. Hip circumference was measured at the largest posterior extension of the buttocks. Waist and hip circumferences were measured to the nearest 0.1 cm.

The waist-hip-ratio was calculated using the following formula:

$$\mathbf{WHR} = \frac{\text{Waist circumference (cm)}}{\text{Hip circumference (cm)}}$$

The waist-stature-ratio was calculated using the following formula:

$$\mathbf{WSR} = \frac{\text{Waist circumference (cm)}}{\text{Height (cm)}}$$

Obesity was assessed according to the following criteria of BMI of WHO (2000).

BMI	Category
<18.5 kg/m^2	Underweight
18.5-22.9 kg/m^2	Normal
23-24.9 kg/m^2	Overweight
25-29.9 kg/m^2	Obese Class I
>30 kg/m^2	Obese Class II

The assessment of abdominal obesity among Jat-Sikh females was done using criteria for WC and WHR given by Snehalatha *et al*. (2003) according to which the subjects having WC ≥80 cm and WHR ≥0.81 were abdominally obese. The criteria used for WSR was given by Hsieh and Muto (2004) according to which the individuals having WSR ≥ 0.50 were abdominally obese. The data was analyzed (Mean and Standard Deviation) using Statistical Software for Social Science for windows version 16.0(SPSS inc., Chicago, IL).

RESULTS

Table 1 shows the characteristic of the study participants depicting the mean and standard deviation of the anthropometric and derived variables. Mean BMI in the present sample was 21.35 ± 3.40 kg/m^2. **Table 2** presents the distribution of all subjects according to BMI classification of WHO (2000). On using the lower cut off value of BMI for Asians, out of 150 Jat-Sikh females, 21.3% were underweight, 48% normal, 20% overweight and 10.7% were obese. In other words the prevalence of overall combined overweight and obesity among young adult females was 30.7%. In this study prevalence of abdominal obesity was estimated with the help of Waist Circumference (WC), Waist-Stature-Ratio (WSR) and Waist-Hip-Ratio (WHR). According to WC and WSR, 34% and 37% females were abdominally obese, respectively while according to WHR about 57% females were abdominally obese (**Table 3**). The comparative profile for general and abdominal obesity among young adult females showed that in the present study the prevalence of abdominal obesity is higher than the general obesity.

DISCUSSION

The mean value of BMI (Table 1) of the young adult females was 21.35 ± 3.40 kg/m^2 which was slightly more than the national average 20.5 kg/m^2 but less than the mean value of BMI for adult women of Punjab according to NFHS-3 (2007). The combined prevalence of undernutrition in young adult females (Table 2) was 21.3% while according to NFHS-3 (2007), 18.9% women in Punjab suffer from undernutrition compared with 35.60% in India as a whole. This shows that

Table 1. Characteristics of the Study Participants.

CHARACTERISTIC	MEAN	SD
Age (years)	21.79	1.41
Weight (kg)	53.56	9.07
Height (cm)	158.36	5.86
Waist Circumference (cm)	76.75	9.04
Hip Circumference(cm)	95.48	6.64
BMI(kg/m^2)	21.35	3.40
Waist Hip Ratio	0.79	0.06
Waist Stature Ratio	0.48	0.05

TABLE 2. Percentage prevalence of undernutrition, overweight and obesity in the sample according to WHO (2000) criterion.

BMI (kg/m^2)	Number	Percentage Prevalence
Underweight (>18.5)	32	21.3
Normal (18.5-22.9)	72	48.0
Overweight (23.0- 24.9)	30	20.0
Obese (≥25)	16	10.7
Total	150	100

Table 3. Percentage prevalence of abdominal obesity in the sample.

Anthropometric Indicators	Number	Prevalence
WC (cm) ≥80	51	34.0
WSR ≥0.50	56	37.0
WHR ≥0.81	86	57.0

the prevalence of undernutrition is quite high even in the young adult Jat-Sikh females of middle socioeconomic group. The prevalence of overweight (20%) was almost double than the prevalence of obesity (10.7%). According to NFHS-3 (2007) report about 29.9% women of Punjab were overweight and obese. This shows that young adult Jat-Sikh females of Amritsar suffer from double burden of malnutrition that is undernutrition and overnutrition. Khor (2008) also reported that double burden of malnutrition is a serious problem in various Asian countries.

The data on prevalence of overweight and obesity according to BMI from some regions of India are shown in **Table 4**. It was apparent from this table that all these studies were done on adult females ranging in age from 20-60 years. The prevalence of obesity in India ranged from 17.45%

Table 4. Percentage prevalence of obesity on the basis of BMI in Indian and Punjab population.

State	Age (years)	Sample size	Criteria used	Percentage prevalence	Investigator
New Delhi	35-64	Urban: 1456 Rural: 1070	≥25	Urban: 48.0 Rural: 40.0	Reddy *et al.* (2002)
Adult Punjabi females, Punjab	≥20	1000	25-29.9 ≥30	20.0 25.3	Sidhu and Tatla (2002)
Punjabi Bhatia, Jaipur	20-60	232	≥25 ≥30	69.40 32.40	Gupat *et al.* (2004)
College girls, Punjab	≥18	500	25-29.9 ≥30	28.20 15.0	Sidhu and Prabhjot (2004)
Bengalee Hindu women	≥20	854	25-29.9 ≥30	37.24 17.45	Bhadra *et al.* (2005)
Punjabi urban females, Punjab	≥20	900	25-29.9 ≥30	22.7 21.11	Sidhu *et al.*(2005)
West Bengal	≥20	110	≥25	71.80	Das and Bose (2006)
Tangkhul Naga Tribal women	20-70	346	≥25	27.10	Mungreiphy and Kapoor (2008)
Working pre-menopausal women of Jalandhar	≥30	330	≥25	70.30	Kokhar *et al.* (2010)
Amritsar	18-25	150	25-29.9 ≥30	Ow: 20.0 Ob: 10.6	Present study

among Bengalee Hindu females (according to BMI ≥30 kg/m^2) to 70.30% among working pre-menopausal women of Jalandhar, Punjab (according to BMI ≥25 kg/m^2). The most comprehensive data on the prevalence of obesity in India were provided by Gopinath *et al.* (1994) who studied urban women of Delhi and reported the prevalence of obesity as 33.4%. A study by Nutrition Foundation of India (1998) has shown the prevalence of overweight and obesity as 50% and 14%, respectively. Females belonging to high socioeconomic status of Hyderabad (Rao *et al.,* 1995) were reported to be 36.3% obese. The prevalence of overweight was reported as 21.9% in Varanasi females (Asthana *et al.,* 1998). A study by Satwanti *et al.* (1980) showed the prevalence of overweight in Punjabi Khatri females as 17.4% and a study by Tondon (2006) showed it to be 30.6%. It reflects an increase of 13.5 points over a period of 26

years. It shows either more energy intake than expenditure or the physical activities undertaken are less than the energy consumption in the present time. A study in Punjab by Sidhu and Tatla (2002) also reported the prevalence of overweight and obesity as 20.0% and 25.3%, respectively. In another study by Sidhu *et al.* (2005) the prevalence of obesity in Punjabi urban adult females was 21.1%. This comparative profile of obesity clearly indicates that in young adult Jat-Sikh females of the present study the prevalence of overweight and obesity was slightly less than what has been reported in other studies of Punjab but comparable with other Indian population. However, the extent of overweight and obesity reported in these studies is not strictly comparable because of the variation in the age of the subjects, the criteria of BMI cut off points used, socioeconomic status of subjects and population variation. Indeed the combined prevalence of overweight/obesity was quite alarming in these young adult females. This is probably a consequence of nutritional changes that Punjabi population experienced especially during the last two-three decades due to green revolution and white revolution (PSCT, 2005), urbanization and modernization.

WC, WHR and WSR are important indices to assess abdominal obesity. WC is a convenient and simple measurement i.e., an appropriate index of intra abdominal fat mass and total body fat while WHR is an indicator of abdominal fat accumulation (WHO, 2000). According to Ashwell and Hsieh (2005); Panjikkaran and Kumari (2012), WSR is a simple screening index to assess abdominal obesity and associated diseases. WC as a measure of obesity suffers from the disadvantage of not considering important criteria such as body weight and height so WSR can also be used as an indicator of obesity.

The prevalence of abdominal obesity in the present sample according to WC, WHR and WSR was 34%, 57% and 37%, respectively. The comparative profile of prevalence of abdominal obesity on the basis of WC in some Indian populations is given in **Table 5**. The prevalence of abdominal obesity in these studies ranged from 55.15% in the Bengalee women to 75.15% in working pre-menopausal women of Jalandhar. The comparative profile of prevalence of abdominal obesity on the basis of WHR in some Indian populations is given in **Table 6**. The prevalence of abdominal obesity in these studies ranged from 40.0% in females of New Delhi to 80.2% in Punjabi Bhatia families in Jaipur. It is evident from the present results that the prevalence of abdominal obesity according to WC and WHR are lower in the young adult females than other populations of India. Undoubtedly, these large differences in prevalence rates

could be due to different measurement techniques and the cut off points used for defining obesity. Unfortunately, there is no report in the current literature regarding the prevalence of obesity on the basis of WSR on Indian females.

Table 5. Percentage prevalence of abdominal obesity on the basis of WC in Indian population.

City	Age group	Sample size	Criteria used	Percentage prevalence	Investigator
Urban slum population, Delhi	≥20	573	70-80 cm	68.4	Gupta *et al.* (2002)
Punjabi Bhatia family, Jaipur	20-60	232	≥88 cm	55.60	Gupta *et al.* (2004)
Bengalee women	20-50	854	≥72 cm	55.15	Bhadra *et al.* (2005)
Working pre-menopausal women of Jalandhar	≥30	330	≥80 cm	75.15	Kokhar *et al.* (2010)
Amritsar	18-25	150	≥80 cm	34.0	Present study

Table 6. Percentage prevalence of abdominal obesity on the basis of WHR in Indian population.

City	Age group	Sample size	Criteria used	Percentage prevalence	Investigator
Urban slum population of northern India	20-60	443	≥0.85	Upper class: 50.0 Middle class: 49.0 Lower class: 50.0	Gopalan (1998)
New Delhi	35-64	Urban: 1456 Rural: 1070	≥0.80	Urban: 40.0 Rural: 36.0	Misra *et al.* (2001)
Punjabi Bhatia family, Jaipur	20-60	232	≥0.80	80.2	Gupta *et al.* (2004)
Bengalee women	20-50	854	≥0.85	42.39	Bhadra *et al.* (2005)
West Bengal	≥20	110	≥0.80	41.80	Das and Bose (2006)
Working pre-menopausal women, Jalandhar	≥30	330	≥0.80	74.54	Kokhar *et al.* (2010)
Amritsar	18-25	150	≥0.81	37.0	Present study

According to this study, WHR identified more number of abdominally obese subjects than WC and WSR. On the other hand, WSR and WC estimated almost similar number of subjects as abdominally obese. Thus, the present study (Table 2 and 3) indicate that the percentage prevalence of adult females classified as abdominally obese varies considerably depending on the obesity variables used. Similar results have been reported by Misra *et al.* (2001), Reddy *et al.* (2002), Gupta *et al.* (2004), Bhadra *et al.* (2005), Das and Bose (2006). It is interesting to note that prevalence of abdominal obesity according to WHR was found to be higher than the general obesity according to BMI. Similar results have also been reported by Gopalan (1998), Sidhu *et al.* (2002) and Bhadra *et al.* (2005). The findings of the study shows that the young adult Jat-Sikh females are at increased risk of overweight/obesity and this may increase the prevalence of obesity related co-morbidities in Punjab. Future research is needed to identify risk factors associated with obesity.

Since, the present study is cross-sectional and restricted only to Jat-Sikh females, further longitudinal studies considering all obesity variables on the other caste group and males are necessary for effective prevention and management of obesity.

ACKNOWLEDGEMENT

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