



## Body mass index (BMI), waist circumference (WC) and obesity in the resident adults of Raipur District (Chhattisgarh state: India)

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### Abstract

Obesity is a medical condition characterized by accumulation of excess body fat leading to negative health consequences and reduced life expectancy. The latter could be attributed to various diseases, particularly cardiovascular diseases, diabetes mellitus type 2, obstructive sleep apnea, certain types of cancer and osteoarthritis. The present investigation was undertaken to evaluate obesity, appraised by BMI, in the Raipur District of Chhattisgarh State, India. A multiphase stratified random sampling method was performed on 688 adults of both sexes, with mean age 34yrs  $\pm$  16, from June to September 2011. Anthropometric measurements were recorded using standard instruments (weight scale and stadiometer). BMI was calculated using the statistical software SPSS version 20.0. The results divulged 19.91% of the adults to be overweight and 57% of them as obese. Amongst the male subjects, 23.55% and 7.97 %; and in case of females, 17.47% and 8.90 % were marked as overweight and obese respectively. As evident from the results, 8.5% were obese and another 20% are being overweight which could lead to future obesity, which is significantly associated with increased likelihoods of having depressive symptoms and an array of other cardiac diseases. Thus, lifestyle and mental health status could well be monitored and evaluated in the obese and overweight subjects in order to prevent the several disorders associated with obesity.

**Keywords:** Obesity, Overweight, Body Mass Index (BMI), Raipur, Chhattisgarh.

### INTRODUCTION

Obesity has become a global epidemic and public health crises (Kopelman, 2007). It has also been associated with socio-economic class (Stewart et al, 2003; Finkelstein et al, 2005 and Vyas and Kumaranayake, 2006). The risk of death from all causes enlarges throughout the range of moderate and severe increase of body weight for both men and women in all age groups (Calle et al., 1999). The World Health Organization (WHO) describes obesity as "one of today's most blatantly visible—yet most neglected—public health problems" and uses the term "globesity" to reflect an "escalating global epidemic of overweight and obesity" (WHO, 2008a). The International Obesity Task Force (IOTF) terms obesity the "millennium disease," highlighting the major international impact of this condition (International Obesity Task Force, IOTF 2008).

In fact, obesity is now a pandemic, affecting both adults and children in developed and developing countries. In 2000, a table of age- and sex specific cut off points based upon a compilation of nationally representative cross-sectional growth studies from a number of countries was developed (Cole et al., 2000; Wang and Beydoun, 2007 and Wang et al 2008).

The risk of death from all causes enlarges throughout the range of moderate and severe increase of body weight for both men and women in all age groups (Calle et al., 1999). The overwhelming prevalence of obesity in developed, developing and first world

nations has lead public health experts to call this increase in adiposity the world's largest and fastest growing epidemic. Overweight children have a tendency to remain overweight as adults or progress to obese state and carry with them an array of obesity-related health problems throughout life. Overweight and obese adults have a 50%-100% increased risk of all-cause mortality, primarily attributed to cardio-metabolic disease when compared to normal-weight individuals (Guh et al., 2009). Severe obesity may also reduce life-expectancy in today's youth, causing them to live shorter lives than their parents (Olshansky et al., 2005). Furthermore, obese individuals are susceptible to the many cardiovascular, metabolic, pulmonary, musculo-skeletal, gastrointestinal and psychosocial disorders that accompany increased adiposity such as hypertension, diabetes, sleep apnea, osteoarthritis, fatty liver disease and depression. Obesity has been reported to be associated with higher mortality and morbidity (Lew and Garfinkel, 1979; Waaler, 1984; Fitzgerald and Jarrett, 1992 and Kopelman, 2007) and morbidity (Chaing et al., 1969; Noppa et al., 1978; Garrison et al., 1980; Hubert et al., 1983; Kannel et al., 1991; Guh et al., 2009).

Studies on the various aspects of obesity have been done earlier by many workers, Reports pertaining to obesity in Asia and particularly in India are few some of them are Janghorbani and Parvin, 1998); Parizkova and Hills (2001); Shahbazpour (2003); Afridi, et al (2003); Weiss et al., (2004); Jazayeri (2005); Barkail (2006); Hadaegh et al., (2007); Gholamreza and Mohsen, 2007); Veghari and Golalipour, (2007); Alhamdan (2008). Parisi and Goodman (2008); Paknahad et al (2008); Ekelund et al., (2009); Wong et al, (2009); Opara, et al 2010); Adebowale et al (2011); Veghari (2011); Hidayah and Bariah, 2011); Hassanzadeh et al (2011); Odenigbo et al (2011); Olusanya and Omotayo, 2011). Reports pertaining to obesity in Asia, particularly in India are few. The present study was conducted at the Raipur District 22, 33' N to 21, 14' N latitude and 82, 6' to 81, 38' E longitude with a total

Received: Jan 10, 2012; Revised: Feb 18, 2012; Accepted: March 15, 2012.

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geographical area of 226 sq. km, targeting the resident adults in order to assess the prevalence of overweight and obesity. Statistical analysis to assess obesity in different age groups with respect to gender, considering their socio-economic status is also provided.

## MATERIALS AND METHODS

### Study Design and Participants

A cross-sectional study was conducted in Raipur district targeting 688 adults. A multiphase stratified random sampling method was performed on the adults of both sexes, with mean age  $34 \pm 16$ , from June to September 2011, after taking their written consent for anthropometrics and to take on the questionnaire to assess socio-economic status. Information regarding socio-economic status and age of the participants were recorded (Vyas and Kumaranayake, 2006). The work has been approved by the local IEC (Institutional Ethics Committee) of Govt' DB Girl's Postgraduate College, Raipur (C.G) for monitoring research on human participants

### Statistical Analysis

General characteristics of the subjects including gender were processed by Surveymeans and Surveyfreq procedures. Continuous variables were presented as mean (standard error) and categorical variables were presented as a weighted percent (standard error). Body Mass Index (BMI) was calculated to assess the normal, underweight, overweight and obese individuals among the total subjects, subjects from different socio-economic and age groups with respect to their gender. The statistic packet SPSS/PC version 20.0 for windows was used for analysis.

### Anthropometric measures

The fasting body weight and height were measured following standardized procedures. Height was measured to the nearest 0.1 cm on a stadiometer with the subject standing barefoot. Body weight was measured to the nearest 0.1 kg on a balanced scale while the subject wore a lightweight gown or underwear. Body mass index (BMI) ( $\text{kg}/\text{m}^2$ ) was calculated as weight (kg) divided by height squared ( $\text{m}^2$ ). Waist circumference (WC) was measured to the nearest 0.1 cm at the midpoint between the lowest rib and the uppermost lateral border of the right iliac crest (Messiah *et al.*, 2008).

### BMI, WC and Obesity Assessment

Subjects having a BMI greater than or equal to  $25 \text{ kg}/\text{m}^2$  and below  $30 \text{ kg}/\text{m}^2$  were considered overweight whereas a BMI greater than or equal to  $30 \text{ kg}/\text{m}^2$  were considered as obese (Flegal *et al.*, 1998 and WHO, 2008b). According to the World Health Organization (WHO), the definition for abdominally overweight and obesity is a WC of greater than or equal to 80 cm and 88 cm, respectively, for

females and 94 cm and 102 cm, respectively, for males. These definitions are consistent with those of the Adult Treatment Panel Report-III (ATP-III) Guidelines (National Heart, Lung and Blood Institute and the World Health Organization Expert Panel on the identification, evaluation and treatment of overweight and obesity, 1998 and World Health Organization: Obesity: preventing and managing the global epidemic. World Health Organization Technical Report Series No. 894; Geneva; WHO, 2008b ).

### Socio-economic Status

Socio-economic status of the participants was assessed using a standard questionnaire mentioned elsewhere (Stewart *et al.*, 2003; Finkelstein *et al.*, 2005; Vyas and Kumaranayake, 2006 and Kolenikov and Angeles, 2009).

## RESULTS

The study revealed that 19.91% of the total 688 human subjects studied were overweight and 8.57% were marked as obese (Table 1 and Figure 1). Furthermore, among the male subjects 23.55% and 7.97%; and in case of female's subjects 17.47% and 8.9 % were overweight and obese respectively (Table 2 and Figure 2). Detailed analysis of the results revealed 26.70% and 13.35% of the subjects from upper economic class and 12.79% and 3.57% from the lower economic class were found to be overweight and obese respectively (Table 3 and Figure 3). Different age groups- A (18-28 yrs.), B (29-38 yrs.), C (39-50 yrs.), revealed 75.80%, 4.30%, 14.51% and 5.37% of the subjects to be normal, underweight, overweight and obese respectively in group A, among which in the case of overweight subjects 33.33% were males and 66.66% were females, while among the obese subjects 30% were males and 70% were females; similarly in the age group B, 73.02%, 1.79%, 17.62% and 7.55% and of the subjects to be normal, underweight, overweight and obese respectively, among which in the case of overweight subjects 51.02% were males and 48.98% were females, while among the obese subjects 33.33% were males and 66.66% were females; whereas in the age group C, 58.92%, 1.33%, 27.23% and 12.5% of the subjects were found to be normal, underweight, overweight and obese respectively, among which in the case of overweight subjects 35.22% were males and 22.05% were females, while among the obese subjects 42.85% were males and 57.14% were females (Table 4 and Figure 4). Significant results were obtained when age and gender adjusted changes in BMI and WC were compared using ANOVA. The Body Mass Index (BMI) and Waist Circumference (WC) values were highest in the age group 39-50 years whereas, in the age group 18-28 years it was lowest in both, male and female subjects (Table 5). A summary of values observed for underweight, overweight, obese subjects along with their normal counterparts with regards to their gender, socio-economic status and age groups has been presented in Table 6.

Table 1.Total and Percentages of the Underweight (UW), Overweight (OW), Obese and Normal Subjects (n=688).

S.No.	Category	Number of Individuals	Percentage
1	Underweight	28	4.07
2	Normal	464	67.44
3	Overweight	137	19.91
4	Obese	59	8.57
5	Total	688	100

Table 2. Gender wise distribution of Underweight, Overweight, Obese and Normal Subjects (n=688).

S.No.	Category	Males		Females	
		Number	Percent	Number	Percent
1	Underweight	9	3.26%	19	4.61
2	Overweight	65	23.55	72	17.47
3	Obese	22	7.97%	37	8.9%
4	Normal	180	65.21	284	68.93
5	Total	276	100%	412	100%

Table 3. Total number and percentages of underweight, overweight, obese and normal subjects on the basis of their socio economic classes.

Obese	Category	Upper Class	Lower Class
1	Underweight	5 (1.42%)	11 (3.27%)
2	Overweight	94 (26.70%)	43 (12.79%)
3	Obese	47 (13.35%)	12 (3.57%)
4	Normal	206 (58.52%)	270 (80.35%)
5	Total	352	336

Table 4. Total number and percentages of underweight, overweight, obese and normal subjects.

S.No	Category	(A) 18-28 Yrs.	(B) 29-38 Yrs.	(C) 39-50 Yrs.
1	Underweight	8 (4.30%)	5 (1.79%)	3 (1.33%)
2	Overweight	27 (14.51%)	49 (17.62%)	61 (27.23%)
3	Obese	10 (5.37%)	21 (7.55%)	28 (12.5%)
4	Normal	141 (75.80%)	203(73.02%)	132(58.92%)
5	Total	186	278	224

Table 5. Body Mass Index (BMI) and Waist Circumference (WC) of males and females.

Age, Years	Males		Females			
	(n)	BMI	WC	(n)	BMI	WC
18-28	82	21.50±2.94 (20.85-22.14)	83.76±3.43 (83.01-84.52)	104	21.23±2.61 (20.53-21.94)	82.24±4.58 (81.34-83.13)
29-38	106	23.87±3.01 (23.29-24.45)	87.58±8.49 (85.94-89.22)	172	23.35±3.10 (22.88-23.82)	84.84±5.74 (83.97-85.70)
39-50	88	26.47±2.71 (25.89-27.04)	95.38±6.4 (94.02-96.74)	136	26.43±4.23 (25.71-27.15)	92.56±6.79 (91.41-93.71)
Total	276	23.99±3.48 (23.58-24.40)	88.93±8.1 (87.97-89.90)	412	23.83±4.1 (23.43-24.24)	86.73±7.21 (86.03-87.43)

Data are represented as Mean ±SD (95% CI) values. Mean BMI and WC values according to age and gender.

Table 6. Consolidated table of Gender, Socio-economic Class and Age variables of the sample size studied (n=688) showing percentages of Underweight, Overweight, Obese and Normal Subjects.

S.No	Category	Distribution	Group	Number (%)
1	Underweight	Gender	Males	9 (32.14)
			Females	19(67.85)
		Economic Class	Upper	6(21.42)
			Lower	22(78.57)
		Age Group	A-18-28	20(71.42)
B-19-38	5(17.85)			
C-39-50	3(10.71)			
2	Overweight	Gender	Males	65(47.44)
			Females	72(52.55)
		Economic Class	Upper	94(68.61)
			Lower	43(31.38)
		Age Group	18-28	27(19.70)
19-38	49(35.76)			
39-50	61(44.52)			
3	Obese	Gender	Males	22(37.28)
			Females	37(62.71)
		Economic Class	Upper	48(81.35)
			Lower	12(20.33)
		Age Group	18-28	105(16.94)
19-38	217(35.59)			
39-50	281(47.45)			
4	Normal	Gender	Males	180(38.79)
			Females	284(61.20)
		Economic Class	Upper	279(60.12)
			Lower	186(40.08)

		Age Group	18-28	129(27.80)
			19-38	202(43.53)
			39-50	134(28.87)
5	Total	Gender	Males	276(40.11)
			Females	412(59.88)
		Economic Class	Upper	425(61.73)
			Lower	263(38.22)
		Age Group	18-28	186(27.03)
		19-38	278(40.40)	
		39-50	224(32.55)	

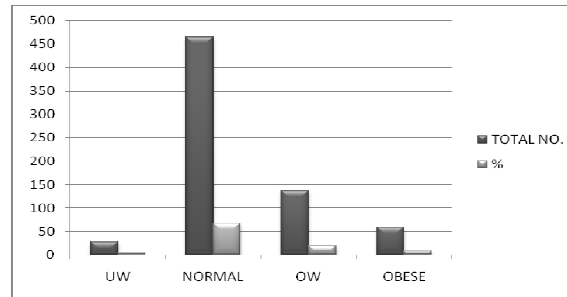


Fig 1. Percentages and number of Underweight (UW), Overweight (OW), Obese and Normal Subjects (n=688).

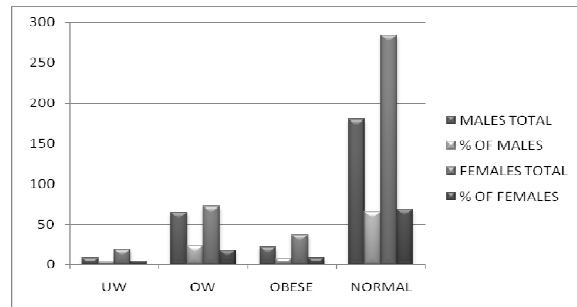


Fig 2. Percentages of Underweight (UW), Overweight (OW) and Obese and Normal subjects. Males (n=276) and Females (n=412).

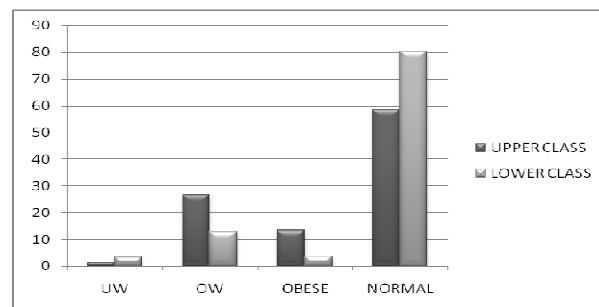


Fig 4. Percentages of Underweight, Overweight, Obese and Normal groups among the human subjects of upper (n=352) and lower (n=336) economic class.

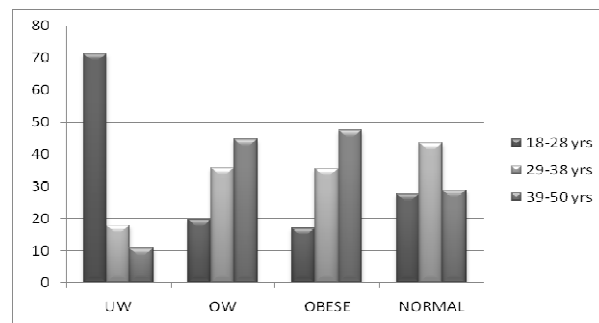


Fig 4. Histogram showing percentages of Underweight (UW), Overweight (OW), Obese and Normal Subjects of the age groups- 18-28 yrs., (n=186); 29 to 38 yrs., (n=278); and 39-50 yrs., (n=224).

## DISCUSSION

The present study is an effort towards assessment of overweight and obesity in the adult population of Raipur district of Chhattisgarh state. The percentages of overweight and obese subjects among the sample size studied can well serve as a precautionary measure to vary the ongoing lifestyle in order to combat overweight and obesity. The overweight percentages observed are quite alarming in the sense that, they provide a foresight into the future obese population of a region. Overweightness can well lead to obesity in a span of time. Other developed countries are also experiencing similar increases and less developed countries also show increases in obesity as they become more affluent (Knowler et al., 2002). The present study also reflects the differences in the prevalence of obesity and overweight, gender-wise in various age-groups as well as in different socio-economic classes. The higher percentages observed in the higher socio-economic groups of the sample size may refer to their obligation for a change in lifestyle. Relatively, little is known about the precise causes of these trends (Taubes, 1998; Martinez 2000; Sorenson, 2002). Although they must reflect energy imbalances in the sense that energy intake must exceed energy expenditure for weight to increase, the nature of the imbalances is not clear. Both dietary intake and physical activity are difficult to measure and trends in these factors are not easy to evaluate. A more fundamental problem is to identify the social, economic and cultural forces leading to energy imbalance. Advances in technology, changes in work life, the advent of computers, trends in eating out vs food preparation at home, time pressures, fear of crime, decreases in tobacco use and many other factors have been suggested, but definitive data are lacking that would clearly associate changes in these factors with the increase in obesity on an individual basis. The increases in overweight and obesity raise questions about the implications of these trends for health outcomes. Obesity is a risk factor for many chronic conditions including diabetes, hypertension, hypercholesterolemia, stroke, heart disease, certain cancers and arthritis. Out of these health conditions, diabetes may be most closely linked to obesity and its prevalence appears to have increased as the prevalence of obesity increased (Harris et al 1998). The increasing incidence of diabetes worldwide is of considerable concern (McKinlay and Marceau, 2000). Clinical trials have demonstrated that a structured lifestyle intervention including dietary change, weight loss and increased physical activity can reduce the risk of progressing to diabetes mellitus from impaired glucose tolerance (Tuomilehto et al., 2001) Obesity is a risk factor for these conditions; however, not everyone with these conditions is obese and not all obese people have these conditions [Anonymous (1997); National Cholesterol Education Program (2002)]. There are several risk factors other than obesity for most of these health conditions and intervening on these other risk factors may be necessary. Changes in other risk factors might also affect trends in these health conditions. It is also possible that some of the conditions associated with obesity may respond to interventions such as change in the fat content of the diet or increases in physical activity that are not necessarily accompanied by large changes in body weight. Relatively little is known about the prevention and treatment of overweight and obesity on a population-wide basis (Douketis et al., 1999; Jeffery, 2001). Furthermore, management of obesity and related risk factors can be achieved to some extent by the use of

medicinal plants. Studies on obesity markers are immensely required in order to track the condition and to prevent the associated risk factors. Study showed the presence of 8-hydroxy-2-deoxy Guanosine as an oxidative Marker in Obese Adolescents of Giza. There is also an immense need of various structured programs that emphasize lifestyle changes, including education, reduced fat and energy intake, regular physical activity and regular expert contacts with participants, which re found to produce modest long-term weight loss on the order of 5% to 10% of starting weight (Wing et al., 2001; Shayo and Mugusi, 2011).

## ACKNOWLEDGEMENTS

Sincere thanks are due to the Principal, Govt' DB Girl's PG College, Raipur and the Head of the Department, Zoology Department, Govt' DB Girl's PG College, Raipur for providing research facilities. One of us, Varsha Singh is thankful to all the human subjects who provided positive consent for recording anthropological measurements and other vital details. Finally, we thank the University Grants Commission, Central Regional Office, and Bhopal for funding a series of research projects to our department.

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