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METABOLICALLY HEALTHY BUT OBESE OR METABOLLICALLY OBESE BUT NORMAL WEIGHT : DEBATE ON HEALTH

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ABSTRACT: Obesity has been associated with increased morbidity and mortality. The indicators used for assessment of nutritional status and risk of metabolic syndrome are body mass index and central obesity by waist circumference and waist to hip ratio. Subtypes of obesity have been a recent topic of debate in field of obesity research. Among these subtypes one is metabolically healthy obese (MHO) characterized by high BMI and normal WHR and the other is defined by normal BMI(< 25kg/m^2) and high WHR *i.e.*metabolically obese normal weight (MONW). The present study was conducted to assess prevalence of MHO and metabolically obese normal weight MONW individuals among those visiting weight reduction centers for losing weight. Among the 624 participants visiting such centers, 19.9% males and 13.9% females were MONW. On the contrary, 54% males and 78% females were MHO. Overall females had a higher BMI than males whereas males had greater central adiposity.

Key Words:

INTRODUCTION :

The risk functions for obesity, (defined as the quantitative relation between degree of obesity throughout its range and the risk of health problems) have been used to define 'obesity' as an excess storage of fat in the body to such an extent that it causes health problems leading to increased mortality . Obesity has become one of the major contributors to the global burden of disease, increasing the risk of metabolic syndrome and risk of morbidity and mortality from cardiovascular diseases, type 2 diabetes and some cancers . Body Mass index (BMI), Waist Circumference (WC) and Waist Hip Ratio(WHR) have been used for assessment of nutritional status and risk factors of metabolic syndrome.

BMI is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults. It is defined as the weight in kilograms divided by the square of

the height in meters (kg/m^2). WHO classifies BMI over 25 as overweight and BMI over 30 as obese . For Asian populations, additional trigger points for public health action were identified as 23kg/m^2 or higher, representing increased risk and 27.5kg/m^2 or higher as representing high risk .

According to , Waist circumference and Waist-to-hip ratio are both related risk of all-cause mortality, throughout the range of adult BMIs; waist circumference and waist-to-hip ratio are strongly predictive in young and middle-aged adults compared to older people and those with low BMI; waist circumference alone could replace waist-hip ratio and BMI as single risk factor for all –cause mortality.

PURPOSE: The present study was conducted to assess prevalence of MHO and MONW individuals among those visiting weight reduction centers, in Jaipur city.

METHODOLOGY: All the individuals visiting commercial weight reduction and fitness center with the purpose of weight loss in the age group of 20-60 years and willing to participate in the study were included in the study. Anthropometric indices such as height (m), weight (kg), waist circumference (cm) and hip circumference (cm) were assessed for all subjects. These indicators were used to calculate body mass index (kg/m^2) and waist –to-hip ratio which indicate the grade of obesity and central adiposity for subjects.

Height was measured using height-o-meter and weight was measured using a digital weighing scale. Waist and hip circumference were measured using non-elastic, non-stretchable, flexible measuring tape. Standard procedures as described by were used. BMI was calculated using height and weight; waist-to-hip ratio was calculated using waist and hip circumference. Statistical tests of mean, standard deviation, percentage, t-test and correlation were applied.

RESULTS AND DISCUSSIONS: A total of 624 subjects were enrolled for the study, comprising 310 males and 314 females. These subjects were trying to lose weight with help of structured weight loss programs.

Table 1 depicts the age and gender wise profile of the patients. Approximately, 49.7% participants were males and 50.3% participants were females. They were categorized into two age categories: 20-40 years and 40 – 60 years. In the age group of 20-40 years 39.9 % were males and 60.1 % were females. In the age group of 40-60 years 60.1% were males and 39.9 % were females. Higher numbers of subjects were in the age group of 20-40 years as compared to 40-60 years.

Table 1: Age and Gender Wise Percent Distribution of Subjects

Age in Years	Males (n = 310)	Females (n = 314)	N= 624
20-40(n= 323)	39.93 (129)	60.06 (194)	51.76 (323)
40-60 (n= 301)	60.13 (181)	39.86 (120)	48.24 (301)
N=624	49.68 (310)	50.32 (314)	100 (624)

*Figures in parenthesis denote numbers

Table 2 presents mean ± SD for different variables for males and females. Females had a significantly lower age, height, weight; waist circumference and waist-to-hip ratio than males. BMI for females was significantly higher as compared to BMI for males.

Figure 1 illustrates that females had a higher BMI than males in both the age groups and there was a steep increase in the BMI of females with age. Males did not show such a rise in their BMI values with age. In a study of 23,627 UK adults aged 18–99 (99% ≤ 70) years, of which 11,582

Table 2: Age and Gender Wise Mean Variables

Variable	Gender	20-40 yrs (n=323)	40-60 yrs (n=301)	t
Age (yrs.)	Male	30.99± 5.08	49.69± 6.21	7.75**
	Female	28.86 ± 5.80	48.03 ± 5.72	
Height (m)	Male	1.73± 0.06	1.69± 0.14	
	Female	1.58 ± 0.06	1.54 ± 0.16	19.47**
Weight (kgs)	Male	79.84± 17.02	78.39± 13.65	6.04**
	Female	70.79 ± 13.20	73.19 ± 14.63	
BMI	Male	27.04± 4.25	27.31± 3.86	5.95**
	Female	28.31 ± 5.27	30.54 ± 4.91	
WC (cm)	Male	94.20 ± 7.04	99.12 ± 8.35	16.09**
	Female	86.10 ± 9.71	93.11 ± 10.30	
HC (cm)	Male	104.32 ±8.76	104.50 ± 7.25	1.75^{NS}
	Female	105.21 ± 10.08	108.46 ± 11.05	
WHR	Male	0.90 ± 0.06	0.94 ± 0.10	12.01**
	Female	0.82 ± 0.10	0.86 ± 0.12	

*Significant at 5% level **Significant at 1% level NS Not significant

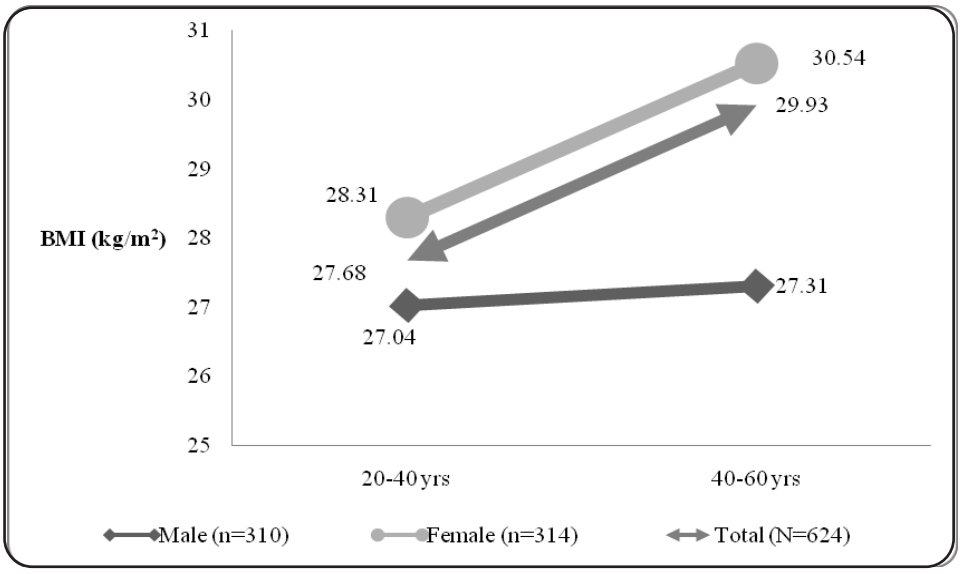


Figure 1: Age and Gender-Wise Mean BMI (kg/m^2) of Subjects

were males with a mean BMI of 26.3 ± 4.7 kg/m^2 and 12,044 females, with a mean BMI of 25.7 ± 5.1 kg/m^2; it was found that BMI progressively increased with age in women and plateaued between 40 and 70 years in men (Meeuwsen*etal.*, 2010).

Figure 2 presents percent distribution of subjects on basis of increased risk of co-morbidities on basis of WHO cut off for global population and Asians. BMI cut off values for increased risk of comorbidities have long been identified as BMI value above 25 kg/m^2. Early in this decade, WHO identified Asians to be at an increased risk of degenerative diseases at a lower BMI (≥ 23 kg/m^2) . When analyzed on the basis of WHO global cut off value (25 kg/m^2) males in the 'increased risk' category for the two age group categories were 68.2 % and 73.5 %, respectively. Similarly, 76.8 % and 86.7 % females were at increased risk of comorbidities in the two age groups in respective order. When assessed on basis of WHO cut off for Asians 85.3 % and 88.4 % males were above the cut- off point of 23 kg/m^2in the two age groups.For females these values were 88.1 % and 95.8 %, indicating a high risk for Indians.

Grades of Obesity: Table 3 represents age-wise and gender-wise distribution of participants as per their BMI cut off points.In the age group of 20-40 years 31.8 % males had normal BMI, 47.3 % males were pre-obese followed by 14 % obese grade I and 7 % obese grade II. Females in the age group of 20-40 years had the following per cent distribution – 23.20 % (normal), 50 % (obese), 17% (obese class I), 6.2 % (obese class II) and 3.6 % (obese class III). In the age group of 40-60 years, 26.5 % males and 13.3 % females had normal BMI, followed by 50.8 % males and 35.8 % females in pre-obese grade. Obese grade I comprised of 18.2 % males and 30.8 % females. Seven per cent males and 17.5 % females were falling in obese grade –II. Obese grade III com prised of 0.6 % males and 2.5 % females.

Majority of the subjects were thus falling in the 'pre-obese' category which is an indication of future burden of obesity as these participants

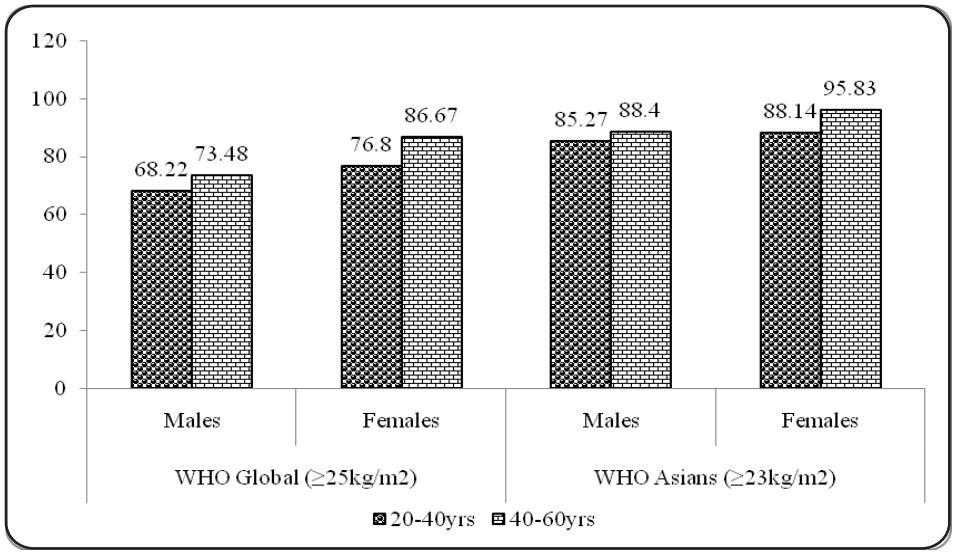


Figure 2: Per Cent Distribution of Subjects on Basis of BMI Cut off Points (Global and Asians)

may swiftly transit to higher obesity grades. A cohort of 1169 Norwegian adults revealed that of the individuals who were already classified as overweight or obese in 1990, 68% had gained additional weight 10 years later, indicating an average increase of 2.6 BMI units. The greatest amount of weight gain occurred for the youngest adults, aged 20–29 years (Rea*et al.*, 2007).

Waist Hip Ratio: Greater tendency for central obesity (mean WHR) was shown among males than females in all age groups. Overall mean WHR values for males were higher than the WHR cut off of 0.90 . Mean WHR for males was 0.93 ± 0.08 and 0.84 ± 0.11 for females and the difference was significant at 1% significance level (t=12.01) as seen from **Figure 3**. A

Table 3: Age and Gender Wise Distribution of Subjects on Basis of BMI Categories

Age in years		20-40 (n=323)		40-60 (n=301)		Total (N=624)	
Grades of Obesity	**BMI Cut-off Points (kg/m2)**	**Male (n=129)**	**Female (n=194)**	**Male (n=181)**	**Female (n=120)**	**Male (n= 310)**	**Female (n=314)**
Normal	18.00-24.99	31.78 (41)	23.20 (45)	26.52 (48)	13.34 (16)	37.44 (149)	19.43 (61)
Pre-obese	25.00 - 29.99	47.29 (61)	50.00 (97)	50.83 (92)	35.83 (43)	43.72 (174)	44.59 (140)
Obese class I	30.00-34.99	13.95 (18)	17.01 (33)	18.23 (33)	30.83 (37)	14.32 (57)	22.29 (70)
Obese class II	35.00-39.99	6.98 (9)	6.19 (12)	3.87 (7)	17.50 (21)	4.52 (18)	10.51 (33)
Obese class III	≥ 40.00	0.00 (0)	3.61 (7)	0.55 (1)	2.5 (3)	0.75 (3)	3.18 (10)

***Figures in parenthesis denote frequencies.**

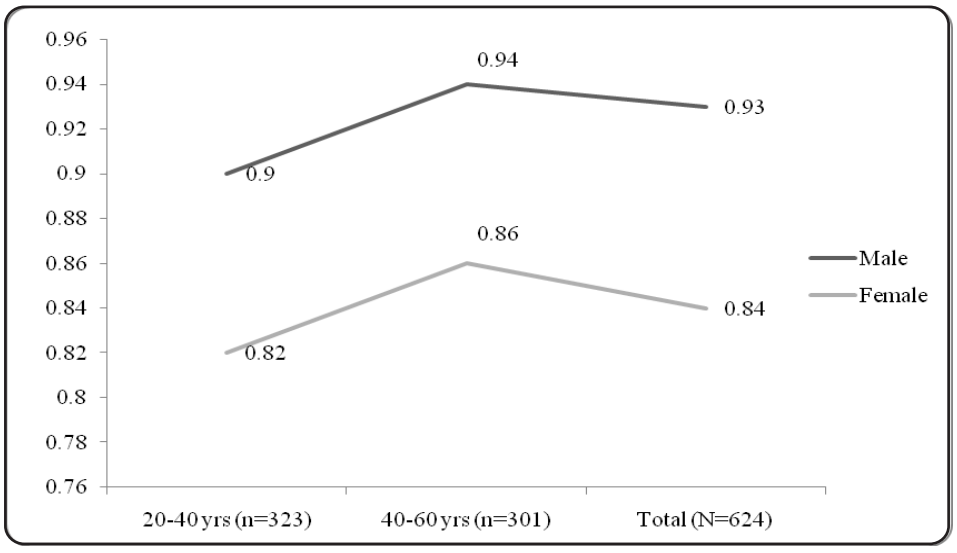


Figure 3: Age and Gender Wise Comparison of Participants on Basis of WHR Cut Off Points

randomized control trial of 130 subjects (58 males and 72 females; BMI 32.5 ± 0.5 kg/m^2) reported that compared to women, men carried an extra 7.0 ±0.9 % of their total body fat in the trunk ($p<0.01$) at baseline (Evans *et al.*, 2012).

Figure 4 depicts distribution of participants on basis of their WHR cut off values for being 'at risk' of co-morbidities. Approximately, 50 % males in the age group of 20-40 years had WHR higher than the cut off values as compared to only 28.4 % females having WHR above the cut off. In the age group of 40-60 years 77.9 % males and 50 % females had WHR higher than the cut off values. Overall, 66.5 % males and 36.6 % females were falling in 'at-risk' category based on WHR cut off values.

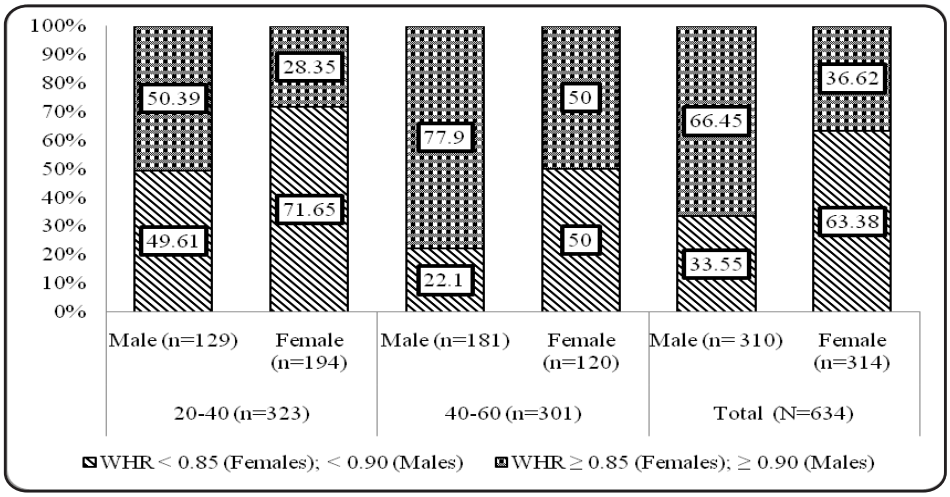


Figure 4: Age Wise and Gender Wise Distribution of Subjects on Basis of Central Adiposity (WHR Cut Off)

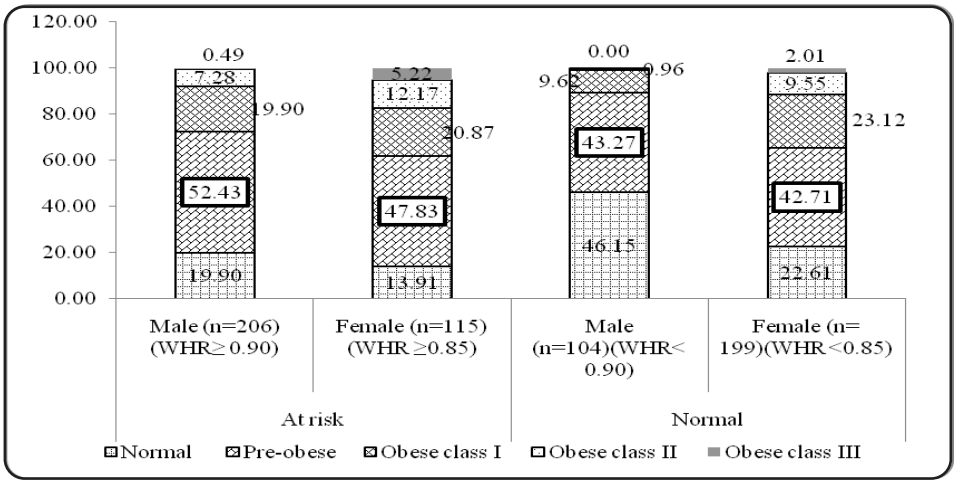


Figure 5: Percent Distribution of Subjects on Basis of BMI and WHR Categories

The results presented in **figure 5** underline one of the most recent debates in obesity-**subtypes of obesity**. Among the subjects with waist-hip ratio above the cut-off values, 19.9% males and 13.9% females had normal BMI (normal weight metabolically obese). On the contrary, among subjects with normal WHR 54% males and 78% females were falling in different grades of overweight and obesity (metabolically healthy obese).

in their recent review concluded that MHO (metabolically healthy obese) is an important, emerging phenotype with risks somewhere intermediate between healthy, normal weight and unhealthy, obese individuals.

First of all identified four subtypes of obesity – (1) Metabolically Healthy Obese (MHO); (2) "At Risk" Obese; (3) Metabolically Obese Normal Weight (MONW) and (4) Metabolically Healthy Normal Weight (MHNW).

males than females. From the above and association it is evident that women were more prone to obesity but men were at more risk due to higher central obesity.

A study revealed that in women categorized in 3 different age groups: 21–29 years; 30 – 39 years and 40 – 55 years; WHR and BMI were strongly correlated r =0.65, r=0.79 and r=0.91. In another study it was found that men were classified as obese more often than women by WHR (92% v. 82%). The relative risk of being obese as determined by WHR (waist-to-hip ratio) if classified as obese by the BMI criteria was 1.04 (95% confidence interval [CI] 0.91–1.18) for men and 1.23 (95% CI 1.03–1.46) for women .

SUMMARY :

Among the 624 participants visiting the center with the purpose of weight reduction 19.9% males and 13.9% females were normal weight status (BMI< 25kg/m^2) but had higher waist-to hip ratio (central adiposity) (MONW-Metabolically obese normal weight). On the other hand 54% males and 78% females were overweight or obese but had normal WHR (metabolically healthy obese). Overall females had a higher BMI than males whereas males had greater central adiposity.

Table 5: Association among Various Parameters (Correlation coefficient)

	MALE (n =310)	FEMALE (n=314)
AGE and BMI	0.037^{NS}	0.196**
AGE and WHR	0.244**	0.175*
AGE and WEIGHT	0.056^{NS}	0.065^{NS}
BMI and WHR	0.272**	0.153*

*Significant at 5% level **Significant at 1% level NS Not significant

Correlations among various parameters were investigated in the study and have been shown in **Table 5**. Age was found to be significantly correlated with BMI only for females and not for males. Progression in age results in increment in WHR but the relationship was stronger for males than females. Body weight was found not to be affected by age for both the genders. BMI and WHR were closely associated but the relationship was stronger for

CONCLUSION :

Recent researches have demonstrated that central obesity defined by waist-to-hip ratio is a better predictor of metabolic syndrome and other degenerative diseases. Body mass index alone is not able to predict the visceral fat deposition which is a risk factor for metabolic syndrome. Therefore, in past decade many experts have advocated concept of obesity subtypes of which normal weight metabolically obese (normal BMI, high WHR) is of great concern as it often goes unnoticed. One study on Jordanian men and women showed that BMI tended to be the weakest index for identifying metabolic syndrome risk factors in both sexes. Waist-to hip ratio exhibited the best predictive index for metabolic syndrome .

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