

Prevalence of Metabolic Obesity Normal Weight (MONW) in Cardiovascular Disease Patients - A Hospital-Based Case Control Study

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ABSTRACT

BACKGROUND

The risk of cardiovascular disease increases with obesity and thereby leads to increase in mortality in obese persons. Excess of adipose tissue causes cardiovascular abnormalities through endothelial dysfunction and insulin resistance. We wanted to study different risk factors for cardiovascular diseases by evaluating anthropometric measurements and lipid profiles in metabolic obese normal weight subjects with cardiovascular diseases.

METHODS

This case control study was conducted in Jawaharlal Nehru Medical College, AVBRH Hospital, Wardha. After taking clearance from the Institutional Ethical Committee, 200 cases with cardiovascular disease, and 200 controls without the cardiovascular disease, were selected and their lipid profile and anthropometric measurements were evaluated and compared gender wise.

RESULTS

There was significant association of weight in females (56.81 ± 3.94), BMI in males (24.32 ± 0.65), cholesterol in females (177.72 ± 16.93), height (163.15 ± 10.94 in males and 154.81 ± 3.76 in females), lean mass (48.92 ± 7.22 in males and 37.05 ± 7.14 in females), % body fat (22.79 ± 7.23 in males and 35.04 ± 9.73 in females), waist circumference (102.93 ± 1.12 in males and 93 ± 0 in females), Serum HDL (30.12 ± 6.98 in males and 33.45 ± 8.34 in females), triglyceride (156.84 ± 7.28 in males and 161.45 ± 10.34 in females) in both males and females. Whereas weight in males, BMI in females, cholesterol in males and serum LDL in both male and female had a P-value of greater than 0.05 and shows no possible association of these factors in the MONW subjects as a cause of cardiovascular diseases.

CONCLUSIONS

In this study, we found that there is a significant association between some factors of anthropometric measurements and lipid profile with MONW. Hence, it was concluded that an early screening will help in identifying persons with high risk of cardiovascular disease, and can be a major contributor in prevention of cardiovascular disease.

KEY WORDS

Cardiovascular Disease, Metabolic Obesity Normal Weight (MONW)

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BACKGROUND

With the turn of the century, cardiovascular diseases (CVDs) have become the leading cause of mortality in India.^[1] In comparison with the people of European ancestry, CVD affects Indians at least a decade earlier and in their most productive midlife years.^[2,3] For example, in Western populations only 23% of CVD deaths occur before the age of 70 years; in India, this number is 52%.^[4] In addition, case fatality attributable to CVD in low-income countries, including India, appears to be much higher than in middle- and high-income countries.^[5,6] The World Health Organization (WHO) has estimated that, with the current burden of CVD, India would lose \$237 billion from the loss of productivity and spending on health care over a 10-year period (2005–2015).^[7] Nearly two-thirds of the burden of NCD mortality in India is currently contributed by CVD-related conditions.^[8] Cardiovascular disease is a broad term for a number of linked pathologies like coronary heart diseases, arrhythmias, peripheral arterial diseases, venous thromboembolism and rheumatic and congenital heart diseases. Cardiovascular disease is a significant and consistent problem in the world, leading to significant morbidity. In the countries people changes their lifestyle in such a ways that makes them obese and more prone to cardiovascular diseases increasing the burden on the countries productivity and health sectors. This burden can only be reduce by decreasing the risk factors for cardiovascular diseases in patients that is we have to adopt primary prevention approach in our health sectors. Risk factor includes weight, height, BMI, waist circumference, lean mass, %body fat, LDL, HDL, triglyceride and cholesterol.

Metabolic obese normal weight (MONW) refers to people with normal weight and body mass index (BMI), who display some metabolic characteristics which increase the risk of developing metabolic syndrome in the same way. With the turn of the century, there is increase in cardiovascular mortality in the persons having normal weight obesity. An excess of the adipose tissue in the body may cause cardiovascular abnormalities as is associated with many comorbidities and pathophysiological processes like lipid metabolism, endothelial dysfunction, and insulin resistance. Clinicians and epidemiologists usually rely on body mass index (BMI) as a means of defining the presence of adiposity. In addition, central obesity is measured by increase in waist circumference (WC) or waist-to-hip ratio (WHR).^[9] Increased weight and waist circumference have been shown to be strongly associated with cardiovascular disease risk factors such as diabetes and hypertension in many populations^[10-12] that shows anthropometric measurements are related to the adiposity of the body. But now metabolic obese normal weight comes as a new effective way of screening for risk of cardiovascular diseases in population. If we use Metabolic obese normal weight along with lipid profile and anthropometric measurements, it not only strength our screening but also decrease cardiovascular disease proportion, its prevalence and the mortality cause by these diseases. These measurements can help to maintain the health better by individuals.

Objectives

1. To estimate different measurements that acts as the risk factors for cardiovascular diseases by doing

anthropometric measurements and lipid profile in metabolic obese normal weight subjects with cardiovascular diseases.

2. To compare gender-wise the anthropometric measurements including BMI, waist circumference in cases of MONW with CVD to healthy non-obese control.
3. To correlate gender-wise the laboratory measurements including lean mass, triglyceride, serum LDL, serum HDL, total cholesterol in cases of MONW to healthy non-obese control.

METHODS

This is a case control study conducted over a period of six months. Patients admitted to medicine department of AVBRH with normal BMI and cardiovascular disease having abnormal ECG following 3 criteria for metabolic obesity normal weight (cases) were compared with patients with normal BMI without cardiovascular disease (controls).

Inclusion Criteria

For cases

1. BMI less than 25 Kg/m²
2. Age should be under greater than 20 to less than 60 years.
3. Patient satisfying three criteria of metabolic syndrome in case.

For controls

1. BMI less than 25 Kg/m²
2. Age should be under greater than 20 to less than 60 years.
3. Patient satisfying less than three criteria of metabolic syndrome in controls.

Exclusion Criteria

1. Individuals having BMI greater than 25 Kg/m².
2. Individuals with age >60 years.

Sample Size

Sample size was estimated using formula

$$n = Z^2pq/e^2$$

where,

n = sample size

Z² = abscissa of the normal curve that cuts off an area α at the tails (1 - α equals the desired confidence level, e.g., 95%). The value for Z is found in statistical tables which contain the area under the normal curve and for 95% confidence level it is 1.96

e = desired level of precision

p = estimated proportion of an attribute that is present in the population

q = 1-p

Assume p = 0.5 (maximum variability) and supposing a desire confidence level of 95% and \pm 5% precision the resulting sample size is

$$n = \frac{(1.96)^2(.5)(.5)}{(.05)^2} = 385$$

Sample size was determined to be 400. We divide this sample size in to two equal halves in between cases and controls.

Criteria for MONW

The updated ATP-III definition of MONW [13] was met when three or more of the following criteria were present:

1. waist circumference ≥102 cm in men and ≥88 cm in women
2. HDL <1.04 mmol/L (40 mg/dL) in men and <1.30 mmol/L (50 mg/dL) in women
3. triglycerides ≥1.7 mmol/L (150 mg/dL) or specific treatment for this lipid abnormality
4. systolic blood pressure ≥ 130 mmHg or diastolic blood pressure ≥85 mmHg or treatment of previously diagnosed hypertension
5. Fasting glucose ≥5.5 mmol/L (100 mg/dL) or previously diagnosed diabetes.

Data Collection

The approval from institutional ethics committee was taken. All the study subjects were explained about the study procedure and informed consent was taken. Patient’s sociodemographic data was collected.

BMI and anthropometric measurements like waist circumference, BMI was taken on admission and then lipid profile was done. With the use of predesigned study Performa, the relevant history and physical examination was recorded.

Anthropometric Measurements and Body Composition Analysis

Body weight was measured by using electronic weighing scale. Stature was measured by using a fixed stadiometer. Participants were made to stand against the upright surface of the stadiometer with back of the head, shoulders, buttocks, calves, and heels touching to it. Waist circumference was measured by using a measuring tape positioned between the lower rib margin and high point of the iliac crest. BMI was calculated by the formula:

$$BMI = \text{weight (Kg)} \div \text{height}^2 (\text{m}^2)$$

Lean mass was calculated by using the Boer Formula:

For males:

$$eLBM = 0.407 \times \text{weight (Kg)} + 0.267 \times \text{height (cm)} - 19.2$$

For females:

$$eLBM = 0.252 \times \text{weight (Kg)} + 0.473 \times \text{height (cm)} - 48.3$$

Then the body fat percentage (BF%) was calculated as follows:[14]

$$BF\% = \text{weight-lean mass/weight} \times 100$$

Laboratory Measurements

Lipids was measured enzymatically by using the commercially available reagents. The test was done with a blood sample, which is drawn through a needle from a vein in the arm during a fasting state. All samples were analysed for total cholesterol, triglycerides, low density lipoprotein-cholesterol (LDL-C), high density lipoprotein-cholesterol (HDL-C). HDL cholesterol was measured in the clear supernatant after precipitating the other lipoproteins with heparin and MnCl₂ (1.3 g/L and 0.046 mol/L, respectively) and removing excess Mn²⁺ by precipitation with NaHCO₃. [14]

Statistical Analysis

Proportion of normal weight obesity in cardiovascular disease patient was compared with obesity in controls. Chi square test was applied over the distribution and p-value was reported. Comparison of proportion between the two groups was done using t-test.

RESULTS

Factors	Case		Control		P-Value	
	Male	Female	Male	Female	Male	Female
weight	65.05 ± 8.72	56.81 ± 3.94	67.84 ± 6.42	69.16 ± 8.28	0.09	0.0007
Height	163.15 ± 10.94	154.81 ± 3.76	172.45 ± 7.52	168.5 ± 8.80	0.00	0.0004
BMI	24.32 ± 0.65	24.055 ± 0.67	22.73 ± 1.51	24.05 ± 0.91	0.000	0.98
Lean mass	48.92 ± 7.22	37.05 ± 7.14	54.45 ± 4.19	48.93 ± 6.14	0.00	0.003
%Body fat	22.79 ± 7.23	35.04 ± 9.73	19.41 ± 5.48	23.36 ± 11.13	0.01	0.03
Waist circumference	102.93 ± 1.12	93 ± 0	88.34 ± 2.04	79.33 ± 0.81	0.000	0.000
LDL	104.71 ± 22.08	110 ± 18.34	98.88 ± 22.41	103.66 ± 20.57	0.23	0.52
HDL	30.12 ± 6.98	33.45 ± 8.34	44.68 ± 6.03	45 ± 5.29	0.00	0.008
Triglyceride	156.84 ± 7.28	161.45 ± 10.34	99 ± 20.83	109.6 ± 18.12	0.00	0.00
cholesterol	167.69 ± 28.31	177.72 ± 16.93	157.68 ± 26.12	153.66 ± 15.78	0.09	0.01

Table 1. Mean Value, Standard Deviation and p-Value of Obtained Anthropometric Measurements and Lipid Profile in Both Male and Female Cases and Their Respective Controls

	Case	Control
Age	Age should be under greater than 20 to less than 60 years.	Age should be under greater than 20 to less than 60 years.
Gender	Male and female both can be taken	Male and female both can be taken
BMI	BMI less than 25 Kg/m ²	BMI less than 25 Kg/m ²
Criteria	Patient satisfying three criteria of metabolic syndrome in case	Patient satisfying less than three criteria of metabolic syndrome in controls
Disease	Only cardiovascular disease patients	Patients of disease other than cardiovascular diseases

Table 2. Showing Comparison between Cases and Controls

In accordance of our obtained values we found that weight in female (56.81 ± 3.94), height in both male (163.15 ± 10.94) and female (154.81 ± 3.76) are significantly associated with the MONW as their P-value is less than 0.05. Whereas the resultant BMI in male (24.32 ± 0.65), lean mass in both males (22.79 ± 7.23) and females (37.05 ± 7.14) are significantly associated with the MONW. The % body fat (22.79 ± 7.23) in males, (35.04 ± 9.73) in females and waist circumference in males (102.93 ± 1.12), female (93 ± 0) are significantly associated with the MONW. According to the obtained data on the lipid profile the Serum LDL in both the genders and cholesterol in males had the P- value of greater than 0.05 that show the both these factors are not associated with MONW thus may be not the cause of developing the Cardiovascular

diseases in MONW subjects. But the cholesterol in female (153.66 ± 15.78) showing a significant association in MONW subjects.

Whereas the Serum HDL male (30.12 ± 6.98), female (33.45 ± 8.34) and Triglyceride male (156.84 ± 7.28), female (161.45 ± 10.34) having P-values less than 0.05 showing a strong association of both these factors in development of cardiovascular disease in MONW subjects.

DISCUSSION

Metabolically obese normal weight subjects have been described since the late 1990s.^[15] MONW is significantly associated with cardio metabolic dysregulation and a high prevalence of metabolic syndrome, which is in fact, similar to the prevalence of metabolic syndrome described in overweight subjects.^[16]

BMI, have a higher risk of cardio metabolic abnormalities and a higher risk of future cardiovascular disease and mortality.^[7] Since fat and lean tissue discrimination is not possible by using BMI; it has limitation as a common scale of obesity. Studies have shown, Asian populations have a greater body fat percentage than Western populations for the same given BMI value.^[17,18]

A report from a cross-sectional sample of 5440 participants of the National Health and Nutrition Examination Surveys 1999–2004 in the US showed: 23.5% (approximately 16.3 million adults) of normal-weight adults who were 20 years and older, were metabolically abnormal whereas 51.3% (approximately 35.9 million adults) of overweight adults and 31.7% (approximately 19.5 million adults) of obese adults were metabolically healthy.^[19] Our results suggest that a normal body mass index (BMI) alone is not a satisfactory measurement but along with it anthropometric measurements and lipid profiling may behave as a booster to the screening for the risk of cardiovascular diseases. According to our results the BMI (in males), body fat%, waist circumference and triglyceride were significantly higher in MONW subjects. Whereas height, lean mass and HDL were significantly lower in MONW subjects similar to other epidemiological studies.

MONW individuals were characterised by having low lean mass and HDL despite having a normal BMI, characteristics similar to individuals with MONW was described in our study.

Our study suggest that a normal BMI alone cannot predict the cardiovascular risk but a screening for BMI with body fat%, waist, triglyceride, height, lean mass, HDL is required to do the complete assessment of a person to know the risk of cardiovascular disease and significant association between MONW and cardiovascular diseases.

CONCLUSIONS

Cardio-Vascular Disease (CVD), although primarily a disease of older population, can be averted well in advance if from an early age precautions and necessary measures are taken, the most important being lifestyle modification. Treatment of CVD is not only prolonged but also expensive for patients. This study shows that Metabolic Obese Normal Weight (MONW) individuals are associated with risk factors for cardiovascular

disease. It can be stated that adiposity screening in subjects with a normal BMI could better identify those who at higher risk for cardiovascular disease.

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