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Original Research Article

Association of Anthropometric Variables with Dyslipidemia in Obesity: A Case-Control Study

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Conflict of interest: Nil

Abstract

Aim: This study aims to determine the association of dyslipidemia of obesity with anthropometric indices.

Methods: This case-control study was carried out in the Department of Physiology, Narayan Medical College, Jamuhar, Sasaram, Bihar, India For the period of 1 year. Total 50 cases and 25 age and gender matched controls were taken. WC was measured, in cm, midway between the lower costal margin and iliac crest during the end expiratory phase, with a non-elastic tape. Hip circumference was measured, in cm, at the level of the greater trochanters, with the person standing and relaxed muscles.

Results: Mean age of obese group and non-obese group was 40.5 ± 8.28 years, 38.5 ± 8.37 years respectively. Mean body weight of obese group and non-obese group was 93.78 ± 4.78 kg, and 91.66 ± 5.47 kg, respectively. Mean height of obese group and non-obese group was 160.7± 3.78 cm, and 158.1 ± 4.15cm, respectively. Mean BMI of obese group and non-obese group was 28.11 ± 2.5kg/m2 , and 23.35 ± 2.7 kg/m2, respectively. Mean WHR of obese group and non-obese group was 0.95 ± 0.10 cm, and 0.78 ± 0.07 cm, respectively. In present study, based on WC 70% of study population were categorized in obese group and 30% as non-obese group. On basis of WHR 60% of subjects were grouped as obese and 40% as non - obese. Further, 54% of subjects were grouped under obese category and 46% as non-obese based on BMI values. Anthropometric indices and serum lipid profile values showed a significant ($p<0.001$) increase in obese group when compared to non-obese group. Of all the 35 obese subjects, WC has correctly identified 29 subjects as obese with abnormal serum lipid profile (table 2). Further, based on percent sensitivity and specificity of anthropometric parameters in predicting dyslipidaemia WC was more sensitive in terms of diagnostic accuracy, i.e. correctly identified the obese with dyslipidaemia, (68%) and WHR showed higher positive predictive value considering the diagnostic power, i.e. ability to correctly predict occurrence of dyslipidaemia (PPV % - 92%) in healthy study subjects.

Conclusion: Obesity strongly correlates with dyslipidemia and altered lipid profile status. Furthermore, from this study, we can say that WHR is the most specific parameter that can be used in the clinical setup to identify within obese subjects those who are more predisposed for developing CVD and treated appropriately.

Keywords: Obesity; Body Mass Index; Lipid Profile; Anthropometric indices.

Introduction

Obesity is previously shown to be associated with increased rates of dyslipidemia and other cardiovascular risk factors. [1] Body mass index (BMI) provides the most useful population level measure of obesity. Its classification allows for meaningful comparison of weight status and level of adiposity within population and identifies the at risk group. With the whole world now in the risk zone of obesity, this has become a big menace of public health in our country with the increasing modernization and imbibing of a low physical activity lifestyle. Obesity is defined by (BMI) calculated as kilograms per square meters. Overweight according to the WHO is BMI ≥25.00, pre-obese: BMI is 25.00–29.99, Class I obese: BMI is 30.00–34.99, Class II obese: BMI is 35.00–39.99, and Class III obese when BMI ≥40.00. [2] The Asian cut-off value for overweight and obese is BMI ≥23.0 and ≥25.0, respectively. [3] BMI fails to differentiate weight associated with muscle or fat; so, the fat content varies with body built and proportions across different ethnic populations. [4] Obesity occurs due to complex interaction between faulty dietary habits, sedentary lifestyle, and lack of physical exercise and is aggravated by genetic predisposition in some subsets of population. The WHO states that in 2016, more than 1.9 billion adults (39%) and above were overweight and of these over 650 million (13%) were obese. [5] In India, over the past one decade, men and women who were overweight and obese (BMI ≥25.00 kg/m2) increased from 9.3–18.6% to 12.6–20.7%, respectively. [6] Obesity itself leads to enhanced risk of development of type 2 diabetes (44%), hypertension, 23% of ischemic heart disease, gallbladder disease, 7–41% of some cancers, and degenerative bone diseases. [7] Abdominal fat is very variable for a narrow range of BMI. High waist–hip ratio >1 in men and >0.85 in women indicates abdominal fat accumulation. [8] Recent evidences indicate that detrimental effect on cardiovascular and metabolic health is more correlated by waist circumference (WC). [9,10]] Dyslipidemia is common in obesity leading to atherosclerosis. Total cholesterol (TC) to high-density lipoprotein cholesterol (HDL-C) ratio is strongly related to risk of coronary heart disease (CHD). [11] Obese is more likely to have high cholesterol levels, which increases their risk of atherosclerosis. Higher percentage of fat accumulation in truncal area and abdomen is seen in Asian Indians which makes them prone for development of insulin resistant syndrome and early atherosclerosis. [12] The National Cholesterol Education Programme Adult Treatment Panel III states that TC < 200 mg/dl is taken as normal and levels more than 240 mg/dl are considered as risk factor for CHD. Furthermore, low-density lipoprotein cholesterol (LDL-C) more than 100 mg/dl and HDL-C <60 mg/dl are considered abnormal. [13] However, due to the inferior cost effectiveness of such modalities compared to time honoured anthropometric techniques, the former methods are not practical for routine clinical use. Using simple, noninvasive, anthropometric methods, diagnosing obesity as a possible predictor of dyslipidemia is expected to be helpful in efforts to prevent, diagnose early, and control both mortality and morbidity.

Further, identifying the best anthropometric index in any population is essential to predict chronic disease risk factor and to facilitate enhanced screening for disease risk factors. There is lack of representative data regarding the anthropometric profile of the population of Bihar region and their association with,

dyslipidemia. Hence the present study will be carried out to determine the anthropometric indices and lipid profile and its association.

Material and Methods

Study Design, Population and Setting

This case-control study was carried out in the Department of Physiology, Narayan Medical College, Jamuhar, Sasaram, Bihar, India for the period of 1 year.

Ethical approval and Informed consent

The study protocol was reviewed by the Concerned Ethical Committee and the ethical clearance was taken. After explaining the purpose and details of the study, a written informed consent was obtained from the participants. It was emphasized that strict confidentiality would be maintained at all times.

Inclusion Criteria:

Case group: 50 Subjects

1. Overweight and obese subjects
2. Age group 20-40 years
3. Either sex
4. Voluntary participation

Control: 25

1. Age matched.
2. Gender matched.
3. Voluntary participation.

Exclusion criteria:

- H/O
- CVD
- Diabetes Mellitus,
- Osteoarthritis,
- Hypertension,
- Asthma,
- Chronic Obstructive Pulmonary Disease

Methodology

All the subjects were classified as normal, overweight, and obese according to the WHO guidelines of BMI. General physical examination for the presence of pallor, icterus, clubbing, cyanosis, lymphadenopathy, and edema was carried out.

Vital parameters such as pulse rate, blood pressure, and temperature was checked. Systemic examination including respiratory, cardiovascular, abdominal, and central nervous system examination was carried out thoroughly in all subjects. Routine blood investigations such as hemoglobin and random blood sugar were done.

Sample collection

Subjects were asked to report in the morning empty stomach for the measurement of anthropometric parameters and for giving blood sample for lipid profile.

The following parameters were assessed at the time of entry (pre-test). Weight was recorded to nearest 0.5 kg using a standard scale. Height was measured to nearest 0.1 cm without footwear by stadiometer in Frankfurt position.

For BMI, Quetelet's index[19] was used. WC was measured with minimal adequate clothing by the tailor's measuring tape in a plane perpendicular to the long axis body at the level of umbilicus without compression of skin during inspiration. Hip circumference (HC) was measured with minimal adequate clothing across the greater trochanter with legs and feet together by a measuring tape without compressing the skin fold. Waist–hip ratio (WHR) is the ratio of WC and HC in cm and is the measure of central pattern of fat distribution.

Lipid profile estimation

Lipid profile was assessed using semi autoanalyzer. TC was reported by enzymatic end point cholesterol-oxidase/ peroxidase method, triacylglycerol (triglyceride [TG]) by enzymatic glycerol phosphate oxidase/peroxidase method, and HDL-C by direct enzymatic end point method.

Statistical analysis

The recorded data was compiled and entered in a spreadsheet computer program (Microsoft Excel 2010) and it was exported to data editor page of SPSS version 19 (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics will include computation of percentages and means. The statistical tests used for the analysis was Pearson's chi-square test (χ^2) for categorical data and independent sample t-test. The sensitivity, specificity, positive predictive value, negative predictive value & accuracy were carried out. For all the tests, confidence interval and p-value was set at 95% and ≤ 0.05 respectively.

Results

Mean age of obese group and non-obese group was 40.5 ± 8.28 years, 38.5 ± 8.37 years respectively. Mean body weight of obese group and non-obese group was 93.78 ± 4.78 kg, and 91.66 ± 5.47 kg, respectively. Mean height of obese group and non-obese group was 160.7± 3.78 cm, and 158.1 ± 4.15cm, respectively. Mean BMI of obese group and non-obese group was 28.11 ± 2.5kg/m2, and 23.35 ± 2.7 kg/m2, respectively. Mean WHR of obese group and non-obese group was 0.95 ± 0.10 cm, and 0.78 ± 0.07 cm, respectively. All the anthropometric variables were found highest in the obese group as compared to non-obese group and this difference between the groups was statistically highly significant table 1.

In present study, based on WC 70% of study population were categorized in obese group and 30% as non-obese group. On basis of WHR 60% of subjects were grouped as obese and 40% as non - obese. Further, 54% of subjects were grouped under obese category and 46% as non-obese based on BMI values. Anthropometric indices and serum lipid profile values showed a significant ($p<0.001$) increase in obese group when compared to non-obese group (Table 1).

Table 1: Anthropometric indices and serum lipid profile in obese and non - obese group; values expressed as Mean ±SD

Parameters	Obese group (N=50)	Non – Obese (N=25)
Age	40.5 ± 8.28	38.5 ± 8.37
Height	160.7± 3.78	158.1 ± 4.15
Waist circumference (cm)	92.89 ± 6.87	80.10 ± 7.01*
Waist Hip Ratio	0.95 ± 0.10	0.78 ± 0.07*
BMI (kg/ m2)	28.11 ± 2.5	23.35 ± 2.7*
Total Cholesterol	241.78±28.07	171.75 ± 23.25*
Triglycerides	251.88 ± 29.79	106.00 ± 28.49*
HDL	31.79 ± 4.87	44.11 ± 2.88*
LDL	134.12 ± 12.02	81.11 ± 9.07*

* - $p<0.001$; obese versus non obese group

Further, based on percent sensitivity and specificity of anthropometric parameters in predicting dyslipidaemia WC was more sensitive in terms of diagnostic accuracy, i.e. correctly identified the obese with dyslipidaemia, (68%) and WHR showed higher positive predictive value considering the diagnostic power, i.e. ability to correctly predict occurrence of dyslipidaemia (PPV % - 92%) in healthy study subjects (table 2)

Table 2: Percent Sensitivity and specificity of anthropometric parameters in predicting dyslipidaemia

	WC (cm)	WHR	BMI (kg/ m 2)
Sensitivity	68	62	56
Specificity	44	48	40
Positive predictive value %	86	92	84
Negative predictive value %	14	12	14

Discussion

Dyslipidemia is an independent and modifiable risk factor for cardiovascular diseases. [15] Prevalence of dyslipidaemia in recent years might be probably due to westernization of diet and transitions in wealth and lifestyle. Obesity poses a significant health threat to individuals and places a major burden on health care system. Obesity is associated with endothelial dysfunction, greater arterial stiffness [16] and insulin tolerance. Early detection of obesity by simple and reliable methods can help reverse or reduce these untoward effects. Anthropometric measurements are surrogate measures of body fat and are better predictors of dyslipidemia. They require no sophisticated equipment, lengthy procedures and are cost-effective. Literature survey shows that anthropometric index varies according to study design, geographic area and characteristics of the study population. [17,18]

WC, WHR and BMI are good indicators for body fatness and central fat distribution. In our study, anthropometric measures of obesity were significantly correlated with prevalence of dyslipidemia. The association of dyslipidemia with obesity observed in this study is in accordance with previous research reports. [17,18] Further, WC more accurately predicted deranged lipid profile and WHR has rightly projected obese subjects with dyslipidaemia. Studies with computed tomography sections have disclosed the fact of nearer relationship between dyslipidemia and WC. [18-20] An increased WC is most likely associated with elevated risk factors because of its relation with visceral fat accumulation, mechanism may involve excess exposure of the liver to fatty acids. [21] Waist circumference (WC) has been recommended as a better indicator of abnormal fat content in the body than BMI. This has also been validated by the Quebec Health Survey done by Lemeui et al. [22] The inability of BMI to correctly predict deranged lipid profile is in agreement with another broad based study done by Shamai et al. [23] BMI does not take into account proportion of weight related to increased muscle mass, bone weight or visceral organ mass. Individuals with a similar BMI can vary considerably in their abdominal fat mass by virtue of these factors. And hence, with same BMI can have varied range of serum lipid profile. Our study observed that compared with BMI, WC and WHR are good indicators for body fatness in adults at the population level and as well provide additional information about central fat distribution. This is in agreement with the studies of Xu C et al. and the fieldwork done by Feldstein *et al.* in the Chinese and Argentine populations, respectively and thus validates that WC is a better predictor of dyslipidaemia than WHR, WHtR and BMI. [24,25]. Identifying early dyslipidaemia can help in instituting corrective measures to reduce disease burden. Raised values of WC and WHR might be useful as relatively inexpensive first stage screening tools to detect dyslipidaemia. Routine health examination will enhance obesity related evaluation of cardiovascular risk factors and thus, in prevention of future health hazards. [26] Present study concluded that WC is a more

sensitive and a reliable predictor while WHR is a more specific anthropometric index in predicting dyslipidaemia among healthy individuals. Incorporating these into routine health examination will enhance obesity related evaluation of cardio vascular risk factors and thus, in prevention of future untoward health hazards.

Conclusion

In the present times when highly sophisticated instruments for accurate measurement of body fat distribution and body composition analysis are available, we can accurately pin point the at risk group. However, most of the centers do not have access to them and it is here the simple anthropometric measurements of body and lipid profile analysis can be used as an alternative. Obesity strongly correlates with dyslipidemia and altered lipid profile status. Furthermore, from this study, we can say that WHR is the most specific parameter that can be used in the clinical setup to identify within obese subjects those who are more predisposed for developing CVD and treated appropriately

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