Association of anthropometric indices of obesity with dyslipidemia: A study from South India

Priyanka N Pawaskar, Arun. S, Kavana G.V, Nayanatara Ak, Anupama N, Ramesh Bhat

Abstract
Anthropometry is a simple reliable method for quantifying body size and proportions. The present study was aimed to study the association of selected established anthropometric indices of obesity such as waist circumference (WC), waist-hip ratio (WHR) and body mass index (BMI) with dyslipidemia in the population residing in south India. Hundred healthy subjects within the age group of 25 and 60 years were selected from out-patients setting in a teaching hospital. Anthropometric data and serum lipid profile were analysed. Based on anthropometric parameters and the lipid profile the subjects were grouped into obese and non-obese groups. Data obtained was statistically analysed. The raised values of WC, WHR and BMI were highly significant (p <0.001) in obese group compared to non-obese group. Based on the present results we conclude that WC was more sensitive for predicting altered lipid profile and WHR is a prime factor to predict occurrence of dyslipidemia. Routine health examination will enhance obesity related evaluation of cardiovascular risk factors.

Keywords: serum lipid profile, waist circumference, waist-hip ratio, Body mass index, dyslipidemia

1. Introduction
In the modern era, obesity has emerged as a ‘global epidemic’. It has affected both developed and developing nations with same intensity, India being no exception. National family health survey reports shows that 14.8% women and 12.1% men are obese in India [1]. Today, in the presence of limited physical exertion and improper regulation of food intake, humans have increased adipose energy stores resulting in susceptibility to various diseases [2, 3]. Obesity is a complex, multi-factorial, chronic condition that is associated with mortality and significant morbidity and is prevalent worldwide [4, 5]. Imbalance of body fat in terms of its quantity and distribution is observed in obesity. Dyslipidemias are disorders of lipoprotein metabolism, including lipoprotein overproduction and deficiency [6]. In many communities there is a general increasing trend in dyslipidemia with increasing obesity [7, 8, 9]. Obesity and dyslipidemia appear to develop from an interaction which involves the integration of social, behavioral, cultural, physiological, metabolic, and genetic factors [10, 11]. BMI has been extensively used in clinical practice to screen obesity [12]. Pattern of body fat distribution is an important determinant of disease risk [13]. Multicompartment models and dual-energy X-ray absorptiometry are all reliable methods to obtain accurate measurement of total body fat [14]. However, due to the inferior cost effectiveness of such modalities compared to time honored 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 South Indians and their association with, dyslipidemia. Hence, the present study intends to compare the ability of simple, non–invasive techniques applicable in field practices in predicting approximately the lipid levels in the body, thus, preventing the future health hazards.

2. Materials and Method

This study was a hospital-based cross sectional analytical
study conducted in a study population comprising of healthy individuals aged between 25 years and 60 years attending the out-patient department at a teaching, tertiary care Hospital in south India. Informed written consent was obtained from all participants, and the experiment protocol was approved by Ethics committee of the college. Subjects were then enrolled considering the exclusion criteria of presence of history of dyslipidemia, hypertension, diabetes mellitus, malignancy or any other major chronic illness, use of lipid lowering agents, and / or other drug delivery system , family history of lipid related disorders as well as critically ill patients presenting with medical emergencies like myocardial infarction, hyperglycemia, ascites or pregnancy were excluded from the study to avoid bias due to distorted anthropometric indices. Thus, this study included a total of 100 cardio –metabolically healthy males & females with the help of self - structured questionnaire. 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. WHR was defined as the WC divided by the hip circumference. Body weight and height were measured without shoes, using an electronic measuring scale. BMI was calculated as weight in kg divided by height in m² (Quetlet’s Index) [15]. 5 ml venous blood was collected from each subject after an overnight fast of 12-14 hours. Serum was separated within one hour of the blood collection and stored at -200C until analyzed for lipid profile. Serum samples were analyzed for lipid profile estimations, using Roche/ Hitachi auto analyzer [16, 17, 18]. The cutoff levels for obesity were as follows WC > 80 cm and 90 cm for males and females, respectively, WHR > 0.9 for males and 0.8 for females, respectively, and BMI > 23 kg/m², according to WHO standards for South Asian population. Subjects were then classified into obese and non-obese groups. Based on the ATP III classification, dyslipidaemia was defined as TC > 200 mg/dl, TG > 150 mg/dl, HDL < 40 mg/dl, and LDL > 100 mg/dl, and the subjects were categorized as obese and non – obese depending on their respective lipid values. Individuals with 2 or more deranged lipid values were considered obese.

2.1 statistical Analysis
All statistical tests were conducted using SPSS version 16. Significance value was taken as ‘p’ < 0.001 or ‘p’ < 0.05. Sensitivities and specificities of anthropometric indices were compared.

3. Results
Considering all inclusion and exclusion criteria and based on the self - structured questionnaire our cross - sectional study included a total of randomly selected apparently healthy 58 males and 42 females. Mean age of all 100 subjects was 43.11 ± 9.98 years. In present study, based on WC 68% of study population were categorized in obese group and 32% as non obese group. On basis of WHR 61% of subjects were grouped as obese and 39% as non - obese. Further, 54% of subjects were grouped under obese category and 46% as non - obese based on BMI values (Fig 1). Anthropometric indices and serum lipid profile values showed a significant (p<0.001) increase in obese group when compared to non-obese group (Table 2). Of all the 68 obese subjects, WC has correctly identified 59 subjects as obese with abnormal serum lipid profile (table 3). 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, (65.5% ) and WHR showed higher positive predictive value considering the diagnostic power, i.e. ability to correctly predict occurrence of dyslipidaemia (PPV % - 88.5%) in healthy study subjects (table 4).

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**Fig 1:** Percentage distribution of obese and Non–obese group based on waist circumference, waist hip ratio and body mass index.

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

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Obese group</th>
<th>Non - Obese</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waist circumference (cm)</td>
<td>94.71 ± 7.24</td>
<td>79.29 ± 8.21*</td>
</tr>
<tr>
<td>Waist Hip Ratio</td>
<td>0.94 ± 0.07</td>
<td>0.80 ± 0.05*</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>27.71 ± 2.1</td>
<td>22.50 ± 2.3*</td>
</tr>
<tr>
<td>Total Cholesterol</td>
<td>248.36 ±28.65</td>
<td>174.33 ± 24.00*</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>255.91 ± 32.22</td>
<td>104.00 ± 28.42*</td>
</tr>
<tr>
<td>HDL</td>
<td>33.19 ± 6.23</td>
<td>44.05 ± 3.06*</td>
</tr>
<tr>
<td>LDL</td>
<td>134.55 ± 12.61</td>
<td>81.8 ± 9.11*</td>
</tr>
</tbody>
</table>

* - p<0.001; obese versus non obese group

**Table 2:** Anthropometric Indices and serum Lipid Values; n - number of subjects

<table>
<thead>
<tr>
<th></th>
<th>Obese</th>
<th>Non – obese</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abnormal Lipid profile</td>
<td>59</td>
<td>9</td>
</tr>
<tr>
<td>Normal Lipid profile</td>
<td>68</td>
<td>32</td>
</tr>
<tr>
<td>Abnormal Lipid profile</td>
<td>53</td>
<td>7</td>
</tr>
<tr>
<td>Normal Lipid profile</td>
<td>61</td>
<td>39</td>
</tr>
<tr>
<td>Abnormal Lipid profile</td>
<td>54</td>
<td>8</td>
</tr>
<tr>
<td>Normal Lipid profile</td>
<td>54</td>
<td>46</td>
</tr>
</tbody>
</table>

**Table 3:** Percent Sensitivity and specificity of anthropometric parameters in predicting dyslipidaemia

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<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>WC (cm)</th>
<th>WHR</th>
<th>BMI (kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive predictive value %</td>
<td>82.4</td>
<td>88.5</td>
<td>83.8</td>
</tr>
<tr>
<td>Negative predictive value %</td>
<td>13.7</td>
<td>14.4</td>
<td>12.19</td>
</tr>
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4. Discussion

Dyslipidemia is an independent and modifiable risk factor for cardiovascular diseases [19]. 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 [20] 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 [21, 22].

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 [21, 22]. 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 [22, 23, 24]. 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 [25].

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. [26]. The inability of BMI to correctly predict deranged lipid profile is in agreement with another broad based study done by Shamai et al. [27]. 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, WHR and BMI [28, 29]. Identifying early dyslipidaemia can help in instituting corrective measures to reduce disease burden. Raised values of WC and WHR might be useful as relatively in - expensive 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. 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 cardiovascular risk factors and thus, in prevention of future untoward health hazards. We suggest using preferably WC as an inexpensive and easy method in clinical and epidemiological fields. The main limitation of this study is that we were not able to adjust for the physical activity level, dietary food intake and socioeconomic status of participants: Further studies therefore need to be conducted on a large population.

5. References

12. Colditz GA, Willett WC, Rotnitzky A, Manson JE.


