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RESEARCH ARTICLE

Waist-to-height ratio versus waist-to-hip ratio in predicting serum lipid concentration and cardiovascular risk factors in adult females

Ramya Reddy[1], Sindhuja Asokan[2]

[1]Department of Physiology, Apollo Institute of Medical Sciences and Research, Chittoor, Andhra Pradesh, India, [2]Department of Physiology, The Oxford Medical College, Hospital and Research Centre, Bangalore, Karnataka, India

Correspondence to: Sindhuja Asokan, E-mail: drsindhu85@gmail.com

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ABSTRACT

Background: The prevalence of dyslipidemia has been on a continuous rise in recent years in both developing and developed countries. Among all other risk factors, obesity tops them all, placing the individual at risk for developing cardiovascular diseases, hypertension, and metabolic syndrome. Anthropometry is an important tool which can be used to screen individuals who are at risk to develop health issues related to obesity. **Aims and Objectives:** This study was conducted to correlate anthropometric indices such as waist-hip ratio (WHR), waist-to-height ratio (WHtR), and body mass index (BMI) with the lipid profile parameters. **Materials and Methods:** In a hospital-based cross-sectional study, a total of 306 adult females who attended Kannur Medical College Hospital for executive checkup were included in the study. Demographic data were collected, thorough general physical examination was done and anthropometric measurements were taken according to the standard protocol. Blood samples were taken and lipid profile was done with the help of automatic analyzer. **Results:** It was observed that the mean age of the subjects was 47 years (S.D. 10.92), the mean waist circumference (WC) was 85.09 cm+10.53, BMI was 23.35+4.09 kg/m, WHtR was 20.88+0.06, and the mean WHR 0.87 + 0.05. Although all anthropometric indicators had a significant positive correlation with lipid parameters, WHR had the highest correlation coefficient when compared to BMI, WHtR, and WC. **Conclusion:** It was concluded that all the anthropometric indices had a positive correlation with lipid profile. However, in our study, it was found that WHR is a better predictor of dyslipidemia and its associated complications than WHtR.

KEY WORDS: Anthropometry; Body Mass Index; Waist circumference; Waist-hip Ratio; Waist-to-Height Ratio; Dyslipidemia; Obesity

INTRODUCTION

In the contemporary times, with an armchair job, laid back lifestyle, unhealthy eating habits, the population of obesity is increasing insidiously as a creeping pandemic, engulfing the entire world. Obesity is one of the pertinent issues that the present day people are suffering from.[1] Today's youngster spends most of their free time indoors playing electrical games such as play station, X box, and avoid physical activity.[2-4] With increase in average calorie consumption in middle class sector, easy availability of low priced and high-calorie food that is unhealthy and processed combined with global food marketplace the status of obesity in India has reached alarming proportions.[4] Anthropometric indices are simple, cost-effective, and very useful tools of measuring obesity. Changes in body fat distribution can also alter serum lipid profile. Waist circumference (WC), waist-hip ratio (WHR), and body mass index (BMI) are useful indicators

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of obesity. Recent addition to the previous indicators is waist-to-height ratio (WHtR) to determine abdominal obesity and discriminate cardiovascular risk factors from metabolic risk factor. Both generalized and abdominal obesity are associated with increased risk of morbidity and mortality. It is unclear which anthropometric measure is the most important predictor of risk of cardiovascular disease in adults. Previous cross-sectional studies show WC as a superior indicator in predicting obesity.[5,6] Studies have also shown the varying relationship of several indicators and their association with cardiovascular risk factors. Hence, the present study was undertaken to assess whether WHR or WHtR correlates better with lipid profile parameters and to determine which one better predicts obesity and its associated complications.

MATERIALS AND METHODS

Type of Study

The study was a hospital-based cross-sectional, descriptive study.

Study Population

The participants of the study were adult females attending Kannur Medical College, Anjarakandy, for executive check-up. The study was done on 306 female subjects.

Inclusion Criteria

The following criteria were included in the study:
- Individuals willing to enroll in the study
- Individuals undergoing executive checkup
- Individuals with no known previous history of hypertension, hyperlipidemia, diabetes mellitus, liver diseases, and endocrine diseases.

Exclusion Criteria

The following criteria were excluded from the study:
- Individuals not willing to enroll in the study
- Individuals with previous history of hypertension, diabetes mellitus, liver disease, and endocrine diseases
- Individuals on lipid-lowering drugs, antitubercular drugs, and herbal medications
- Pregnant and lactating women.

Method of Collection of Data

- Institutional ethical committee approval was obtained.
- Informed consent was taken from all subjects.
- History was taken thoroughly from all subjects.
- All the participants underwent complete general physical examination for the presence of pallor, icterus, clubbing, cyanosis, lymphadenopathy, and edema.
- Vital parameters such as pulse rate, blood pressure, and temperature were checked.
- Systemic examination including respiratory, cardiovascular, abdominal, and central nervous system examination was done thoroughly in all subjects.
- Routine blood investigations such as hemoglobin and random blood sugar were done. Patients who were on medications for tuberculosis, herbal medications, and lipid-lowering drugs and who were on thyroid medications were excluded based on history.

Investigations Done

Blood investigations

- Low-density lipoprotein cholesterol (LDL-C)
- High-density lipoprotein cholesterol (HDL-C)
- Total cholesterol (TC)
- Triglycerides (TG)
- Very low-density lipoprotein cholesterol (VLDL-C)
- LDL/HDL
- TC/HDL.

Anthropometric measurements

- Height
- Weight
- BMI
- WC
- Hip circumference
- WHR

Lipid profile tests were done in fully automated analyzer.

Fully random access clinical chemistry analyzer Humastar 300:

Anthropometric Measurements

BMI

Body weight was measured in kg by a mechanical scale to the nearest kg. Height was measured to the nearest 1 cm. BMI was calculated using Quetelet's index. BMI = Weight in kg/ Height (m2)

WHtR

WC divided by height in cm gives the WHtR.

WC and WHR

WC was measured midway between the lowest rib and the iliac crest and hip circumference at the level of the greater trochanters with legs close together, using a non-stretchable measuring tape by average of three measurements nearest to 0.5 cm. WHR equals WC divided by hip circumference.[7]

Statistical analysis

Data were entered into Microsoft Excel data sheet and were analyzed using SPSS 22 version (IBM SPSS Statistics, Somers NY, USA) software. Continuous data were represented as mean and standard deviation. Pearson correlation or Spearman's correlation was done to find the correlation between two quantitative variables and qualitative variables, respectively.

Graphical representation of data was made by scatter plots. $P < 0.05$ was considered as statistically significant after assuming all the rules of statistical tests.

RESULTS

Table 1 shows correlation between WHR and lipid profile and Table 2 shows correlation between WHtR and lipid profile. WHR and WHtR had similar correlations with lipid profile parameters.

DISCUSSION

The impact of lifestyle disorder cannot be overlooked because people compromise their health overeating habits and succumb to various illness such as diabetes, hypertension, and obesity, leading to premature deaths, impaired quality of life, and increase in health-care cost. Within the Indian subcontinent, a dramatic increase in the prevalence of coronary artery disease has been predicted in the next 20 years due to rapid changes in lifestyle consequent to economic development.[8,1]

Central obesity is known to be an important risk factor in the development of various cardiovascular diseases, atherosclerosis, diabetes mellitus, metabolic syndrome, etc.,[9-11]

In our study, there was significant positive correlation between WHR and TC, LDL, VLDL, triglyceride, LDL/HDL, and TC/HDL, respectively, i.e. with increase in WHR, there was increase in TC, LDL, VLDL, triglyceride, LDL/HDL, and TC/HDL, respectively, and vice versa. Similar results were obtained with WHtR and all the lipid parameters mentioned above except for VLDL, i.e., the correlation between WHR and WHtR was similar with lipid profile parameters except for VLDL. Significant correlation was observed between WHR and VLDL, and there was no significant correlation between WHtR and VLDL. From this, it can be concluded that WHR and WHtR are similar in predicting the risk of cardiovascular diseases and complications related to obesity.

Different methods are used for the measurement of obesity ranging from simple anthropometric measurements such as BMI, WC, WHR, to skinfold thickness, and body density. A study showed considerable variation in waist and hip circumferences and WHR. WC and WHR, both of which are used as indicators of abdominal obesity, seem to measure different aspects of the human body: WC reflects mainly the degree of overweight, whereas WHR does not.[12] Another

Table 1: Correlation between WHR and lipid profile

Correlation								
WHR		**TC (mg/dl)**	**LDL (mg/dl)**	**HDL (mg/dl)**	**VLDL (mg/dl)**	**TG (mg/dl)**	**LDL/HDL**	**TC/HDL**
WHR								
Pearson Correlation	1	0.587**	0.560**	0.092	0.137*	0.178**	0.508**	0.538**
Sig. (two-tailed)		<0.001	<0.001	0.106	0.017	0.002	<0.001	<0.001
N	306	306	306	306	306	306	306	306

** Correlation is significant at the 0.01 level (two-tailed), * Correlation is significant at the 0.05 level (two-tailed), WHR: Waist-hip ratio, TC: Total cholesterol, LDL: Low-density lipoprotein, VLDL: Very low-density lipoprotein, HDL: High-density lipoprotein, TGs: Triglycerides. In the study, there was significant positive correlation between WHR and TC, VLDL, TG, LDL/HDL, and TC/HDL, respectively, i.e., with increase in WHR, there was an increase in TC, LDL, VLDL, TG, LDL/HDL, and TC/HDL, respectively, and vice versa

Table 2: Correlation between WtHR and lipid profile

Correlation								
WHR		**TC (mg/dl)**	**LDL (mg/dl)**	**HDL (mg/dl)**	**VLDL (mg/dl)**	**TG (mg/dl)**	**LDL/HDL**	**TC/HDL**
WHR								
Pearson Correlation	1	0.529**	0.504**	0.087	0.098*	0.133*	0.456**	0.485**
Sig. (two-tailed)		<0.001	<0.001	0.129	0.087	0.02	<0.001	<0.001
N	306	306	306	306	306	306	306	306

** Correlation is significant at the 0.01 level (two-tailed), * Correlation is significant at the 0.05 level (two-tailed), WHR: Waist-hip ratio, TC: Total cholesterol, LDL: Low-density lipoprotein, VLDL: Very low-density lipoprotein, HDL: High-density lipoprotein, TGs: Triglycerides

study concluded that BMI and WC are simple yet sensitive method to compare central and abdominal obesity in adult female.[13]

Therefore, measures that reflect abdominal adiposity and which have an influence on blood lipid profile such as WC, WHR, and WHtR are considered superior to BMI in predicting cardiovascular disease risk.[14,15]

Changes in body fat distribution can also alter serum lipid profile. BMI does not account for factors such as body fat distribution, specifically abdominal obesity and cannot distinguish between lean and fat body mass.[14,16] WC reflects abdominal fat, which contains higher amount of visceral fat. It is the visceral fat which is converted into cholesterol and released into the bloodstream where it forms plaque on the artery walls, resulting in high blood pressure and cardiovascular disease.

A meta-analysis including data on more than 300,000 diverse population across the world confirms that measures of abdominal obesity, especially WHtR, provide a superior tool for discriminating obesity-related cardiometabolic risk compared with BMI. The rank order for association with cardiovascular risk factor was WHtR > WHR > BMI.[17] In another study, the pooled estimate of relative risk confirmed the association of BMI, WC, and waist/hip ratio with incident diabetes. The association is stronger with WC than BMI.[18] A study by Flegal et al concluded that BMI, WHtR and WC are closely related to each other and not with body fat percentage(19) which was in contrast to another study conducted by Neovius et al, where they found the correlation between body fat and BMI and WC, but no correlation between body fat and WHR.[20]

CONCLUSION

Research over the past 4 decades has consistently shown the burden of dyslipidemia to be very high in terms of morbidity, mortality, and medical costs. Obesity and overweight are now seen no less than a serious, chronic medical condition which has a negative impact on various parts of the body including the endothelial dysfunction and increases in arterial stiffness from as early as the first decade of life.[21]

Obesity and dyslipidemia are key independent modifiable risk factors for many non-communicable chronic diseases[21]. In a developing country like India using simple, non-invasive anthropometric methods, diagnosing obesity as a possible predictor of dyslipidemia is expected to be helpful in efforts to prevent, diagnose early and control morbidities associated with lifestyle disorders. WHR and WHtR are similar in predicting cardiovascular diseases associated dyslipidemia.

A fit body and a sound mind can lay strong foundation and work toward a better tomorrow. The younger age group can increase physical activity, couple it with yoga, and adjust dietary intake to prevent overweight and obesity and, hence, the complications such as dyslipidemia, diabetes mellitus, hypertension, cardiovascular disease, and polycystic ovarian syndrome, which are prone to occur in obese adult females.

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