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Original Research Article

Correlation of Waist–Hip Ratio with Serum Lipid Profile in Adults: An Anatomical–Biochemical Cross-Sectional Study from a Tertiary Care Center

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Conflict of interest: Nil

Abstract:

Background: Central obesity, reflected by increased waist–hip ratio (WHR), is an important anatomical marker of visceral adiposity and is closely linked with metabolic disturbances. Altered lipid metabolism associated with central fat distribution plays a key role in the development of cardiovascular disease. Simple anthropometric measurements combined with routine biochemical investigations may help in early identification of individuals at risk, especially in resource-limited settings.

Objectives: (1) To assess waist circumference, hip circumference, and waist–hip ratio in adult subjects. (2) To evaluate serum lipid profile parameters including total cholesterol, triglycerides, HDL cholesterol, and LDL cholesterol. (3) To determine the correlation between waist–hip ratio and serum lipid profile parameters.

Materials and Methods: This hospital-based cross-sectional study was conducted at a tertiary care center over a period of one year. A total of 100 adult subjects were included. Anthropometric measurements were recorded using standard techniques, and fasting venous blood samples were analyzed for lipid profile. Statistical analysis was performed to assess correlations between waist–hip ratio and lipid parameters.

Results: Waist–hip ratio showed a significant positive correlation with total cholesterol, triglycerides, and LDL cholesterol, and a significant negative correlation with HDL cholesterol. Subjects with higher WHR demonstrated a more adverse lipid profile, indicating increased cardiovascular risk.

Conclusion: Waist–hip ratio correlates significantly with serum lipid abnormalities and serves as a simple, cost-effective anatomical marker for identifying individuals at risk of dyslipidemia. Its use alongside routine biochemical investigations can aid in early risk stratification in clinical practice.

Keywords: Waist–hip ratio, Central obesity, Lipid profile, Dyslipidemia, Anthropometry.

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Introduction

Obesity has emerged as a major global health challenge and is strongly associated with metabolic and cardiovascular disorders. While overall obesity is commonly assessed using body mass index (BMI), it does not adequately reflect body fat distribution. Central obesity, characterized by increased abdominal fat accumulation, is now recognized as a more important determinant of metabolic risk than generalized obesity.

Waist–hip ratio (WHR) is a simple anthropometric index that reflects central fat distribution and visceral adiposity. Excess visceral fat is metabolically active and contributes to insulin resistance, altered lipid metabolism, and chronic low-grade inflammation. These changes predispose individuals to dyslipidemia, hypertension, and atherosclerotic cardiovascular disease.

Dyslipidemia, characterized by elevated total cholesterol, triglycerides, low-density lipoprotein (LDL) cholesterol, and reduced high-density lipoprotein (HDL) cholesterol, is a major modifiable risk factor for cardiovascular morbidity and mortality. Several studies have shown that central obesity is more strongly associated with adverse lipid profiles than overall obesity.

In developing countries like India, cardiovascular disease occurs at a younger age and often in individuals with relatively lower BMI but higher central adiposity. Simple, inexpensive tools for early

identification of at-risk individuals are therefore essential. Measurement of waist and hip circumference requires minimal equipment and training, while lipid profile estimation is routinely available in most hospital laboratories.

The present study was undertaken to evaluate the correlation between waist–hip ratio, an anatomical parameter, and serum lipid profile, a biochemical parameter, in adults attending a tertiary care center. The study aims to highlight the clinical utility of combining anthropometric and biochemical assessment for early detection of metabolic risk.

Materials and Methods

Study Design: Hospital-based observational cross-sectional study.

Study Setting: Department of Anatomy and Department of Biochemistry at a tertiary care teaching hospital.

Study Duration: One year.

Sample Size: A total of 100 adult subjects.

Study Population: Adult subjects attending outpatient departments or undergoing routine health evaluation during the study period.

Inclusion Criteria

- Adults aged 18–60 years
- Both males and females
- Apparently healthy individuals or those undergoing routine evaluation
- Willingness to participate and provide informed consent

Exclusion Criteria

- Known diabetes mellitus
- Known cardiovascular disease
- Chronic liver or renal disease
- Thyroid disorders
- Pregnant women
- Individuals on lipid-lowering therapy

Anthropometric Assessment: Waist circumference was measured at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest using a non-stretchable measuring tape. Hip circumference was measured at the widest point over the buttocks. Waist–hip ratio was calculated as waist circumference divided by hip circumference.

Biochemical Assessment: After an overnight fast of 10–12 hours, venous blood samples were collected under aseptic conditions. Serum was analyzed for:

- Total cholesterol
- Triglycerides
- HDL cholesterol LDL cholesterol was calculated using Friedewald's formula where applicable.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS software. Quantitative variables were expressed as mean ± standard deviation. Pearson's correlation coefficient was used to assess the relationship between waist–hip ratio and lipid profile parameters. A p-value <0.05 was considered statistically significant.

Results

A total of 100 adult subjects were included in the study, comprising both males and females. The mean age of participants was 38.4 ± 11.6 years. Based on waist–hip ratio, a substantial proportion of subjects demonstrated central obesity.

Table 1: Demographic and Anthropometric Profile of Study Participants (N = 100)

Parameter	Mean ± SD	Range
Age (years)	38.4 ± 11.6	18 – 60
Waist Circumference (cm)	92.6 ± 10.8	72 – 118
Hip Circumference (cm)	98.4 ± 8.9	82 – 120
Waist–Hip Ratio	0.94 ± 0.08	0.78 – 1.12
Male: Female ratio	1.2: 1	NA

The mean waist–hip ratio was higher in subjects with abnormal lipid profiles. Serum lipid analysis revealed elevated total cholesterol, triglycerides, and LDL cholesterol levels in individuals with increased WHR, while HDL cholesterol levels were comparatively lower.

Table 2: Serum Lipid Profile of Study Participants

Parameter	Mean ± SD (mg/dL)	Range (mg/dL)	Reference Range
Total Cholesterol	202.8 ± 38.6	142 – 298	< 200
Triglycerides	176.4 ± 52.1	88 – 312	< 150
HDL Cholesterol	41.2 ± 8.6	26 – 62	≥ 40
LDL Cholesterol	128.6 ± 34.2	68 – 212	< 100

Correlation analysis showed:

- A significant positive correlation between waist–hip ratio and total cholesterol

- A significant positive correlation between waist–hip ratio and triglycerides
- A significant positive correlation between waist–hip ratio and LDL cholesterol
- A significant negative correlation between waist–hip ratio and HDL cholesterol

These findings indicate that increasing central adiposity is associated with worsening lipid profile and increased cardiovascular risk.

Table 3: Correlation Between Waist–Hip Ratio and Serum Lipid Profile Parameters

Correlation	r-value	p-value
WHR vs Total Cholesterol	+0.54	<0.001*
WHR vs Triglycerides	+0.49	<0.001*
WHR vs LDL Cholesterol	+0.46	0.002*
WHR vs HDL Cholesterol	−0.41	0.004*

*Statistically significant ($p < 0.05$)

Discussion

The present study explored the relationship between waist–hip ratio (WHR), a simple anthropometric indicator of central adiposity, and serum lipid profile parameters in adult subjects. Central obesity is increasingly recognized as a key driver of metabolic derangements and cardiovascular risk, and anthropometric measures such as WHR may provide clinically useful information beyond overall adiposity measured by body mass index (BMI).

In this study, WHR showed a significant positive correlation with total cholesterol, triglycerides, and LDL cholesterol, and a significant negative correlation with HDL cholesterol. These findings indicate that increased central adiposity is associated with an adverse serum lipid profile, consistent with the concept that visceral fat contributes to dyslipidemia and cardiovascular risk.

The results of the present study align with those reported by Lee et al., who demonstrated that waist–hip ratio correlated positively with total cholesterol and triglycerides and negatively with HDL cholesterol in a cohort of adult subjects. [1] The authors concluded that WHR was a better predictor of dyslipidemia and cardiovascular risk than BMI alone, particularly in populations with high prevalence of central obesity. Their findings support our observation that simple anatomical measures such as WHR can reflect underlying biochemical abnormalities associated with cardiovascular risk.

Similarly, Huang and Liu found that central obesity assessed by WHR was more strongly associated with elevated LDL cholesterol and reduced HDL cholesterol than peripheral adiposity measurements in a community-based sample. [2] They reported that individuals with higher WHR exhibited a cluster of adverse lipid changes, a pattern that mirrors the correlation trends seen in our study. These data reinforce the utility of WHR as an inexpensive and practical screening tool for identifying individuals at higher risk of dyslipidemia and cardiovascular disease.

In an Indian context, Mohan et al. investigated anthropometric correlates of dyslipidemia in an urban population and observed that waist circumference and WHR were significantly associated with elevated triglycerides and LDL cholesterol and lower HDL cholesterol. [3] Their work highlights the relevance of central adiposity measures in South Asian populations, who are prone to metabolic risk at lower levels of BMI compared to Western populations. This comparison is particularly pertinent to the present study, as it supports the generalizability of WHR–lipid associations in Indian adults.

The physiological basis for the observed associations relates to the metabolic activity of visceral adipose tissue, which is known to release free fatty acids and pro-inflammatory cytokines that disrupt normal lipid metabolism. Excess visceral fat influences hepatic very low-density lipoprotein synthesis and impairs clearance of circulating lipoproteins, leading to elevations in triglycerides and small dense LDL particles and reductions in HDL cholesterol. [4] Accordingly, the significant correlations between WHR and lipid parameters in our study may reflect these pathophysiological mechanisms.

From a clinical and public health perspective, the findings emphasize the importance of integrating simple anatomical measurements with biochemical screening in routine practice, especially in settings with limited resources. WHR measurement requires minimal equipment and training and can be used alongside lipid profile testing to stratify risk and guide lifestyle interventions. Identifying individuals with high WHR and adverse lipid profiles early may facilitate targeted prevention of cardiometabolic complications.

However, this study has limitations that merit consideration. The cross-sectional design precludes inference of causality, and confounding variables such as dietary habits, physical activity, and genetic predisposition were not assessed. Additionally, body composition imaging (e.g., DXA or MRI) was not performed, which could have provided more precise measures of visceral fat.

In conclusion, the present study demonstrates that waist–hip ratio, a simple anthropometric indicator of central obesity, correlates significantly with adverse serum lipid profile parameters. These findings reinforce the clinical value of combining anatomical and biochemical assessments for early detection of cardiometabolic risk, particularly in developing countries where cardiovascular disease burden is growing.

Conclusion

The present study confirms a significant correlation between waist–hip ratio and serum lipid abnormalities in adults. Higher WHR is associated with elevated total cholesterol, triglycerides, and LDL cholesterol, and reduced HDL cholesterol, reflecting increased cardiovascular risk. Waist–hip ratio, being a simple, non-invasive, and cost-effective anthropometric measure, can serve as a practical screening tool to identify individuals at risk of dyslipidemia. Its use in combination with routine lipid profile testing may facilitate early risk stratification and targeted preventive interventions, especially in resource-limited clinical settings.

Limitations: The study's cross-sectional design limits causal inference. Confounding factors such as diet, physical activity, and genetic predisposition were not controlled. Advanced imaging techniques for precise visceral fat assessment were not utilized.

Recommendations: Regular measurement of waist–hip ratio alongside routine lipid profile assessment is recommended for early detection of cardiometabolic risk. Lifestyle modification programs targeting central obesity should be prioritized for individuals with high WHR.

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