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Correlation between Central Obesity and Liver Function in Young Adults—A Cross-Sectional Study

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Abstract:

Background Visceral fat is a more accurate predictor of metabolic and cardiovascular disease risk than body fat alone. Although the liver function is associated with waist-to-hip ratio (WHR) in studies, this correlation is not well established in young central obese individuals. In this study, we examined the correlation between liver function parameters and central obesity in young obese subjects.

Methods Subjects with central obesity among the student and staff community between 18 and 40 years were recruited for the study after their written and informed consent. Male subjects whose WHR is above 0.90 and females above 0.85 were included. The liver function was assessed by estimating alanine transaminase (ALT), aspartate transaminase (AST), albumin, globulin, albumin:globulin ratio (A:G ratio), total bilirubin, direct bilirubin, and Gamma-glutamyl transferase (GGT). The data were analyzed using Pearson correlation to find the statistical significance between lung function parameters in centrally obese individuals with their WHR using SPSS version-16. A *p*-value less than 0.05 was considered the level of significance.

Results The results showed an insignificant correlation between the liver function parameters ($p > 0.05$) and WHR except for serum albumin ($p < 0.021$). The level of AST, ALT, total protein, globulin, A:G ratio, GGT, total Bilirubin, and direct bilirubin in young male and female central obese subjects have not deviated from the normal physiological range.

Conclusion The serum albumin level estimation will be considered an early indicator of metabolic disorder due to central obesity.

Keywords

- central obesity
- waist-to-hip ratio
- albumin
- globulin
- A:G ratio
- total bilirubin
- direct bilirubin

Introduction

Abdominal obesity, also known as central obesity or visceral obesity, occurs when excessive visceral fat or intra-abdominal fat inside the peritoneal cavity, packed in between internal organs and the torso, contributes to the protrusion of the abdomen. A person's waist-to-hip ratio (WHR) estimates their health and the risk of developing severe health conditions. It has shown that people with "apple-shaped" bodies (with more weight around the waist) are more susceptible to health problems than their

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"pear-shaped" counterparts.[1] The WHR is a better predictor of cardiovascular disease than waist circumference or body mass index.[2]

Women within the WHR range of 0.7 have optimal estrogen levels and are less susceptible to major diseases such as diabetes, cardiovascular disorders, and ovarian cancers.[3] Women with high WHR (0.80 or higher) have significantly lower pregnancy rates than women with lower WHRs (0.70–0.79), independent of their body mass index.[4] Obesity has been associated with a higher prevalence of cardiovascular risk factors and cardiovascular disease.[5] Studies reported that body mass index is inversely associated with mortality in patients with coronary artery disease, the so-called "obesity paradox."[6]

Obese individuals with excess fat in intra-abdominal depots are at particular risk of adverse health consequences; visceral fat is a better predictor of cardiovascular and metabolic disease risk than the amount of body fat index.[7]

Multirisk factors associated with cardiometabolic diseases are driven by abdominal obesity independently of body mass index. Obesity affects the secretion of adipokines, which are bioactive substances, derived from adipocytes. Adipokines such as adiponectin, interleukin-6, and tumor necrosis factor-α and plasminogen activator inhibitor-1 are among them. These adipokines worsen the insulin resistance and associated cardiometabolic risk factors.[8,9] Visceral fat is a reliable indicator of waist circumference, and central adiposity correlates with health risks far more strongly than adipose tissues in other body regions. It is due to a strong correlation between visceral fat and insulin resistance.[9]

Adiposity in the viscera is a significant independent predictor of insulin sensitivity, impaired disease, and liver cancer increases with obesity. A liver function test gives information about the health of a patient's liver. Transaminases of the liver (aspartate transaminase/serum glutamic oxaloacetic transaminase [AST/SGOT] and alanine transaminase/serum glutamic-pyruvic transaminase [ALT/SGPT]) are useful biomarkers of liver damage in patients with intact liver function. Many liver diseases cause only mild symptoms at first. Hepatocellular involvement in certain conditions can have significant consequences. The association between WHR and markers of liver function in the young adult population with abnormal WHR has not been well documented, even though WHR has been associated with various disorders. As a result, this study was designed to investigate the association between WHR and liver function markers in young adults with abnormal WHR.

Methods

This cross-sectional study was conducted after approval from the institutional ethical committee. The study group included centrally obese subjects among the staff and student community of 18 to 40 years of both sex and having the WHR above 0.90 for males and above 0.85 for females were included. An informed and written consent duly signed by each participant was obtained. Participants with WHR below 0.90 for males and below 0.85 for females and those who are diagnosed for diabetes, hypertension, and renal dysfunction were excluded. The sample size was arrived at per our previously published article.[10] The sample size was calculated by considering the power of the study as 80 and 5% significance level. The selection of participants was shown in the flow chart (►Fig. 1). A total of 240 subjects were listed randomly within 18 to 40 years of either sex and screened for eligibility. However, only 210 participants were consented for the study, out of which 202 were found eligible as per our inclusion criteria and remaining 8 were excluded as they were diagnosed for diabetes and hypertension.

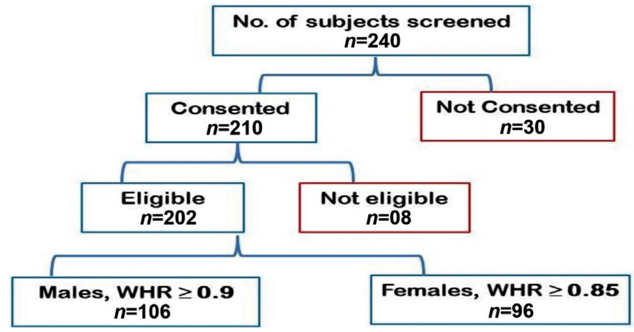

Fig. 1 Flowchart describing the steps involved in establishing the study sample as per the inclusion criteria of the subjects.

Measurement of WHR

The WHR is the ratio of the waist circumference to that of the hips. The waist circumference was measured at the highest point of the iliac crest, and hip circumference was measured at the buttocks' maximum circumference using a metallic measuring tape.

Collection of Blood

Approximately 5 mL of blood was collected without anticoagulant in appropriate sterile vials by venous arm puncture. The serum was separated by centrifugation at 1500 RPM for 15 minutes and stored at 4°C to estimate serum uric acid and blood glucose levels. All the required kits and reagents were procured from Sigma–Aldrich (Merck), Bangalore, Karnataka, India.

Estimation of Liver Function Parameters

The liver function tests include various parameters such as ALT or SGPT), AST or SGOT, albumin, globulin, albumin: globulin ratio (A:G ratio), total bilirubin, direct bilirubin, and gamma-glutamyl transferase (GGT). All the required chemicals and kits were procured from Sigma–Aldrich. The assays were performed as per the manufacturer's guidelines in the auto analyzer in the central research laboratory.

Statistical Analysis

The data were analyzed using Pearson correlation to determine the statistical significance between serum levels of lung function parameters in centrally obese individuals with their WHR using SPSS Version-16. A p-value less than 0.05 was considered the level of significance.

Results

This study included 202 centrally obese individuals between 18 and 40 years, belonging to both sexes. The WHR was measured in all the subjects to meet the inclusion criteria. The ALT (SGPT), AST (SGOT), total protein, albumin, globulin, A:G ratio, bilirubin (total and direct), and GGT of the recruited subjects were measured using the standard procedure as mentioned above. The results showed that the total protein, albumin, and A:G ratio were negatively correlated, whereas other variables studied positively correlated with the WHR of centrally obese individuals.

The number of age and sex-matched subjects recruited in this study was balanced. The males were 52%, and the females were 48% (►**Table 1**). The number of subjects recruited in this study belong to 18 to 24 years was 142 (70%), 46 (23%) participants were between the age group of 25 to 31 years, and 14 (7%) were between 32 and 38 years of age (►**Table 1**), indicating that all the subjects were young adults. Thirty-four (17%) participants were married, and 188 (93%) participants belonged to college education (►**Table 1**).

The mean difference of all the parameters studied along with the upper and lower limit of 95% confidence interval of difference is shown in ►**Table 2**. The results showed that the total protein ($r = -0.150$, $p = 0.351$), albumin ($r = -0.359$, $p = 0.021$), and A:G ratio ($r = -0.295$, $p = 0.061$) were negatively correlated with WHR of centrally obese individuals. The other variables such as SGPT ($r = 0.002$, $p = 0.992$), SGOT ($r = 0.026$, $p = 0.871$), globulin ($r = 0.229$, $p = 0.150$), GGT ($r = 0.151$, $p = 0.346$), total bilirubin ($r = 0.021$, $p = 0.898$), and direct bilirubin ($r = 0.227$, $p = 0.153$) are positively correlated with WHR of centrally obese individuals. These results clearly showed that both synthetic and secretory functions of liver are altered in centrally obese young adults. Results also showed that the level of albumin was negatively correlated with WHR of centrally obese individuals (►**Table 3**).

Table 1 Baseline characteristics of eligible study participants

Characteristics	*n*	%
Demographic domain		
Gender		
Male	106	52
Female	96	48
Age (y)		
18–24	142	70
25–35	46	23
36–40	14	7
Social domain		
Marital status		
Unmarried	168	83
Married	34	17
Employment status		
Studying	136	67
Employed	66	33
Unemployed	Nil	0
Educational status		
<High school	Nil	0
High school but <College	14	07
≥College	188	93
Clinical domain		
Hypertension	Nil	0
Congenital heart disease	Nil	0
Diabetes	Nil	0
Smokers		
Former smokers	08	04
Recurrent smokers	24	13
Very rarely smokers	58	27
Never smokers	112	56

Table 2 Descriptive statistics showing the mean values of all the measured liver function parameters in centrally obese individuals

Variables	Mean ± SD	95% Confidence Interval of the difference	
		Lower limit	Upper limit
SGPT	22.12 ± 13.27	17.9304	26.3097
SGOT	28.07 ± 9.45	25.0862	31.0523
Albumin	2.61 ± 1.49	2.1417	3.0833
Total protein	6.99 ± 1.43	6.5444	7.4494
Globulin	4.38 ± 1.41	3.9407	4.8280
A:G ratio	0.79 ± 0.87	0.5101	1.0652
GGT	27.01 ± 5.67	25.2166	28.7980
Total bilirubin	1.24 ± 0.39	1.1133	1.3604
Direct bilirubin	0.77 ± 0.42	0.6330	0.8991
Waist-to-hip ratio	0.94 ± 0.03	0.9303	0.9508

Abbreviations: A:G ratio; albumin:globulin ratio; GGT, gamma-glutamyl transferase; SD, standard deviation; SGOT, serum glutamic oxaloacetic transaminase; SGPT, serum glutamic-pyruvic transaminase.
$n = 202$.

Table 3 Correlation of various liver function parameters in centrally obese individuals with their waist-to-hip ratio

Variable	Pearson correlation	2-tailed significance
	r-Value	p-Value
SGPT	+0.002	0.992, NS
SGOT	+0.026	0.871, NS
Albumin	−0.359	0.021, Sig
Total protein	−0.150	0.351, NS
Globulin	+0.229	0.150, NS
A:G ratio	−0.295	0.061, NS
GGT	+0.151	0.346, NS
Total bilirubin	+0.021	0.898, NS
Direct bilirubin	+0.227	0.153, NS

Abbreviations: A:G ratio; albumin:globulin ratio; GGT, gamma-glutamyl transferase; NS, nonsignificant; SGOT, serum glutamic oxaloacetic transaminase; SGPT, serum glutamic-pyruvic transaminase; Sig, significant.
Note: $p < 0.05$ was considered the level of significance.
$n = 202$.

Discussion

Central obesity is caused by large amounts of abdominal fat accumulating around the stomach and abdomen. A strong correlation exists between central obesity and cardiovascular disease.[11,12] This condition has been associated with Alzheimer's disease and other metabolic and cardiovascular diseases.[13]

In this study, the results were quite different from the expected, which may be due to the relatively young age of the recruited subjects. Additionally, the recruited subjects have a WHR of 0.941 with a 95% confidence interval of 0.930 to 0.950, indicating they are on the edge of central obesity. The results of our study indicated that only the albumin level was significantly correlated with the WHR of the recruited subjects, suggesting that albumin may be a better marker for the early detection of metabolic problems caused by central obesity.

Globally, obesity is a significant health concern. There are approximately 300,000 deaths each year due to obesity in the United States. Furthermore, obesity increases the risk of developing chronic diseases such as type-II diabetes, insulin resistance, coronary heart disease, cerebrovascular disease, high blood pressure, gout, gallstones, colon cancer, and sleep apnea.[14] and a form of liver disease called nonalcoholic fatty liver disease.[15] Obesity increases the risk for liver disease, including liver cancer.[16] The mechanisms for this association are not well understood. Obesity might function as a comorbidity factor. They accentuate processes such as microsomal enzyme induction or proinflammatory cytokine production. These processes mediate liver damage caused by alcohol, hepatotoxic drugs, or certain viral infections. However, a growing body of evidence suggests that obesity-related insulin resistance plays a fundamental role in the initiation and progression of liver damage by altering the viability of liver cells.

Conclusion

In this study, we found that the correlation between the markers of liver function and WHR in centrally obese individuals was insignificant except for the functional feature of the liver, the albumin. Hence, it has been concluded that assessing the albumin level could be an early indicator of the onset of metabolic risk. However, a larger sample size with a wide range of age groups and belonging to a broader range of WHR is required to establish or confirm the association between the liver function parameters in central obese subjects is warranted.

Conflict of Interest
None declared.

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