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# STUDIES ON HIGH SENSITIVITY C- REACTIVE PROTEIN (hsCRP), LIPID PROFILE AND THYROID-STIMULATING HORMONE (TSH) WITH THE RELATION OF WAIST-HIP RATIO IN HEALTHY INDIVIDUALS

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**Abstract**

**Background**: Abdominal obesity, evaluated by waist-hip ratio (WHR), signifies high risk of metabolic and cardiovascular ailments due to central adipose tissue accumulation. Elevated Thyroid-Stimulating Hormone (TSH) levels correlate with Abdominal Obesity (AO) incidence, emphasizing endocrine-fueled fat distribution. Excess fat accrues from imbalanced energy intake and expenditure, leading to lipid abnormalities like elevated triglycerides, Very Low-Density Lipoprotein (VLDL), apolipoprotein B, and non-HDL-C, all linked to obesity-related complications. Obese individuals often exhibit high-sensitivity C-reactive protein (hs-CRP), reflecting inflammation and metabolic implications. Interventions targeting endocrine function, lipid metabolism, inflammation, and adipose distribution mitigate the risk of abdominal obesity. **Aim & Objectives:** A study of correlation among serum TSH, serum hs-CRP and Lipid Profile in relationto waist-hip ratio (WHR) in apparently healthy subjects. **Material and Methods**: A cross-sectional study, 104 apparently healthy subjects in the age group 18- 60 were included. Anthropometric measures (age, height, weight and WHR) measured by Welcare Accuniq BC 310. And for TSH, hs-CRP using an ELISA. The atherogenic indices, including total serum cholesterol and triglycerides, were measured using a semi-automated analyzer (Vitros 5600). **Results**: WHR showed highly significant positive correlation with serum hs-CRP with ($r = 0.305$, p value $< 0.002$), also WHR showed significant positive correlation with TG ($r = 0.209$, p value $< 0.033$), and TC($r = 0.150$, p value $< 0.129$). WHR showed non-significant negative correlation with TSH ($r = -0.072$, p value $< 0.467$). **Conclusion:** Abdominal obesity also indicated by WHR, correlates with elevated serum TG and TC levels and increased inflammatory markers, such as hs-CRP. This association underscores the intricate interplay between metabolic factors, abdominal fat distribution and low-grade inflammation, emphasizing the potential impact on overall health and inflammation-related risks.

**Keywords:** Obesity, Waist-Hip Ratio, High Sensitivity C Reactive Protein (hs-CRP) Thyroid dysfunction,Obesity, Thyroid Stimulating Hormone (TSH), serum Lipid Profile.

## INTRODUCTION

Obesity is a state which characterized by accumulating excess body fat, typically as a result of a mismatch between calorie intake and expenditure **[1]**. The study conducted by Ahirwar et al, 2019, showed the prevalence of general obesity and

abdominal obesity in Uttar Pradesh region for male 12.5% and female 16.5%, indicating higher prevalence in female **[2]**.Numerous factors, including waist circumference (WC), body mass index (BMI), and waist to hip ratio (WHR), are used to determine if a person is obese, also known as anthropometric body shape index (ABSI), out of which BMI is the most frequently used criterion for measuring global obesity; for abdominalor truncal obesity, WC and WHR are more appropriate. Obesity can be categorized into Generalized Obesity (GO) & Abdominal Obesity (AO), both of which are associated with higher mortality & morbidity rates. While AO is characterized by fat buildup around the waist & is assessed using the WC & WHR, GO is assessed using the BMI **[3]**. According to the WHO, waist-hip ratio (WHR) is a more accurate anthropometric measure of AO than body mass index (BMI) and could be used to evaluate AO. Visceralor central obesity other names for abdominal fat accumulation; is important because it indicates a person's higher risk of obesity-related morbidity because of the buildup of abdominal fat. WHR is the most often marker for measuring obesity among the several metrics that can be utilized **[4,5,6]**.

The concentration of circulating C - Reactive Protein (CRP), which is significantly elevated in obese individuals, is commonly utilized as a biomarker of the low-grade inflammatory process. Acute-phase protein known as hs-CRP is produced by the liver in reaction to infection and chronic inflammatory diseases. Beyond that, via activating endothelial cells and coronary artery smooth muscle cells, hs-CRPis a predictor of future cardiovascular events and likely plays a direct role in the pathophysiology of atherosclerosis. Increasing data indicates that atheromatous plaque macrophages contain hsCRP as well. A persistent, low-leve l stimulation of the acute-phase response has been linked to obesity. Insulinresistance, endothelial dysfunction, and atherosclerosis are linked to obesity's increased cytokine and acute-phase response protein (hs-CRP) production. A few risk factors have been linked to high levels of hsCRP, including age, smoking, blood pressure, triglycerides, WC and BMI. It is therefore regarded as the primary modulator of hepatic inflammatory response and hs-CRP stimulant **[7]**.

WHR is positively correlated with the transformation of triglycerides (TG). This shows that lipid profile may be impacted by WHR in a different way. Since obese people are more likely to acquire cardiovascular disease. In affluent nations, this illness is typically brought on by elevated blood lipid levels brought on by bad eating habits and a sedentary lifestyle **[8]**. The study conducted in Indian population published in 2017, showed that there is rise in serum hs-CRP level in obese individual, a substantial relationship between WHR, hs-CRP with abdominal obesity says that abdominal obese people with high Waist hip ratio are more likely to acquire high hs-CRP **[9]**. The endocrine system possesses major control mechanism which integrates the various metabolic functions of the body tissues. It releases hormones into the circulation which are biochemically chemicalmediators **[5]**. An essential part of the endocrine system is the thyroid gland, it releases hormones that regulate many metabolic pathways **[6]**. TSH is increased if insufficientsynthesis of thyroid hormone by the thyroid gland and suppressed if it is synthesizing too much, according to the functional interrelationship of the hypothalamus- pituitary-thyroid gland (HPT Axis). TSHacts on the thyroid to produce Tetra-iodothyronine (T4). Triiodothyronine (T3) concentration is influenced by the concentration of free T4 (fT4) **[10]**. There appears to be a positive association betweenTSH and the gradual growth in weight and WHR over time, as seen by the tendency for slightly overweight euthyroid persons to gain weight and higher TSH

levels, these changes may also be minor**.** The study concludes that there is a positive link between dyslipidemia, WHR and obesity **[11,12].**

## MATERIALS AND METHOD

This study was completed at Sharda University in Greater Noida, Uttar Pradesh, in the Department of Biochemistry after receiving approval from the Institutional Ethical Committee. The study's cross-sectional sample consisted of 104 individuals who appeared to be in good health. In accordance with how the WHO classifies young adults (above 18 years age groups), subjects were separated into groups basedon gender (male & female).

### Inclusion Criteria:

Apparently healthy young adults aged above 18-60 years.

### Exclusion Criteria:

The study excluded pregnant women, participants who had a history of using medications like statins, those with chronic disorders including thyroid and renal diseases.

### Biochemical Parameters:

Blood samples were taken, and serum was stored at -20°C. Serum hs-CRP levels were estimated by ELISA. Using a semi-automated analyzer (Vitros 5600), Spectrophotometry was used to assess the atherogenic indices, including TC and TG. Anthropometric measures (age, height, weight and WHR) measured by Welcare Accuniq BC 310.

### Statistical Analysis:

The statistical analysis employed descriptive and inferential statistics, and the mean, standard deviation.Significant results are those with a p-value derived at a 95% level of reliability of less than 0.05. An extremely significant p-value is one that is less than 0.001, according to general consensus. Statisticalsoftware in version 22 of Statistical Package for the Social Sciences (SPSS) was used to conduct the analysis.

## RESULTS

A total of 104 apparently healthy subjects were taken into the study in which 54 were females and 50 males.

**Table: Showing Anthropometric measures, Atherogenic indices, TSH and hs-CRP levels in healthy subjects.**

| Statistics | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **Age** | **WHR** | **BMI ($kg/m^2$)** | **TG (mg/dl)** | **TC (mg/dl)** | **TSH (ulU/ml)** | **hs-CRP (mg/l)** |
| N | Valid | 104 | 104 | 104 | 104 | 104 | 104 | 104 |
| Mean | | 22.76 | .79462 | 25.0240 | 151.125000 | 188.0633 | 2.25562 | 1.697885 |
| Std. Error of Mean | | 0.433 | 0.006691 | 0.26774 | 0.6108091 | 0.36983 | 0.098414 | 0.1101289 |
| SD | | 4.419 | .068236 | 2.73046 | 6.2290548 | 3.77150 | 1.003634 | 1.1230988 |

**Table: Correlation of all parameters**

| | | WHR | BMI (kg/m2) | TG (mg/dl) | TC (mg/dl) | TSH (uIU/ml) | hsCR (mg/l) |
|---|---|---|---|---|---|---|---|
| WHR | Pearson Correlation | 1 | 0.424** | 0.209* | 0.150 | -0.072 | 0.305** |
| | Sig. (2-tailed) | | .000 | .033 | .129 | .467 | .002 |
| | N | 104 | 104 | 104 | 104 | 104 | 104 |
| BMI (kg/m2) | Pearson Correlation | .424** | 1 | 0.425** | 0.133 | -0.051 | 0.486** |
| | Sig (2-tailed) | 0.000 | | 0.000 | 0.178 | 0.607 | 0.000 |
| | N | 104 | 104 | 104 | 104 | 104 | 104 |
| TG (mg/dl) | Pearson Correlation | .209* | .425** | 1 | .357** | .012 | .575** |
| | Sig.(2-tailed) | .033 | 0.000 | | 0.000 | 0.907 | 0.000 |
| | N | 104 | 104 | 104 | 104 | 104 | 104 |
| TC (mg/dl) | Pearson Correlation. | 0.150 | 0.133 | 0.357** | 1 | 0.035 | 0.333** |
| | Sig.(2-tailed) | .129 | 0.178 | 0.000 | | 0.727 | 0.001 |
| | N | 104 | 104 | 104 | 104 | 104 | 104 |
| TSH (uIU/ml) | Pearson Correlation | -0.072 | -0.051 | 0.012 | 0.035 | 1 | -0.106 |
| | Sig. (2-tailed) | .467 | 0.607 | 0.907 | 0.727 | | 0.284 |
| | N | 104 | 104 | 104 | 104 | 104 | 104 |
| hsCRP(mg/l) | Pearson Correlation | .305** | 0.486** | .575** | 00.333** | -0.106 | 1 |
| | Sig. (2-tailed) | .002 | 0.000 | 0.000 | 0.001 | 0.284 | |
| | N | 104 | 104 | 104 | 104 | 104 | 104 |
| **. Correlation is significant at the level 0.01 (2-tailed). | | | | | | | |
| *. Correlation is significant at the level 0.05 (2-tailed). | | | | | | | |

**At the 2-tailed 0.01 significance level, the correlation is extremely significant. p-value is less than 0.05.The correlation is at the two-tailed 0.05 level. p-value. At p value >0.05, correlation is not statistically significant.

## DISCUSSION

The accumulation of excess body fat, typically as a result of a mismatch between the amount of calories consumed and expenditures is the hallmark of obesity [1]. Numerous factors, such as body mass index(BMI), waist circumference (WC), and waist to hip ratio (WHR), are used to determine an individual's obesity status. Of these, BMI is most commonly used to measure generalized obesity, while WC and WHR are more appropriate for measuring abdominal and truncal obesity [3]. The study conducted in Department of Biochemistry with 104 apparently healthy subjects consisting of 54 females, 50 males. The mean ± SD age group of subjects was (22.7 ± 4.41).

An in progress, low-level inflammation-related acute-phase response has been linked to obesity. Insulin resistance, endothelial dysfunction, and atherosclerosis are associated with increased cytokine production and acute-phase response proteins, such as hs-CRP, that are seen in obesity. A few risk factors have been linked to high levels of hsCRP, including age, smoking, blood pressure, triglycerides, body mass index, WC and BMI. It is regarded as the primary modulator of hepatic inflammatory response and hsCRP stimulation. Lavanya et al in (2017) stated that the overweight, obesity and WHRhave positive significant correlation with hs-CRP. The present study observes positive link between WHR and serum hsCRP with r value (0.305) and p value (0.002), in apparently healthy subjects with age level range of 18 years to 26 years of Western U.P region in India [9].

The thyroid hormones which are regulated by TSH are important determinants of energy expenditure affected appetite. Leptin secreted from fat cell alters the central nervous system (CNS), whichcommunicates the quantity of stored energy, and hence the way in which the hypothalamus-pituitary- thyroid axis functions. Thyrotropin-releasing hormone (TRH) is produced by the hypothalamic paraventricular nucleus, when its level rises with fat. Moreover, it modifies deiodinase activity, which facilitates the conversion of T4 to T3. Because of these interactions, the distribution of adiposity throughout the body can affect how well an obese person's thyroid operates [14]. Demir et al in (2021)concluded in the study that TSH was found to be negatively correlated with anthropometric measurements, such as WHR (p = 0.006) [13]. In the present study WHR is negatively correlated withserum TSH with r value (-0.072) and p value (0.467) among 54 female subjects, out of 104.

Due to this, the WHR and TSH level may get affected because in females' high estradiol concentrations are e deemed as responsible for maintaining a low WHR, since hormone regulates fat accumulation in the buttocks, hip & thighs. Estradiol also affects women behaviour and personality. The function of feminine testosterone in psychological and metabolic processes, including weight loss. It appears that testosterone has the opposite effect on WHR as oestrogen. In pre- and perimenopausal women and indiseases like polycystic syndrome and morbid obesity when this hormone is naturally elevated, high WHRs are associated with high testosterone levels. Strong evidence that oestrogen levels mitigate the effects of testosterone may be seen in the WHRs, which were highest for testosterone and lowest for estradiol [15].

The normal described value of serum cholesterol and triglyceride are <150 mg/dl and <200 mg/dl. In the present study of apparently healthy subjects between 18-26 years of age showed serum cholesterol in normal limit. Present study showed mild hypertriglyceridemia, the mean ± SD of serum triglyceride is151.1%. However, there is a positive correlation of serum triglyceride with WHR even it is not indicatingobesity. Many studies have shown a positive correlation of Lipid Profile with WHR, Raj et al (2020), showed that triglyceride levels are higher in those with larger waist circumferences. Thus, waist circumference and hypertriglyceridemia are significantly correlated [12].

## CONCLUSION

The conclusion is focused for young adult female subjects with normal WHR. In spite of normal level of blood parameters with normal adiposity in the study groups, the statistical correlation analysis suggested that with minor changes in WHR, there is proportionately positive alternation in serum hs-CRP and serum TG without showing Abdominal Obesity. Therefore, it may be concluded that serum TG, hs-CRP and WHR may be monitored regularly and be advised accordingly to prevent the risk of metabolic disorders by controlling abdominal obesity.

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