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# INFLUENCE OF WAIST CIRCUMFERENCE (WC) ON THYROID STIMULATING HORMONE (TSH) AND TUMOR NECROSIS FACTOR-ALPHA (TNF-A) IN YOUNG HEALTHY FEMALES FROM WESTERN UTTAR PRADESH, INDIA

**Saurabh Singh [1], Rajesh Kumar Thakur [2], Manoj Kumar Nandkeoliar [3], Subhra Sucharita Sahoo [4], Bhaskar Charana Kabi [5]* and Thuraya Abdulsalam Abdo Ahmed Al-Azazi [6]**

[1] M.Sc. Medical Biochemistry Final Year, Department of Biochemistry, School of Medical Sciences & Research, Sharda Hospital and Sharda University, Greater Noida, Uttar Pradesh, India.
[2] Associate Professor, Department of Biochemistry, School of Medical Sciences & Research, Sharda Hospital and Sharda University, Greater Noida, Uttar Pradesh, India.
[3, 5] Professor, Department of Biochemistry, School of Medical Sciences & Research, Sharda Hospital and Sharda University, Greater Noida, Uttar Pradesh, India.
[4] Assistant Professor, Department of Biochemistry, School of Medical Sciences & Research, Sharda Hospital and Sharda University, Greater Noida, Uttar Pradesh, India.
[6] Tutor, Department of Biochemistry, School of Medical Sciences & Research, Sharda Hospital and Sharda University, Greater Noida, Uttar Pradesh, India.
*Corresponding Author Email: bhaskar.kabi@hotmail.com

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**Abstract**

**Background:** Obesity is defined as a condition with excess fat accumulation and declared as global epidemic by World Health Organisation (WHO). A direct relationship between obesity and thyroid disorders predominantly hypothyroidism has been hypothesized. Increase in Thyroid Stimulating Hormone (TSH) could be due to the increased fat accumulation. Tumor Necrosis Factor-Alpha (TNF-α) which is a pleiotropic cytokine may directly associate with the obesity. Abdominal obesity (AO) which is indicated by raised Waist Circumference (WC) has high prevalence in females of North India which is approximately 75%. To study the association of AO with thyroid disorders through the anthropometric measures which can help in better intervention of thyroid dysfunction and adiposity in females in transition phase from adolescent to adulthood. **Aim:** To determine the influence of Waist Circumference on Serum TSH & TNF-α in young healthy female subjects from Western Uttar Pradesh. **Materials & Methods:** Waist circumference (WC) was measured anthropometrically using non-elastic tape on 100 young healthy female subjects of 18-24. Serum TSH & TNF-α levels were estimated by ELISA method. **Results:** Among 100 subjects, between 18-24 years of age, 31 subjects were shown to have abdominal obesity with WC≥80 cms. Out of which 38% subjects with abdominal obesity were presented with the Subclinical Hypothyroidism (SCH). Serum TSH & TNF-α levels were statistically positively significant with WC ($p$<0.05). **Conclusion:** The Serum TSH & TNF-α levels showed positive correlation with WC in young females of age 18-24 years with abdominal obesity. This anthropometric parameter (WC) may be useful in appropriate interventional measures like healthy lifestyle & diet may lower the risk of thyroid disorder by controlling abdominal obesity.

**Keywords:** Abdominal Obesity, ELISA, Inflammation, Subclinical Hypothyroidism (SCH), TNF-α, TSH, Waist Circumference.

## INTRODUCTION

Obesity is defined as a condition with excess fat accumulation and declared as global epidemic by World Health Organisation (WHO) (1). Abdominal Obesity (AO) is a form of obesity which is characterised as excessive fat accumulation in the abdominal area with a prevalence of 75% in North Indian females (2). According to the current guidelines for South Asians, AO is defined as having a WC ≥80 cms in women and ≥90 cms in males, independent of Body Mass Index (BMI) (3,4). The pathogenesis of obesity includes an imbalance in energy metabolism. The thyroid hormone is closely

related to obesity because of its essential role in modulating energy expenditure and appetite (5). Thyroid Stimulating Hormone (TSH) secreted by anterior pituitary gland and the normal reference range is 0.5-4.5 µIU/L and regulates thyroid hormones (6-8). Subclinical hypothyroidism indicated by high TSH level ranging from 4.5-10.0 µIU/L may be the primary event that induces alterations in energy expenditure with subsequent increases in body weight (7,8). During transition from adolescence to adulthood, there are significant physical, hormonal & metabolic changes occurs especially in females including fat deposition around breast and hips (9). Factors contributing to adiposity includes an unhealthy eating habit, sedentary lifestyle, lack of physical activity along with biochemical dysfunction such as thyroid disorder as well as inflammatory and immunological processes which includes Tumor Necrosis Factor-Alpha (TNF-α) (10,11). The novelty and the goal of this study was to investigate the AO influence on serum TSH & TNF-α levels. The current study demonstrates the potential benefit of using anthropometric parameters for screening women who are obese. Therefore, it helps in educating the population about lifestyle changes to be made to prevent obesity and related complications.

## MATERIAL & METHODS

A Cross-sectional study carried out on 100 healthy female subjects between the age group of 18-24 years from Western Uttar Pradesh, visiting Sharda University, Greater Noida, Uttar Pradesh, India after getting an approval from Institutional Ethical Committee (IEC).

**Inclusion Criteria:** Healthy female subjects of 18-24 years and willing to volunteer in the study.

**Exclusion Criteria:** The subjects with known thyroid disorder, Type II Diabetes Mellitus, Hypertension and history of pregnancy were excluded from the study.

Waist Circumference was measured at the horizontal plane halfway between the superior iliac crest and the bottom edge of the lowest rib using a stretch resistant tape as described by WHO (12). The fasting serum samples of selected subjects were collected and stored at -20ºC, and were tested for Serum TSH & TNF-α by Enzyme Linked Immunosorbent Assay (ELISA).

## STATISTICAL ANALYSIS

The statistical analysis employed by using statistical software SPSS version 22. Significant results are those with a p-value<0.05 derived at a 95% level of reliability. A highly significant p-value <0.001.

## RESULTS

Among the 100 healthy young females, subjects were categorised on the basis of WC as without Abdominal Obesity (WC<80 cm) & with Abdominal Obesity (WC≥80 cm). Among them 31 subjects were shown to have AO, based on standard cut off values for abdominal obesity by WHO (13). The mean age of the study subjects was 21.87±1.83 years.

**Table 1: Statistical analysis of means using unpaired student t-test values of biochemical & anthropometric parameters**

| Parameter | Mean±S.D | | *t*-value | *p*-value |
|---|---|---|---|---|
| | Without AO (n=69) | AO (n=31) | | |
| **Serum TSH** (**µ**IU/L) | **2.1±0.9** | **3.8±1.6** | **6.97** | **<0.0001**** |
| Range (**µ**IU/L) | 0.6-4.41 | 1.1-6.7 | | |
| **Serum TNF-α (pg/mL)** | **2.1±1.4** | **3.3±1.4** | **3.96** | **<0.0001**** |
| Range **(pg/mL)** | 0.1-5.2 | 1.0-6.5 | | |
| **Waist Circumference (WC)** (cms) | **74.4±2.4** | **84.1±3.0** | **17.26** | **<0.0001**** |
| Range (cms) | 71.0-79.6 | 80.0-89.0 | | |

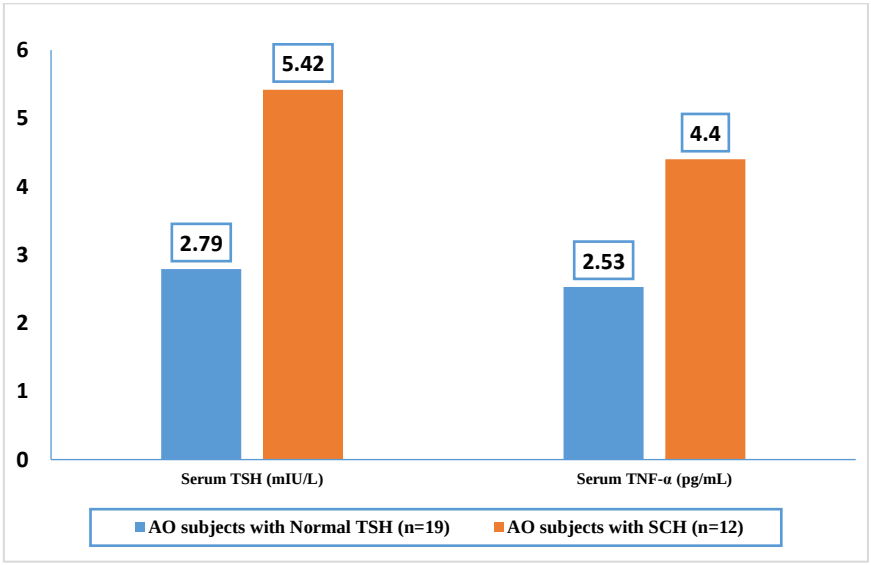
****Highly Significant <0.001 *Significant <0.05 Non-Significant >0.05**

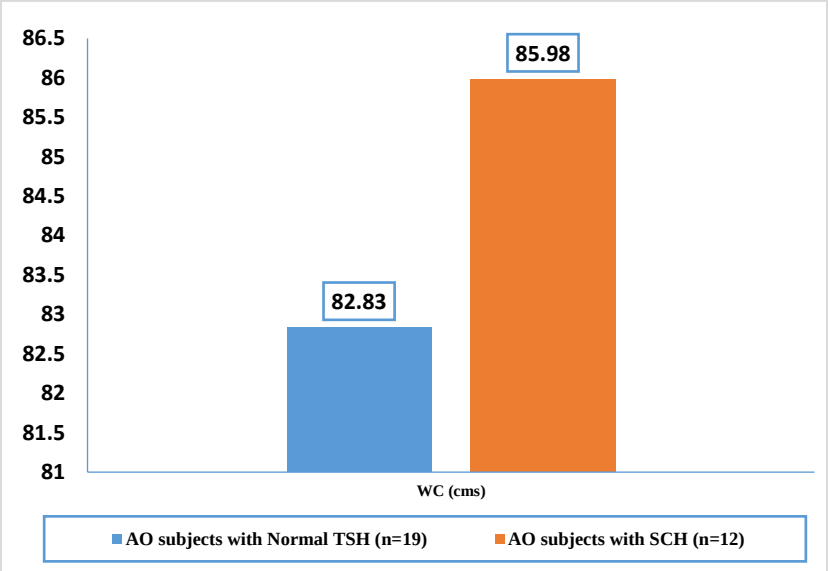
Data showing significant difference in the mean values of Serum TSH, Serum TNF-α & WC ($p<0.05$) in subjects with abdominal obesity and without abdominal obesity groups.

**Table 2: Levels of Serum TSH and TNF-α in abdominal obese subjects**

| Parameters | Mean of AO Subjects (n=31) | |
|---|---|---|
| | Normal TSH (n=19) | SCH (n=12) |
| **Serum TSH (µIU/L)** | **2.79±1.1** | **5.42±0.61** |
| Range **(µIU/L)** | 1.1-4.5 | 4.65-6.70 |
| **Serum TNF-α (pg/mL)** | **2.53±0.92** | **4.40±1.14** |
| Range **(pg/mL)** | 1.0-4.67 | 2.3-6.5 |
| **Waist Circumference (WC) (cms)** | **82.83±2.50** | **85.98±2.82** |
| Range (cms) | 80.0-87.20 | 81.1-89.0 |

**Figure 1: Levels of Serum TSH, Serum TNF-α in abdominal obese subjects**





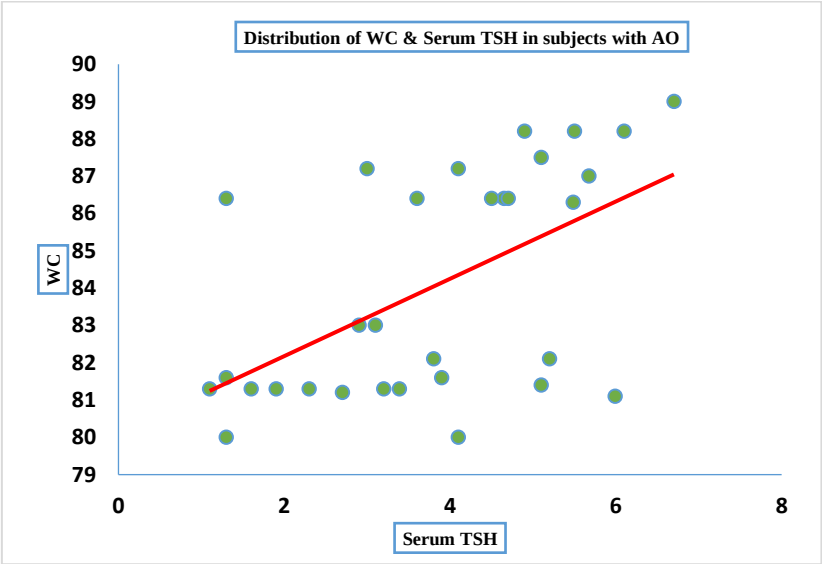

Data shows that out of 31 abdominal obese subjects, 12 subjects were shown to have TSH levels within the Subclinical Hypothyroidism (4.5-10 mIU/L) group (6,7). The mean of both the group is shown in Table 3.

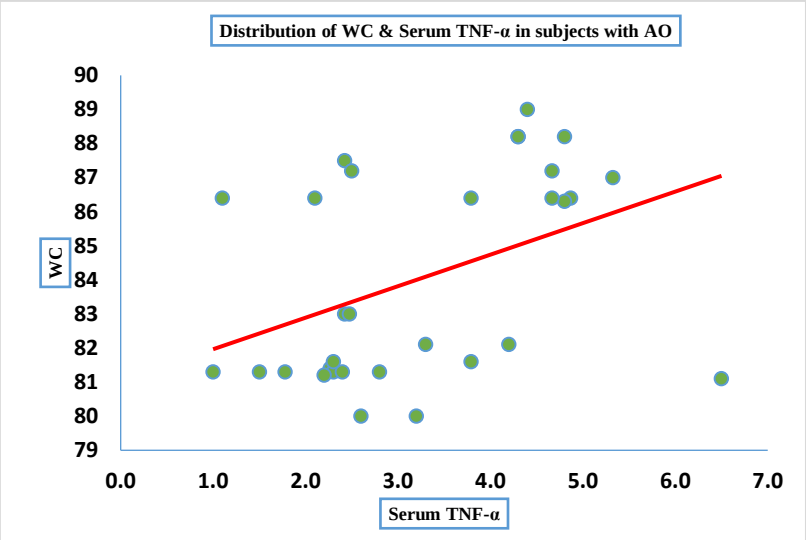
**Table 3: Correlation of Serum TSH & Waist Circumference (WC) in both the study groups**

| Serum TSH | Without AO (n=69) (WC<80 cms) | AO (n=31) WC≥80 cms |
|---|---|---|
| | WC | WC |
| Correlation Coefficient | 0.017 | **0.550**** |
| Sig. (2-tailed) | 0.887 | <0.001 |

****Highly Significant <0.001** ***Significant <0.05** **Non-Significant >0.05**

**Figure 2: Scatter diagram showing distribution of WC with Serum TSH & Serum TNF-α level distribution in subjects with AO**





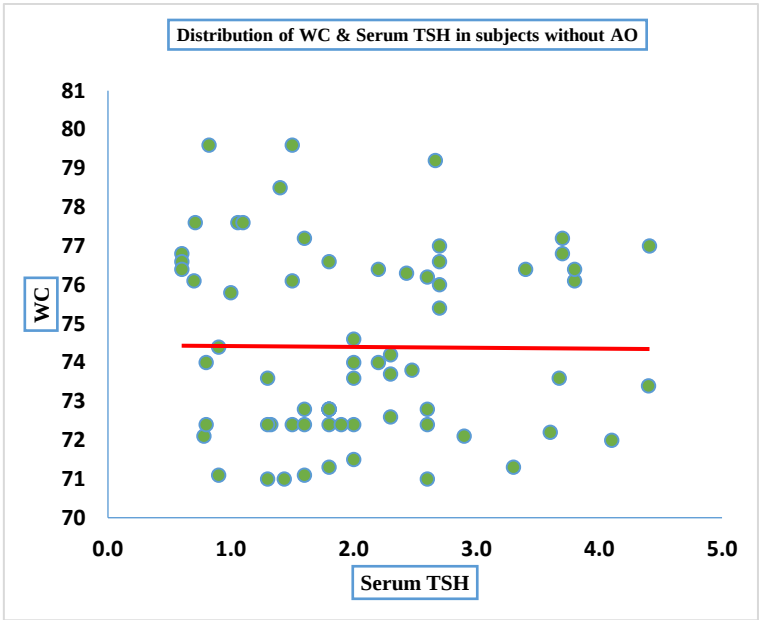

The mean of serum TSH was 2.1±0.9 µIU/L in non-abdominal obese and 3.8±1.6 µIU/L in abdominal obese female subjects. Serum TSH shows high positive significant correlation with WC ($p<0.001$) in young obese female subjects but no correlation was found in young non abdominal obese female subjects as shown in Table 2.

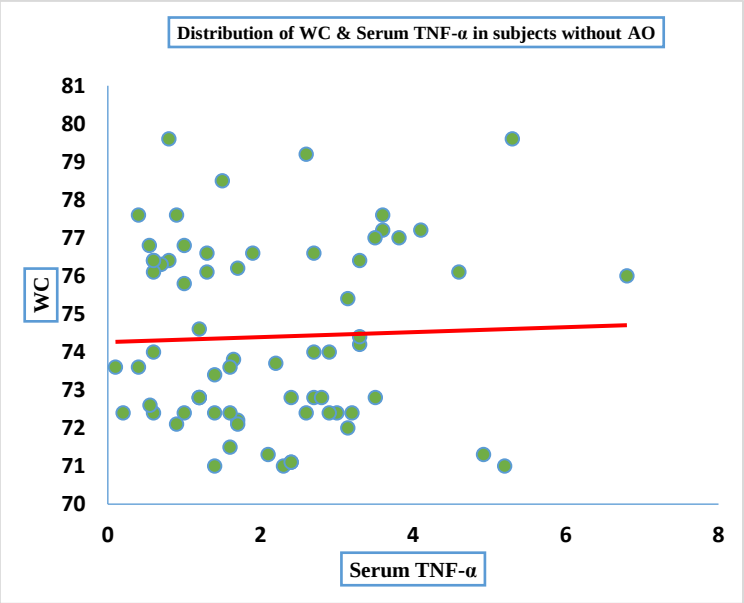
**Table 4: Correlation of Serum TNF-α with Waist Circumference (WC) in both the study groups**

| Serum TNF-α | Without AO (n=69) (WC<80 cms) | AO (n=31) WC≥80 cms |
|---|---|---|
| | WC | WC |
| Correlation Coefficient | 0.038 | **0.416**** |
| Sig. (2-tailed) | 0.754 | 0.02 |

****Highly Significant <0.001** ***Significant <0.05** **Non-Significant >0.05**

**Figure 3: Scatter diagram showing distribution of WC with Serum TSH & Serum TNF-α level distribution in Subjects without AO.**






The mean of serum TNF-α is 2.1±1.4 pg/mL in non-abdominal obese & 3.3±1.4 pg/mL in abdominal obese female subjects. Serum TNF-α showed a positive significant correlation with WC ($p<0.05$) in young obese female subjects while no correlation was found in young non abdominal obese female subjects as shown in Table 3.

## DISCUSSION

Abdominal obesity is around 36% prevalent in subjects among age group between 26-52 years in Northern India as reported by Pradeepa R et al. in 2015 (14). The present study selected a younger age group of 18-24 years than above report. It was based on the fact that they have transitioned to adulthood from adolescent phase of life and assumed to be in their active phase physically and metabolically. As per the selection criteria the subjects did not have history of pregnancy. They showed an incidence of almost 31% in Western Uttar Pradesh region. It seems AO has encroached even the younger generation of Indian subjects. There was high levels of serum TSH & TNF-α in the above subjects and positively correlated with abdominal obesity (Table 3&4). Study conducted in India & abroad did show a positive association of elevated serum TSH level with raised WC among healthy subjects of age group 18-90 years (10,15). Different studies did propose that the aetiopathogenesis of AO is based on low grade inflammation and deposition of White Adipose Tissue (WAT) with elevation of serum TNF-α (16,17). The thyroid function is being regulated by TNF-α, suppressing iodine uptake in thyroid follicular cells and in turn increases TSH levels in blood (9,18,19). Reports says, rise in serum TSH & TNF-α levels in subjects with obesity can be normalised by modifying the lifestyle (20,21).

On further analysis in the abdominal obese group, 38% had WC>85 cms & their serum level of TSH and TNF-α were significantly elevated in comparison to subjects with WC between 80-85 cms. The serum TSH levels of the subjects with WC>85 cms falls in the range of Subclinical Hypothyroidism having a mean value of 5.4±0.6 mIU/L (Table 2). Studies done on subclinical hypothyroidism in Western Uttar Pradesh by Shailza Verma et al. & Thuraya Abdulsalam A.A.Al-Azazi et al in 2022, in the age group 18 to 60 years, found a mean serum TSH level as 7.0±1.7 & 6.9±1.4 µIU/L respectively (7,8). Probably, the lower side of serum TSH level in the subclinical hypothyroidic

obese group was may be due to the selection of younger age group population. The serum TNF-α level was proportionately raised almost twice (Mean-4.40±1.14 pg/mL) in those obese subjects as shown in Table 2. So, it may be concluded that the females with WC more than 85cms in age group 18-24 years may be in subclinical hypothyroidic state and needs a thorough biochemical & medical intervention. Being an anthropometric marker, it can be useful even in remote area and health-conscious females can themselves suspects the risk of thyroid disorder by using a non-elastic tape & measuring their WC. Similar approaches are performed in the society such as glucometer for the screening of diabetes, pregnancy test by rapid card, breast cancers by performing breast self-exam, urine dip stick test to check sugar in urine and blood pressure monitoring etc. However, large number of subjects will be required to establish this hypothesis of using anthropometric marker (WC) as a Point of Care Testing (POCT) for thyroid disorder.

## CONCLUSION

Rise in waist circumference in abdominal obesity (AO) in women increases the level of serum TSH & TNF-α, presenting a risk of hypothyroidism.

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