

# Correlation of Neck Circumference with Waist Circumference and Insulin Resistance

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## ABSTRACT

**Background:** Upper body subcutaneous adipose tissue (SCAT) is associated with insulin resistance and other metabolic complications. Studies done in the past have used neck circumference as a surrogate anthropometric measure of subcutaneous fat in the upper body. The present study was undertaken to assess the correlation of neck circumference with waist circumference and insulin resistance. **Aim:** To assess the correlation of neck circumference with waist circumference and insulin resistance. **Materials and Methods:** The present study was conducted at a tertiary care hospital in Mysuru, Karnataka, India. 200 subjects were included in the study. The collected data was analysed using SPSS version-23. Relationship among different variables was assessed using Pearson's correlation. A p value of less than 0.005 was considered as statistically significant. Institutional ethics committee approval was taken before commencement of the study. **Results:** The study revealed a statistically significant positive correlation between neck circumference and waist circumference (p value - <0.001) There was a positive correlation between neck circumference and insulin resistance but was not statistically significant (p value - 0.060). **Conclusion:** Neck circumference can be used as a useful surrogate anthropometric measurement for waist circumference and of insulin resistance in general population.

## Introduction

There is considerable variation in body fat distribution. Central obesity alone cannot account for all the complications observed with obesity indicating the role of other pathological fat depots. Waist circumference is a measure of central obesity and is associated with insulin resistance and other metabolic risk factors. Previous studies have used the neck circumference as a surrogate anthropometric measure of subcutaneous fat in the upper body [1,2]. Neck circumference measurement is an easy and relatively time saving screening measure. Data on the relationship of neck circumference with waist circumference and insulin resistance is sparse in the Indian subcontinent. The present study was undertaken to assess the correlation of neck circumference with waist circumference and insulin resistance.

## Materials and Methods

This is a prospective study done in a tertiary care medical college hospital located in Mysuru, Karnataka, India. A total of 200 patients above the age of 16 years were included in the study. Patients with thyroid nodules/neck swelling, ascites, HIV, TB, pregnant women and patients on anti-obesity medications were excluded from the study. Measurement of neck circumference was done just below the laryngeal prominence perpendicular to long axis of the neck to mid cervical spine and the waist circumference at the

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midpoint between the lower margin of last palpable rib and highest point on iliac crest. Insulin resistance was assessed with measurement of fasting serum insulin levels.

## Statistical Analysis of data

Descriptive statistics (mean  $\pm$  SD) was used to describe the subject population. Pearson product-moment correlation (SPSS version - 23) was used to find out the relationship between neck circumference and waist circumference and insulin resistance. Statistical significance was established at  $p < 0.05$ . Scatter plots have been used to represent the correlation visually.

## Results

The total number of subjects included in the study were 200, out of which 113 (56.5%) were females and 87 (43.5%) males.

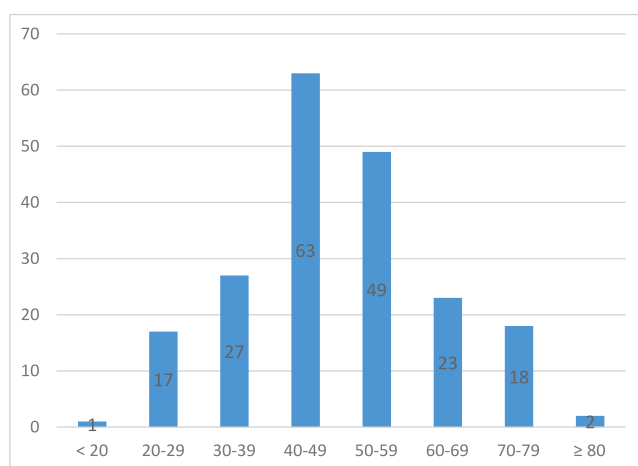


Figure 1: Age distribution of study subjects

Age distribution showed majority of subjects were in the age group 40-49 years. The mean age of females was  $47.65 \pm 13.32$  years and of males was  $50.99 \pm 14.87$  years.

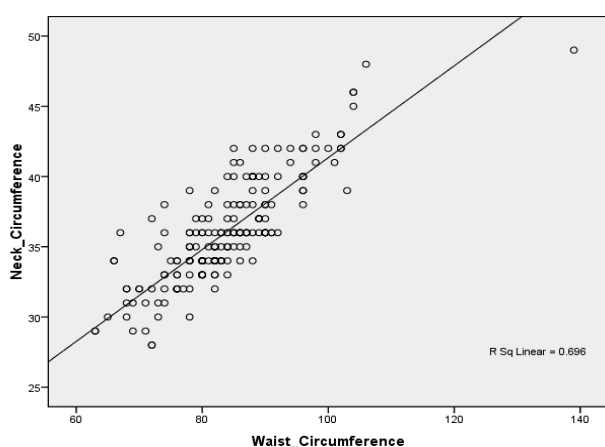


Figure 2: Correlation of neck circumference with waist circumference

The above scatter plot diagram ( Fig 2) shows a positive correlation between neck circumference and waist circumference with a correlation coefficient of 0.83 and a p value of  $<0.001$ .

The above scatter plot diagram (Fig. 3) shows a positive correlation between neck circumference and insulin resistance with a correlation coefficient of 0.13 however it was not statistically significant (p value - 0.060).

## Discussion

Obesity is an important risk factor for cardiometabolic disorders like diabetes, hypertension and coronary heart disease. Several anthropometric measures are used to

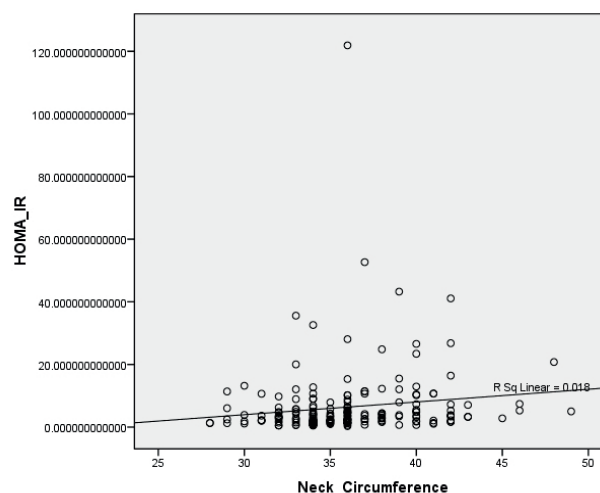


Figure 3: Correlation of neck circumference with insulin resistance.

measure overall obesity and abdominal obesity. Abdominal obesity measured with waist circumference is associated with insulin resistance and other metabolic risk factors. Although BMI, WHR and waist circumference are used in regular clinical practice, they have some limitations. BMI may overestimate the body adipose tissue, especially in athletes and others who have got a muscular build and it can underestimate body adipose tissue in elderly and others who have lost muscle mass. Adipose tissue is mainly present in subcutaneous tissue, rather than around visceral organs which corresponds to only 10-20% of total body fat stores. WC and WHR are markers of abdominal adiposity and do not take upper body subcutaneous fat into consideration. In males, apple-shaped obesity is seen because of preferential deposition of adipose tissue around the waist region. In females, adipose tissue tends to get deposited around the hip region so they have pear shaped obesity and a wide pelvis. This results in falsely normal or low WC in women and similarly, in men, WHR can be falsely low or normal.

WC and WHR are markers of visceral fat rather than the subcutaneous adipose tissue which is responsible for the bulk of free fatty acid release into the portal circulation. Measurement of waist circumference and waist hip ratio is more difficult as an accurate measurement may not always be possible since it requires disrobing which is a difficult task, especially in women in India.

Overweight and obesity are associated with fat deposition in the neck, resulting in higher neck circumference [1]. Neck circumference measurement is an easy and relatively time-saving screening measure that can be used, as a marker of subcutaneous adipose tissue in upper body. Studies done in the past have used neck circumference to represent the upper body subcutaneous tissue and have demonstrated significant correlation between neck circumference and multiple cardio-metabolic risk factors like type 2 diabetes, hyperinsulinemia, hypertension and hypertriglyceridemia

[2,3]. Alzeidan R and colleagues in their study noted that neck circumference stands out as an independent predictor of obesity and the metabolic syndrome [4]. Tseh W and colleagues observed the relationship of neck circumference with abdominal adiposity in young male and female adult participants and recommended that clinicians and practitioners from a practical perspective may use neck circumference, collectively with other anthropometric tools, to determine an individual's health risk [5]. Wahrenberg H and his colleagues in their study demonstrated that waist circumference has a linear correlation with insulin resistance [6]. Similar observations was made by Tabata et.al. [7]. Yan et.al. performed a study that demonstrated a strong association between high neck circumference and metabolic syndrome which includes insulin resistance, in both elderly men and women, with odds ratios of 11.53 and 7.69, respectively [8]. A study in severely obese pre-menopausal women showed that neck circumference was a better predictor of not only insulin resistance, but also of menstrual problems, polycystic ovary syndrome and infertility [9].

The current study revealed a positive correlation between neck circumference and waist circumference which was statistically significant (p-value <0.001). There was also a positive association between neck circumference and insulin resistance, however, it was not statistically significant (p-value - 0.060). The limitations in the study include a small sample of subjects and non-exclusion of diabetics who were on medications that increase insulin sensitivity from the study.

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<b>Conflict of Interest:</b>	All authors declare no COI
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