The Trends of CRP Levels at Different Waist-to-Hip Ratios Among Normotensive Overweight and Obese Patients: A Pilot Study

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ABSTRACT

Objective: To determine the correlation between CRP (C-reactive protein) and Waist to Hip Ratio (WHR) among over weight and obese patients with normal blood pressure.

Study Design: An analytical study.

Place and Duration of Study: Medical indoor and outpatient clinics of Mayo Hospital, Lahore, from March to August 2013.

Methodology: Willing patients with Body Mass Index (BMI) of > 23 kg/m², normal blood pressures, and age between 18 - 65 years were inducted in the study. Patients with signs of fluid retention, collagen vascular disease, CAD, on corticosteroids, immunomodulators or lipid lowering medications, hypertensives and febrile patients were excluded. Patients were considered to be at low risk for cardiovascular events if WHR among males and females was < 0.95 and < 0.80, respectively. Similarly, males and females with WHR > 1 and > 0.85, respectively were taken as high risk. Levels in-between these ranges were taken as moderate risk. Data was analyzed on SPSS 15. Descriptive statistics were determined. The p-value was calculated by ANOVA and independent sample t-test among males and females respectively, to compare WHR in relation to different CRP levels and < 0.05 was taken as significant.

Results: There were 34 male and 74 female patients. The gender-wise mean WHR did not show statistically significant difference categorized CRP levels (p=0.072 in male, and 0.052 in females). There was an increasing trend in CRP levels as WHR increased among females, but this was statistically insignificant (p=0.05).

Conclusion: Although the impact of central obesity on cardiac health is well known, however, WHR alone is an unreliable indicator of systemic inflammation and raised CRP level.

Key Words: CRP (C-reactive protein). Waist-to-Hip Ratio (WHR). Normal blood pressure. Cardiovascular risk.
METHODOLOGY

It was an analytical study. After approval from Institutional Review Board of Mayo Hospital, Lahore, it was conducted in medical wards on patients who presented in emergency or OPD clinic from March till August 2013. Willing patients having age between 18 - 65 years, blood pressure < 140/90 mm Hg, and BMI > 23 kg/m² were recruited. Detailed medical history was taken and clinical examination was done to identify any exclusion criteria. Patients with signs of fluid retention (like cardiac, renal or hepatic failure), ascites due to any cause, arthritis, acute febrile illness, hypertension and patients on drugs like corticosteroids, immunomodulators, statins or antihypertensive medications were excluded from the study.

After assessing the recruitment criteria, 108 patients were selected. Informed consent was taken from patients and BMI was calculated using formula; BMI = weight (kg)/height (m)².

Instead of WHO criteria, BMI criteria for Asians by Regional Office for Western Pacific Region of WHO (WPRO criteria) for obesity were applied as WPRO criteria have BMI cut-off point much lower than WHO criteria. Patients of BMI ≥ 23 kg/m² were recruited.

Waist circumference was noted at the point, midway between costal margin and anterior superior iliac spine (usually just above the umbilicus). Hip circumference was measured at the widest part. Patients were considered to be at low risk for cardiovascular events, if WHR among males and females was < 0.95 and < 0.80, respectively. Similarly, males and females with WHR > 1 and > 0.85, respectively were taken as high risk. Levels in-between these ranges were taken as moderate risk.

After an overnight fast, blood samples were collected for CRP levels. CRP was measured by Latex enhanced nephelometry. CRP level of < 1 mg/L was considered low, values between 1 - 3 mg/L were considered to be average and those > 3 mg/L were taken as high.

Data entry and analysis was done by using SPSS 15. Quantitative variables were presented by using mean and standard deviations. Qualitative variables were presented by using frequency table and percentages. Analysis of variance was used to compare the waist-to-hip ratio in relation to different CRP level. The p-value was calculated by ANOVA and independent sample t-test among males and females, respectively. A p-value of < 0.05 was taken as significant.

RESULTS

This study was conducted on 108 subjects. There were 34 male and 74 female patients in the study. Mean CRP level among male and female patients was 4.85 ± 2.32 and 4.45 ± 2.60, respectively. Similarly, WHR among male and female patients was 0.924 ± 0.080 and 0.865 ± 0.083, respectively. Male patients with average CRP level (1 - 3 mg/L) showed normal WHR (0.88 ± 0.05), whereas males with high CRP level (> 3 mg/L), exhibited average WHR (0.94 ± 0.08).

Females with normal CRP level (< 1 mg/L) showed moderate risk with mean WHR of 0.84 ± 0.07. Moreover, mean WHR among females with average (1 - 3 mg/L) and high CRP levels (> 3 mg/L) was 0.89 ± 0.10 & 0.87 ± 0.08, respectively. In both genders, the mean WHR was statistically insignificant in correlation to categorized CRP levels (p-value for WHR in males was 0.054 and 0.202 for females). However, it was observed that high risk male patients with CRP level > 3 mg/L had higher values of WHR than the males with average CRP level of 1 - 3 mg/L.

CRP levels were not significantly associated with WHR (p-values in males and females were 0.072 and 0.052 respectively). Although female patients showed an increasing trend in CRP level rise as WHR increased, however this was not statistically significant (p=0.05). Similarly no significant linear correlation was observed

| Table I: CRP and waist-to-hip ratio (WHR) in male and female patients. |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| Risk criteria for WHR (males) | Number | | | |
| <0.80 | 0.81-0.85 | > 0.85 | < 0.95 | 0.96 - 1 | > 1 |
| Number | 25 | 13 | 36 | 22 | 6 |
| CRP | | | | | |
| < 1 mg/L | 4 | 0 | 0 | - | - |
| 1 - 3 mg/L | 10 | 5 | 12 | 10 | 1 |
| > 3 mg/L | 11 | 0 | 24 | 12 | 5 |
| Chi-square test | 9.373 | | | 5.270 | |
| p-value | 0.052 (insignificant) | | | 0.072 (insignificant) | |
| Table II: Categorized CRP and WHR for male and female patients. |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| Risk criteria for WHR (males) | Number | | | |
| <0.80 | 0.81-0.85 | > 0.85 | < 0.95 | 0.96 - 1 | > 1 |
| CRP | | | | | |
| < 1 mg/L | 4 | 0 | 0 | - | - |
| 1 - 3 mg/L | 10 | 5 | 12 | 10 | 1 |
| > 3 mg/L | 11 | 0 | 24 | 12 | 5 |
| Chi-square test | 9.373 | | | 5.270 | |
| p-value | 0.052 (insignificant) | | | 0.072 (insignificant) | |
| Correlation of CRP with waist-to-hip ratio | | | | | |
with Pearson correlation for CRP level and WHR among male and female patients ($r=0.133$ (p=0.257) and ($r=0.191$, (p=0.278 respectively).

**DISCUSSION**

CRP is an important marker of inflammation that is released from the liver in response to some infection, inflammation or vascular endothelial injury. In healthy subjects, it is found in traces in the blood. Many previous studies have shown a significant association of raised CRP with components of metabolic syndrome, endothelial dysfunction and atherogenesis. It potentiates the effect of traditional cardiovascular risk factors but it is not well known whether lowering CRP decreases this risk or not.12

The markers of obesity are body mass index, skin fold thickness, waist circumference and WHR. Body mass index is a measure of heaviness. It does not depict the pattern of fat accumulation in the body. Skin fold thickness indicates the presence of sub-cutaneous fat in the body. On the other hand, waist circumference is related to the presence of visceral fat that leads to central obesity. Similarly, WHR is a reflection of fat distribution in different parts of the body. It is a better indicator of central obesity which carries significant cardiovascular risk.4

In 1999, Visser et al. conducted a study in the USA on 3512 overweight children and their normal weight peers. They concluded that markers of obesity like skin fold thickness and BMI are associated with high CRP levels, suggesting the presence of low grade inflammation among overweight children.10 This is further supported in 2006 by the research work of Thorand et al. in Germany. They suggested that adiposity is strongly associated with markers of low grade systemic inflammation and this is especially true among females for raised CRP levels.11

A Taiwanese study done by Cheng et al. in 2010 on 1669 individuals showed a strong association of all indicators of obesity (% fat mass of body, BMI, WHR and waist circumference) with high CRP levels among female patients; whereas in males, WHR was not associated with high CRP levels. However, the percentage fat mass was the only indicator of adiposity that had a positive association with raised CRP levels. They stressed the importance of estimating percentage fat mass of body as a better indicator of obesity for determination of cardiovascular risk.12 Their results in the male population are strongly consistent with our results. This is primarily due to same demographics (i.e. South Asian region) of the two study populations.

According to a Finnish study done by Gang et al., high sensitivity CRP was associated with increased risk of developing type 2 diabetes mellitus and this association was much stronger in females as compared to males.13

In this study, the female patients had a trend of higher CRP level as the waist-to-hip ratio increased, but this was not statistically significant. This increasing trend among female gender is consistent with this Finnish study.

Craig et al. conducted a research in 2007 on 767 subjects from Tongan population to identify cut points in anthropometric indexes to predict undiagnosed diabetes and cardiovascular risk estimation.14 They used BMI, waist circumference, weight-to-height ratio, percentage fat mass estimation and WHR to determine undiagnosed diabetes and cardiovascular risk. Their study showed marked difference in cut points as compared to Asian and Caucasian populations.

Thompson et al. worked on British women in 2005, to determine association between CRP and phenotypic components of the metabolic syndrome. They concluded that BMI, WHR, systolic blood pressure and insulin resistance were associated with CRP levels. However, the instrumental variable analysis showed no causal association between CRP and phenotypes of metabolic syndrome.15

There had been numerous studies to find association of these anthropometric measurements with overall cardiovascular risk. Many researchers prefer to consider waist circumference and WHR as better indicators of central obesity and hence future risk of morbidity and mortality due to cardiac problems, whereas others label BMI as a better parameter.16,17 The main aim of these measurements is estimation of visceral fat accumulation, which is an important component of metabolic syndrome.18,19 Halting this process of fat accumulation by early recognition of visceral obesity, lifestyle modification or pharmacological treatment of underlying conditions is important to achieve better outcomes.20

To the best of author’s knowledge, this is the first attempt to study the relationship of CRP with anthropometric index, i.e. WHR, among subjects in Lahore. However, in future, the authors plan to extend their research as a longitudinal study of these parameters in detail with large group of patients.

**CONCLUSION**

Although impact of central obesity on cardiac health is well known; however, WHR alone is an unreliable indicator of systemic inflammation. In fact, taking an account of all determinants of central obesity (e.g.: BMI, skin fold thickness, waist circumference and percentage fat mass of the body) is a better method to judge the presence of raised CRP, leading to endothelial injury, vascular inflammation, atherogenesis; and hence, future risk of developing complications due to cardiovascular disease.
REFERENCES


