Research Article

Relation between high sensitivity C reactive protein to obesity among indians

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Received April 28, 2015. Accepted May 12, 2015

Abstract

Background: Indians tend to have excess body fat and abdominal and truncal adiposity. These features have been referred to as the "Asian Indian phenotype or paradox." The adipose tissue produces proinflammatory cytokines. Little data exist about the relationship between obesity inflammation in Indians.

Objective: To correlate high-sensitivity C-reactive protein (hs-CRP) to various anthropometric parameters and various grades of obesity.

Materials and Methods: This cross-sectional study was conducted in a tertiary-care center in north Karnataka. About 100 participants aged 20–60 years, who fulfilled the inclusion–exclusion criteria were enrolled for the study. Informed consent was taken from the participants. Anthropometric values were taken based on standard guidelines. The hs-CRP and other routine blood investigations were done. Statistical analysis was done using descriptive methodologies such as mean, standard deviation, and regression analysis.

Result: About 100 participants were enrolled (39 women and 61 men). Their mean hs-CRP was 3.55 ± 1.88 mg/L. Women revealed higher CRP (4.12 ± 2.43 mg/L) when compared with men subjects (3.19 ± 1.32 mg/L). On the basis of body mass index (BMI) (mean, 25.74 ± 4.07 kg/m^2), participants with BMI > 23 kg/m^2 showed higher CRP (3.99 ± 1.96 mg/L) when compared with participants with BMI between 18.5 kg/m^2. and 23 kg/m^2 as controls (2.42 ± 0.98 mg/L). As the grades of obesity increased, the CRP increased accordingly. On regression analysis, correlation of hs-CRP with anthropometric values was stronger for BMI (r = 0.51), waist circumference (WC) (r = 0.42) than for waist-to-hip ratio (WHR) (r = 0.32). The hs-CRP was classified risk-wise as low, average, and high, based on CDC/AHA guidelines. A high level of hs-CRP was correlated with obese group.

Conclusion: CRP, a key inflammatory marker, increases with increasing grades of BMI. CRP level correlates with all the anthropometric parameters, more so with WC than BMI or WHR among Indians. In this study, we also found that women showed an elevated CRP when compared with men.

KEY WORDS: CRP, BMI, waist circumference, WHR

Access this article online	
Website: http://www.ijmsph.com	Quick Response Code:
DOI: 10.5455/ijmsph.2015.280420153141	

Introduction

Our view about adipose tissue has changed from that of a passive storage organ to an endocrine organ. Recently, many hormones and inflammatory chemical mediators were detected to be released from the adipose tissue, which contribute to the inflammatory milieu. The development of obesity, metabolic syndrome, and vascular diseases—an inflammatory condition, in sequence, suggests that the adipose tissue itself may be an important source of proinflammatory mediators. About 30% of the total body interleukin

(IL)-6 is synthesized by the adipose tissue, which is a very important proinflammatory cytokine. India is considered to be the capital of diabetes and metabolic syndrome. For any given body mass index (BMI), the Indians tend to show an increased waist circumference (WC).[1] Furthermore, Indians also tend to reveal an excess body fat and abdominal and truncal adiposity. Similarly, for any given WC, Indians tend to exhibit an increased fat accumulation and increased insulin resistance.[1] These features have been referred to as the "Asian Indian phenotype or paradox."[2]

Little data exit about the relationship between obesity and inflammatory markers in Indians. C-reactive protein (CRP) is a very sensitive marker of inflammation. This study was done to correlate between obesity and inflammation.

Objective

To correlate high-sensitivity C-reactive protein (hs-CRP) to various anthropometric parameters and various grades of obesity.

Materials and Methods

This case–control study was carried out in a tertiary-care hospital, Karnataka, India, over 1 year. Permission was taken from the hospital's ethical committee. About 100 subjects aged 20–60 years, attending the executive health check-up, were enrolled. Subjects with BMI between 18.5 and 23 kg/m^2 were grouped as control, and those above 23 kg/m^2 were taken as cases. Subjects with diabetes, hypertension, ischemic heart disease, or angina, subjects who experienced trauma or surgery within 2 months, infection/inflammation, or any systemic illness, and subjects with creatinine of more than 1.5 mg/dL were excluded. Subjects on oral antidiabetic/antihypertensive/hypolipidemic medication were also excluded. BMI was calculated for all patients. The BMI was calculated as weight (kg)/height (m^2). WC was measured at the level of the high point of the iliac crest, and hip circumference was measured at the level of maximum extension of the buttocks. The waist-to-hip ratio (WHR), calculated as the waist circumference divided by hip circumference, was used as an indicator of abdominal visceral fat. CRP levels were measured by using nephelometry, a latex particle-enhanced immunoassay (NA Latex CRP Kit, Dade Behring, Tokyo, Japan]. The material has achieved international standardization in the assay of CRP. The function of the assay was found to be satisfactory.[3] The assay is sensitive enough to detect 0.5 mg/L of CRP. Undetectable CRP values were recorded as 0.015 mg/L. Mean, standard deviation, and regression analysis were used for the statistical analysis of the obtained data.

Result

A total of 100 participants were enrolled in the study, which included 39 women and 61 men [Table 1]. Their BMI ranged from 18.75 to 36.71 kg/m^2, and their mean value was 25.57 ± 4.07 kg/m^2. WC ranged from 69 to 116 cm for women and 69 to 120 cm for men. CRP varied from 0.5 to 11.6 (mean 3.55 ± 1.88) mg/L. Women revealed a higher CRP (4.12 ± 2.43 mg/L) when compared with men (3.19 ± 1.32 mg/L). This difference in CRP was statistically significant ($p < 0.02$). This is suggestive of the fact that women present a higher inflammation rate than men.

Table 1: Population characteristics

Parameters	Mean ± SD, $n = 100$
Age	42.50 ± 9.806
SBP (mm Hg)	120.54 ± 7.89
DBP(mm Hg)	77.28 ± 6.97
BMI (kg/m^2)	25.57 ± 4.07
WC (cm)	93.87 ± 10.45
WHR	0.92 ± 0.07
FBS (mg/dL)	89.06 ± 9.17
PPBS (mg/dL)	116.05 ± 16.10
CRP (mg/L)	3.55 ± 1.88

Table 2: Showing correlation between various grades of BMI and hs-CRP

Grades BMI (kg/m^2)	CRP (mg/L)
Group A, 18.5–22.9, $n = 28$	2.42 ± 0.98
Group B, 23.0–24.9, $n = 23$	3.06 ± 0.55
Group C, 25.0–29.9, $n = 33$	3.84 ± 1.79
Group D, >30, $n = 16$	5.65 ± 2.58

The participants were classified into four groups based on the various grades of obesity as per Asia Pacific Task Force guidelines[4] [Table 2]. Group A consisted of participants with BMI between 18.5 and 22.9 kg/m^2 (control); group B, 23.0–24.9 kg/m^2 (overweight); group C, 25.0–29.9 kg/m^2 (obese 1); and group D >30 kg/m^2 (obese 2). A comparison between groups A and B, groups B and C, and groups C and D showed that there was an increase in the level of CRP, which was statistically significant (group A vs. group B, p 0.001; group B vs. group C, p 0.001; and group C vs. group D, p 0.001). On the basis of the BMI, patients with BMI between 18.5 and 23 kg/m^2 were considered as control and those with BMI more than 23 kg/m^2 as cases. Subjects were matched for age, blood pressure, and blood sugar levels. There is an increase in the level of CRP in cases (3.99 ± 1.96 mg/L) when compared with control (2.42 ± 0.98 mg/L), with statistically significant p value of <0.001.

WC, a measure of abdominal obesity, is set separate for men and women by the Asia Pacific Task Force. Women were grouped into two groups: those with WC of <80 cm as controls ($n = 2$) and ≥80 cm ($n = 37$) as cases. Similarly, men were also grouped: those with WC < 90 cm ($n = 19$) as controls and ≥90 cm ($n = 42$) as cases. For women, the mean CRP of the control group was 2.40 ± 0.71 mg/L, and that for cases was

Table 3: Levels of CRP and anthropometric measurement

CRP (mg/L)	Low risk <1, *n* = 3	Average risk 1–3, *n* = 35	High risk >3, *n* = 62
BMI (kg/m²)	22.24 ± 0.23	23.03 ± 2.54	27.17 ± 4.06
WC (cm)	86.00 ± 8.19	88.20 ± 9.05	97.45 ± 9.74
WHR	0.87 ± 0.03	0.90 ± 0.07	0.94 ± 0.06

4.21 ± 2.46 mg/L. This increase in the value of CRP was statistically insignificant ($p<0.312$). Among men, cases showed statistically significant elevated CRP of 3.50 ± 1.39 mg/L when compared with that of 2.51 ± 0.80 mg/L in the control group ($p < 0.006$). Similarly, WHR guidelines are set separately for men and women. Women with the WHR of <0.80 are graded as normal, and those with ≥0.80 as obese, and for men, those with WHR <0.95 are normal and with ≥0.95 as obese. Women with WHR of >0.80 ($n = 37$) showed CRP level of 4.21 ± 2.46 mg/L when compared with those with WHR of <0.80 ($n = 2$) of 2.41 ± 2.36 mg/L. This increase in the level of CRP is statistically insignificant ($p = 0.142$). But, men with high WHR of >0.95 ($n =24$) showed statistically elevated CRP of 3.65 ± 1.50 mg/L when compared with CRP of 2.77 ± 0.94 mg/L seen in those with normal WHR of <0.95 ($n = 32$; $p < 0.005$).

Association of CRP with anthropometric value was stronger for WC and BMI than for WHR ($r = 0.51$ for BMI, 0.42 for WC, and 0.32 for WHR). A correlation of various levels of CRP with that of anthropometric variables was also done [Table 3]. CRP values were divided into three levels as low risk (<1 mg/L), average risk (1–3 mg/L), and high risk (>3 mg/L). There were three participants with low risk, 35 of them with average risk, and 62 of them with high risk. On comparing between those with low-risk and average-risk CRP levels, there was insignificant increase in the BMI (22.24 ± 0.23 kg/m² to 23.03 ± 2.54 kg/m², $p = 0.6024$), WC (86.00 ± 8.19 cm to 88.20 ± 9.05 cm, $p = 0.6872$), and WHR (0.87 ± 0.03 to 0.90 ± 0.07, $p = 0.5004$). On a similar comparison between average and high risk CRP levels, there was statistically significant increase in the mean BMI (23.03 ± 2.54 kg/m² to 27.17 ± 4.06 kg/m²), WC (88.20 ± 8.19 cm to 97.45 ± 9.74 cm), and WHR (0.90 ± 0.07 to 0.94 ± 0.06) with p value of <0.001, <0.001, and <0.001, respectively.

Discussion

The study was aimed to assess the relation between the hs-CRP and various grades of obesity. Obesity is increasing to epidemic proportions in India. The prevalence of obesity has also risen in children and adolescents. In parallel, there is also an increase in the coronary events in young adults. Recent evidence suggests that atherosclerosis, a cause for coronary vascular events, is an inflammatory condition. Moreover, many inflammatory cytokines are said to be released from adipose tissue. Among all the proinflammatory cytokines, IL-6 plays a major role, most of which is produced from adipose tissue. This cytokine and other proinflammatory mediators released from adipose tissue stimulate the release of CRP—a novel inflammatory marker released from the liver. In this study, we tried to rule out all possible inflammatory and infectious causes where CRP could have increased. So, we choose participants from voluntary health check-up.

The study population was matched for age, BMI, WC, and WHR. In this study, women showed elevated levels of CRP when compared with men. This gender difference has been reported in other studies.[5] This shows that women have high inflammatory burden when compared with men because of obesity. This could be because of the hormonal effects. The study showed no relation between the age and CRP. Other studies have shown modest relation between age and CRP.[6]

BMI was classified based on the Asia Pacific task force recommendation and correlated with hs-CRP. There was statistically significant increase in the level of CRP when compared between various groups. Similar correlation was found in a study on western population.[7,8] Furthermore, CRP was correlated with each anthropometric parameter. There was no difference in the age, systolic blood pressure (SBP), diastolic blood pressure (DBP), and blood sugar level between nonobese and obese group. The obese group showed a high mean CRP when compared with normal weight, nonobese group. This statistically significant increase in the CRP may imply that obese people are prone to atherosclerosis, because atherosclerosis is considered to be an inflammatory condition. Similar reports have been observed in other studies, but BMI categorization has not been uniform.[9] WC and WHR were also classified based on the Asia Pacific task force guidelines. Women with WC < 80 cm showed a lower CRP when compared with those with >80 cm, which was statistically insignificant. This insignificant increase could be because of less number of women with WC < 80 cm. Further studies are required with more number of participants in each group. Similarly, men with WC ≥ 90 cm showed statistically significant increase in the CRP when compared with those with WC < 90 cm. Similar results were found in other studies.[7,9] Another study reported that, after adjustment for BMI, hip circumference and WHR were no longer associated with CRP whereas WC was still.[9] This indicates that WC is a more good measure of obesity than any other anthropometric parameter. Similarly, although women with WHR of ≥0.85 showed a high CRP when compared with those with WHR less than 0.85, it was statistically insignificant. This was because of less number of participants with WHR < 0.85. But, men with WHR more than equals to 0.95 revealed a higher CRP when compared with those with WHR less than 0.95. This increase in CRP was statistically significant.

On regression analysis, the correlation of CRP with anthropometric value was stronger for BMI ($r = 0.51$) and WC ($r = 0.42$) than for WHR ($r = 0.32$). This correlation is similar to that found in other studies.[8,10]

In our study, WC and BMI correlated better than WHR indicating that abdominal obesity rather than generalized

obesity is the main cause of metabolic syndrome, insulin resistance, and coronary heart disease (CHD) seen in Indians.

For serum hs-CRP concentration, we used the three-tiered categorization into low-risk (<1 mg/L), average-risk (1–3 mg/L), and high-risk (>3 mg/L) groups based on CDC/AHA guidelines. We then correlated hs-CRP value with the mean of anthropometric measures.

Subjects with hs-CRP in high-risk group were more obese when compared with those in average-risk and low-risk groups. This rise in anthropometric measures between high- and average-risk groups was statistically significant, but between those with low- and average-risk groups was insignificant. This could be because of the less number of subjects in the low-risk group. These results are in concordance with other studies.[8,11]

Conclusion

The hs-CRP, a key inflammatory marker, increases with increasing grades of BMI. The hs-CRP level correlates with all the anthropometric parameters, more so with WC than BMI or WHR. In addition, this study shows that women revealed elevated CRP when compared with men and there is no correlation between age and hs-CRP.

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How to cite this article: Sadanand CD, Anitha J, Raveesh PM. Relation between high sensitivity C reactive protein to obesity among indians. Int J Med Sci Public Health 2015;4:1523-1526

Source of Support: Nil, **Conflict of Interest:** None declared.