

## Research Article

# Elevated C reactive protein levels in obese individuals with metabolic syndromes

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## ABSTRACT

**Background:** C reactive protein (CRP) is a sensitive marker of inflammation. Apart from CRP, obesity is also one of the established risk factor for CVD in adults and children. This study was therefore conducted to assess the association between elevated levels of CRP and obesity.

**Methods:** 1432 patients, >35 years of age who had come to our hospital for the assessment of risk factors for Cardiovascular disease were included into study. A detailed medical and clinical history was taken from all the patients and BMI was calculated based on the height and weight. Phlebotomy was performed on all patients and blood was collected to test the samples for CRP, LDL cholesterol, HDL cholesterol, triglycerides, fasting blood glucose, uric acid.

**Results:** The mean age for 1432 patients was 55.3 years. Males had a mean age of 57.2 years and females were 52.9 years. The levels of CRP were within the normal ranges till class I obese individuals. Among the class II and III patients there was an elevated level of CRP. Only about 4.5% of the patients with CRP levels more than 10 mg/l had normal BMI while 42.8% of the patients were under the class III obese BMI.

**Conclusions:** It was shown in our studies that higher BMI is associated with higher CRP concentrations especially in patients with metabolic syndromes.

**Keywords:** C reactive protein, Obesity, Metabolic syndromes

## INTRODUCTION

The acute phase protein, the C reactive protein (CRP) is a sensitive marker of inflammation. Plasma CRP levels are low in healthy patients without acute illness. But through the use of high sensitivity tests, it has been possible to investigate the relation between plasma CRP levels and cardiovascular disease and inflammation.<sup>1,2</sup> These tests have shown that CRP is independently associated with the risk of cardiovascular disease causing severe morbidity and mortality along with acute coronary events in both men and women.<sup>3-7</sup>

Apart from CRP, obesity is also one of the established risk factor for CVD in adults and children.<sup>8,9</sup> Obesity has

double worldwide since 1980. In 2014, it has been estimated that more than 1.9 billion adults who were 18 years or older were overweight, and of these 600 were obese. 39% of the adults aged 18 years and over were overweight in 2014 and 13% were obese.<sup>10</sup>

Adipose tissue has always been considered a passive storage depot for fat, but it is also known to play an active role in metabolism by producing the proinflammatory cytokine, interleukin-6 (IL 6).<sup>11-14</sup> As IL-6 has inflammatory properties, as well as stimulation of acute phase protein production in liver, the release of IL-6 from adipose tissue may induce low-grade systemic inflammation in persons with excess body.<sup>15,16</sup>

This study was therefore conducted to assess the association between elevated levels of CRP and obesity in patients with metabolic syndromes.

## METHODS

1432 patients >35 years who had come to the Department of Medicine were included into the study. This study was conducted over a period of two years at Bhaskara Medical College. All these patients had come to our hospital for the assessment of risk factors for cardiovascular disease.

All these patients were included into the study after obtaining an informed consent. Patients who refused the informed consent or those with an overt inflammatory disease were excluded from the study.

A detailed medical and clinical history was taken from all the patients. Demographic details such as age, gender, height, weight etc. were taken. History of cigarette smoking was noted as 'never', 'occasional' or 'regular'. Amount of physical activity was also categorized as never, rare or regular, depending the amount of physical activity done by the patient. BMI was calculated based on Weight (kg) and height (m) of the patient using the formula  $\text{weight/height}^2$ . Patients were categorized as normal with BMI <25 kg/m<sup>2</sup>, overweight BMI 25.0-29.9 kg/m<sup>2</sup>, Class I obese BMI 30.0-34.9 kg/m<sup>2</sup>; Class II obese BMI 35.0-39.9 kg/m<sup>2</sup>; and class III obese BMI 40.0 kg/m<sup>2</sup>. This categorization was according to the classification proposed by World Health Organizational expert committee.<sup>17</sup>

The categorization of metabolic syndrome in patients was based on the third report of national cholesterol educational program expert panel on detection, Evaluation and treatment of high blood cholesterol in adults' criteria.<sup>18</sup> The following cutoff limits were as per this criteria; 1. Blood pressure  $\geq 135/85$  mmHg, (2) triglyceride 150 mg/dl, (3) low HDL cholesterol 40 mg/dl for men and 50 mg/dl for women, (4) fasting glucose 110 mg/dl (5) a BMI cut point of 30 kg/m<sup>2</sup> for obesity.<sup>19</sup> Patients with 3 or more of the above criteria were considered to have a metabolic syndrome.

Phlebotomy was performed on all patients and blood was collected to test the samples for CRP, LDL cholesterol, HDL cholesterol, triglycerides, fasting blood glucose, uric acid.

All statistical analysis was performed using SPSS statistical software (version 10.1).

## RESULTS

The mean age for 1432 patients was 55.3 years. Males had a mean age of 57.2 years and females were 52.9 years. Of the patients around 40% had a family history of diabetes.

**Table 1: Demographic details of the patients.**

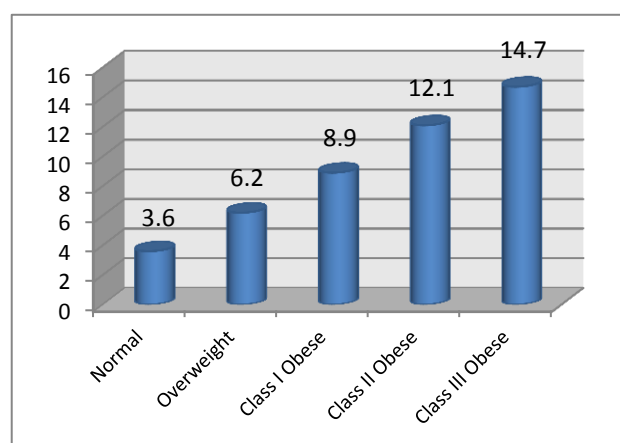
Parameters	Mean in males n= 687	Mean in females n= 745
Age	57.2 $\pm$ 3.8	52.9 $\pm$ 4.3
Weight	91.9 $\pm$ 2.9	66.9 $\pm$ 3.5
Height	5 ft 10 inches $\pm$ 2 in	5 ft 2 in $\pm$ 5in
Family history of diabetes	289 (42.1%)	231 (31%)
Smoking status		
Never	308 (44.8%)	709 (95.2%)
Occasional	166 (24.2%)	28 (3.7%)
Regular	213 (31%)	8 (1.1%)
Alcoholism		
Never	346(50.4%)	597 (80.2%)
Occasionally	199 (29%)	106 (14.2%)
Regularly	142 (20.6%)	42 (5.6%)

The average blood pressure of the patients were in the normal range but the lipid profile of the patients and the fasting blood sugars were on the higher side showing that many of the patients were diabetic.

**Table 2: Blood pressure and lipid profile in patients.**

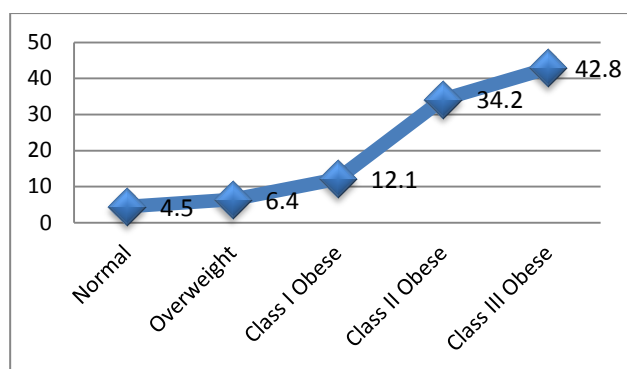
Systolic blood pressure mmHg	128.7 $\pm$ 21.2
Diastolic blood pressure mmHg	87.2 $\pm$ 6.9
Triglyceride (mg/dl)	134.5 $\pm$ 17.1
HDL cholesterol (mg/dl)	42.6 $\pm$ 3.8
LDL cholesterol (mg/dl)	146.8 $\pm$ 3.9
Fasting plasma glucose (mg/dl)	116.1 $\pm$ 17.2
CRP (mg/dl)	8.43 $\pm$ 2.1

The levels of CRP were within the normal ranges till class I obese individuals. Among the class II and III patients there was an elevated level of CRP (Figure 1).



**Figure 1: Levels of CRP in Different categories of BMI.**

Only about 4.5% of the patients with CRP levels more than 10 mg/l had normal BMI while 42.8% of the patients were under the class III obese BMI (Figure 2).



**Figure 2: Percentage of patients with >10 mg/l CRP levels.**

## DISCUSSION

One of the factors which pose a considerable health risk especially for cardiovascular diseases is obesity and overweight and elevated levels of CRP.<sup>20-22</sup> CRP levels above 10 mg/l have been associated with increased risk of myocardial infarction, ischemic stroke and peripheral arterial disease.<sup>23,24</sup> Raised CRP levels release IL6, which is observed in patients with angina.<sup>25,26</sup> These levels are also expected to predict the incidence of cardiovascular disease in patients.<sup>5,27</sup>

Our results showed that in patients above the age of 35 years, CRP is strongly associated with obesity and Body Mass Index and to components of metabolic syndrome. This was independent of other factors which are known to influence CRP levels, such as smoking, HRT and physical activity. Levels of CRP were found to increase with the increasing number of metabolic syndromes, although BMI was found to be the predominant contributor.<sup>28</sup>

This association of metabolic syndrome with elevation of acute phase proteins was shown in many other studies. Festa et al found a linear increase of CRP levels with increase in metabolic disorders and that body mass index, systolic blood pressure and insulin sensitivity were related to CRP levels.<sup>29</sup> Frohlich et al also observed that there was a statistically significant correlation between CRP and BMI, triglycerides, glucose and uric acid and a negative correlation with HDL cholesterol.<sup>30</sup> Similar results were observed in other studies also.<sup>31-33</sup> It was found that subjects with metabolic syndrome had high CRP levels if they were obese that those who were not obese. Also regardless of the presence of metabolic syndrome, obese persons had high CRP levels the normal weight persons.<sup>28,29,34</sup>

Around 25% of the circulating IL6 is estimated to be released by human subcutaneous adipose tissues and stimulates the production of acute phase proteins in the liver. This might explain the relation between CRP and obesity.<sup>15,16</sup>

In our study the levels of IL6 were not available. As a result, the hypothesis that increase in IL6 levels increases the CRP levels could not be verified. Thus future studies should be performed to gather this association.

## CONCLUSION

It was shown in our studies that higher BMI is associated with higher CRP concentrations especially in patients with metabolic syndromes. >10 mg/l levels of CRP suggest a source of infection or inflammation which is more common in obese individuals.

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