Association of C-Reactive Protein and Cardiovascular Disease in Obese Patients

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Abstract

C- reactive protein (CRP) is an acute phase reactant and nonspecific marker of inflammation that is predominantly produced in the liver in response to proinflammatory cytokines, particularly interleukin 6 (IL-6). It has been recognized that approximately 30% of IL-6 originates from adipose tissue and its concentration increases with increasing obesity. This study investigated the association of CRP with cardiovascular disease in obese patients, utilizing National Health and Nutritional Examination Survey (NHANES) data on adults aged ≥40 years of age. Mean CRP levels were significantly higher ($p<0.0001$) in obese subjects (Body Mass Index (BMI) >30 kg/m²) compared to Normal. However, CRP levels were not significantly different ($p=0.0575$) in patients with self-reported history of cardiovascular disease (CVD) compared to those that did not report CVD. People with CVD were 1.5 times more likely to have increased CRP levels and 1.4 times more likely to be obese which was significant. This study also examined if obesity was a risk factor for high CRP levels using logistic regression and found that Individuals with high CRP levels were more likely to be obese ($p<0.0001$). The results of this study have important implications for obese individuals with high CRP levels.

Introduction

- C-reactive protein (CRP) is an acute phase reactant that is predominantly produced in the liver in response to interleukin 6 (IL6), which is one of the cytokines released by activated leukocytes, smooth muscles in atherosclerotic plaques[1], and adipose tissue[2]. It has been recognized that approximately 30% of IL6 originates from adipose tissue and its concentration increases with obesity[3]. Since CRP synthesis in the liver is regulated by IL6, and IL6 increases with obesity, the correlation of increased CRP levels in obese individuals is plausible.
- Obesity has been established as an independent risk factor for cardiovascular disease[4].
- The purpose of this study was to determine the role of CRP in cardiovascular disease in overweight and obese patients.
- Aim 1: To determine the correlation between CRP levels and body mass index.
- Aim 2: To investigate the association of CRP with cardiovascular disease in overweight/obese individuals.

Methods

This was a retrospective observational cross-sectional population based study that utilized National Health and Nutritional Examination Survey (NHANES) data from January 1, 2009 to December 31, 2010. Respondents who were ≥40 years old, had available C-reactive protein results, and had available body mass index results were included in the study.

Results

Demographic Characteristics of the Study Population.

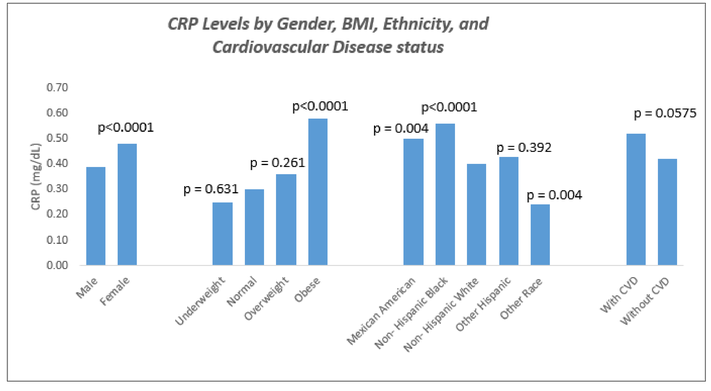
Categories	n (%)	Mean Age	SD
Overall Population	3,759 (100%)	59.42	12.45
Gender			
Male	1,845 (49.08%)	59.56	12.34
Female	1,914 (50.92%)	59.30	12.56
Ethnicity group			
Mexican American (Overall)	665 (17.69%)	56.56	11.01
Male	322 (8.57%)	55.84	10.74
Female	342 (9.10%)	57.24	11.23
Non- Hispanic Black (Overall)	643 (17.10%)	58.14	11.26
Male	327 (8.70%)	57.93	10.77
Female	316 (8.41)	58.34	11.76
Non- Hispanic White	1,907 (50.73%)	61.55	13.13
Male	951 (25.30%)	61.81	13.01
Female	956 (25.43%)	61.30	13.25
Other Hispanic	365 (9.71%)	56.58	11.17
Male	157 (4.18%	56.50	11.24
Female	2,058 (5.53%)	56.69	11.10
Other Race	179 (4.76%)	57.86	12.52
Male	87 (2.31%)	60.13	12.91
Female	92 (2.45%)	55.72	11.80

Note: n is number of respondents; SD is standard deviation

Distribution of Body Mass Index of the Study Population

	n (%)	Mean	SD
BMI Overall Population (mean ± SD)		29.51	6.62
Gender			
Male	1,845 (49.08%)	29.05	5.72
Female	1,914 (50.92%)	29.97	7.36
Respondents across BMI categories			
Underweight (≤18.50 kg/m²)	51 (1.36%)	17.44	1.17
Normal (18.50-24.99 kg/m²)	851 (22.64%)	22.53	1.69
Overweight (≥25 kg/m² - < 30 kg/m²)	1,353 (36.0%)	27.50	1.41
Obese (≥30 kg/m²)	1504 (40.01%)	35.70	5.62
BMI across Ethnicity Group (mean ± SD)			
Mexican American	665 (17.69%)	30.13	5.37
Non- Hispanic Black	643 (17.10%)	31.08	8.18
Non- Hispanic White	1,907 (50.73%)	29.07	6.49
Other Hispanic	365 (9.71%)	29.63	5.76
Other Race	179 (4.76%)	26.22	5.74

Note: BMI is body mass index measured in kg/m²; n is number of respondents; % is proportion of respondents; SD is standard deviation.



- Mean CRP levels for women were significantly higher than that of men ($p<0.0001$).
- Obese individuals had significantly higher mean CRP levels than those with normal Body Mass Index ($p<0.0001$).
- Non Hispanic Blacks ($p<0.0001$) and Mexican Americans ($p=0.004$) had significantly higher mean CRP levels than Non Hispanic Whites.
- The difference in mean CRP levels among those with and without cardiovascular disease was not significant ($p=0.0575$).

Results

Logistic Regression Analysis Results for Outcome of Cardiovascular Disease Status.

Predictor	OR	95% CI
CRP	1.519*	1.166-1.981
Obesity	1.379*	1.097-1.734

Note: *Statistically significant, OR: odds ratio, CI: confidence interval.

- Results indicate that people with CVD were 1.5 times more likely to have increased CRP levels and were 1.4 times more likely to be obese.
- People with high CRP levels were twice as likely to be overweight or obese (OR: 2.083; CI: 1.539 - 2.819) which was significant.

BMI Categories as Predictors for High CRP Levels.

Categories	OR	95 % CI
BMI: 25 to <30 kg/m²	1.192	0.841 to 1.691
BMI: 30 to <35 kg/m²	1.832*	1.283 to 2.615
BMI: 35 to <40 kg/m²	3.458*	2.359 to 5.071
BMI: ≥40 kg/m²	6.867*	4.677 to 10.082

* statistically significant, OR is odds ratio, CI is confidence interval, BMI is body mass index

Conclusions and Discussion

- CRP levels are significantly increased in obese individuals and levels increase with increasing levels of obesity.
- There is no association of increased CRP with overweight status of an individual.
- Increased CRP levels and obesity are independent predictors of cardiovascular disease.
- Reducing obesity could potentially reduce CRP levels, thus decreasing CVD risk. Therefore, incorporation of CRP levels in the cardiovascular disease assessment for obese individuals could help to identify individuals who are at risk of cardiovascular disease.

References

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