Original Research Article

Association between obesity and c reactive protein among patients with risk factors for cardiovascular disease

Ch Bhadra Reddy1,*, Kunachgi Preeti Nagkumar1, M Hima Bindu2, Chinthaparthi Mallikarjuna Reddy2

1Dept. of General Medicine, Mallareddy Institute of Medical Sciences, Suraram, Hyderabad, Telangana, India
2Dept. of Microbiology, Mallareddy Institute of Medical Sciences, Suraram, Hyderabad, Telangana, India

A R T I C L E   I N F O

Article history:
Received 19-02-2021
Accepted 24-04-2021
Available online 07-06-2021

Keywords:
Obesity
Overweight
BMI
C Reactive Protein

A B S T R A C T

Background: One of the main markers of inflammation is C reactive protein, which is normally raised in patients with myocardial infarction, vascular diseases, stroke or sudden cardiac death. Obesity is associated with a raised CRP level probably due to the cytokine stimulation by the adipose tissues. Elevated CRP with an addition of overweight/obesity is a risk factor for cardiac disorders.

Materials and Methods: Demographic details were taken from 371 patients with cardiovascular risk factors and blood was sent for CRP and lipid profile. Height and weight were noted for the calculation of BMI.

Results: The mean age of the males was 48.37 ± 8.92 years and of the females the same was 45.72 ± 6.23 years, the male to female ratio was 2.1:1. 38.8% of the people were under normal weight, 39% were overweight and 22.1% were obese. A majority of the overweight patients (61.4%) had elevated CRP levels, and 10.3% had clinically raised CRP levels. Amongst the obese patients, 43.9% had clinically raised CRP levels while 35.4% had elevated CRP levels.

Conclusions: There is a strong association between the increase in weight among the patients and elevated CRP levels. Both these two are not only the risk factors of CVD, but also the cause of depression and reduced quality of life among the individuals.

© This is an open access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/) which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

1. Introduction

Inflammation of the arteries is one of the causes of atherosclerosis.1,2 One of the main markers of inflammation is C reactive protein, which is normally raised in patients with myocardial infarction, vascular diseases, stroke or sudden cardiac death.3,4

Adipose tissue earlier used to have a passive role in storage of fat in the body, but now it is known to play an active role in its metabolism.5,6 One of the compounds that is released into the blood circulation by the adipose tissues is the proinflammatory cytokine interleukin (IL6).7,8 About 25% of the IL6 produced in the body is secreted by the adipose tissues.9

*Corresponding author.
E-mail address: cpmreddy@gmail.com (C. B. Reddy).

The incidence of overweight and obese persons in increasing worldwide probably due to inactivity of the people with very less physical activity, change of life style and diet. This is seen more so among the children and adolescents, where in the subjects prefer to be indoors with internet rather that physical exercise outdoors. This may lead in atherosclerosis and elevated blood pressure as they grow older.10 In the United states alone it is reported that >50% of the adults are overweight and around one in every five individuals is obese. The fatality rates among the obese individuals is also high.11,12

Obesity is associated with a raised CRP level probably due to the cytokine stimulation by the adipose tissues. Elevated CRP with an addition of overweight/obesity is a risk factor for cardiac disorders. Other independent factors
for the cardiovascular diseases are diabetes, hypertension, and insulin resistance. Elevated CRP for longer periods is a feature of acute inflammation, probably due to an ongoing inflammation, and must be differentiated from chronic infection. Therefore, a CRP test must be done to confirm after 2 weeks of the first test.

We had performed this study to assess the association between obesity and elevated levels of CRP.

2. Materials and Methods

This cross sectional study was performed by the Department of Medicine and Microbiology at Mallareddy Institute of Medical Sciences from June 2019 to September 2021. This study was cleared by the institutional Ethical Committee. 371 patients with cardiovascular risk factors who had come to our hospital for treatment were explained the nature of the study in detail and were enrolled into the study after obtaining the informed consent. A detailed medical history was taken for all the patients and demographic details were also noted. All pregnant women were excluded from the study and patients who had overt inflammatory diseases were also excluded. Patients who were on drugs for hypertension or diabetes mellitus were also excluded from the study.

All the patients were asked about history of smoking, alcoholism, familial status diabetes etc. and the details were noted. The height and weight of the patients was taken and body mass index was calculated.

Blood was collected by phlebotomy and was sent for tests such as complete blood picture, random blood sugar levels, Hba1c, Lipid profile and C reactive protein levels. C reactive protein was estimated using chemiluminescence and a value of \( \leq 0.22 \text{mg/dL} \) was considered to be normal, between 0.22 and 1.00 mg/dL was considered elevated and more than 1.00 mg/dL was considered to be clinically raised levels for CRP.

3. Results

371 patients were included into the study, out of which 252 (67.9%) patients were males and 119 (32.1%) were females. The mean age of the males was 48.37±8.92 years and of the females the same was 45.72 ± 6.23 years. The body mass index was normal in 105 (41.67%) males and in 39 (32.8%) females, while 92 (36.5%) and 53 (44.5%) of males and females respectively were overweight and 55 (21.8%) of the males and 27 (22.7%) had clinically raised CRP levels. However, among the overweight people, a majority of them had elevated CRP levels, with 89 (61.4%) and 15 (10.3%) had clinically raised CRP levels. Amongst the obese patients, 36 (43.9%) had clinically raised CRP levels while 29 (35.4%) had elevated CRP levels (Figure 1). Only 17 (13.9%) had normal levels.

4. Discussion

Obesity is one of the most common condition which impairs health and quality of life among the people, not to mention leading to depression. This condition, along with other risk factors, lead to atherosclerosis and cardiovascular diseases. Apart from obesity, low grade inflammation is also said to be a risk factor.13,14

In this study, we assessed the increased CRP levels among the increase in weight of the patients. The number of males in our study was higher than the females with a male to female ratio of 2.1:1. However, more percentage of women than men were either overweight or obese. This

| Variables                    | Male     | Female   |
|------------------------------|----------|----------|
| Number                       | 252 (67.9%) | 119 (32.1%) |
| Age (Mean in years ±SD)      | 48.37±8.92 | 45.72 ± 6.23 |
| BMI Normal (<25 kg/m²)       | 105 (41.67%) | 39 (32.8%) |
| Obese (≥ 30 kg/m²)           | 55 (21.8%)   | 27 (22.7%)   |
| Smoking Status               |           |           |
| Regular                      | 48 (19.1%)   | 7 (5.9%)    |
| Occasional                   | 103 (40.9%) | 24 (20.2%)  |
| Never                        | 101 (40.1%) | 88 (73.9%)  |
| Alcohol Status               |           |           |
| Regular                      | 29 (11.5%)   | 9 (7.6%)    |
| Occasional                   | 92 (36.5%)   | 21 (17.6%)  |
| Never                        | 131 (52%)    | 89 (74.8%)  |
| Familial history of diabetes | 149 (59.1%)  | 77 (64.7%)  |
| History of comorbid diseases |           |           |
| Inflammatory diseases        | 43 (17.1%) | 31 (26.1%) |
| Cardiovascular diseases      | 66 (26.2%) | 52 (43.7%) |
| Diabetes                     | 102 (40.5%) | 69 (58%)   |
| Hypothyroidism               | 76 (30.2%) | 61 (51.3%) |
| Estrogen use                 |           |           |
| None                         | 79 (66.4%) |          |
| Contraceptives               | 31 (26.1%) |          |
| Hormone replacement          | 9 (7.6%)   |          |
A study by Meyer et al reported that obese patients who had depressive moods also had elevated CRP levels. Christian et al also reported that in elderly, the poor self-rated health is associated with an elevated CRP levels and IL-6 levels and thereby affecting the quality of life.

5. Conclusions

There is a strong association between the increase in weight among the patients and elevated CRP levels. Higher CRP levels denote an infection or inflammation and is more common among the obese patients. Both these two are not only the risk factors of CVD, but also the cause of depression and reduced quality of life among the individuals. Therefore, an early detection is necessary to prevent CVD and improve quality of life.

6. Acknowledgement

None.

7. Source of Funding

No financial support was received for the work within this manuscript.

8. Conflict of Interest

The authors declare that they have no conflict of interest.

References

1. Ross R. Atherosclerosis: An inflammatory disease. N Engl J Med. 1999;340:115–26.
2. Libby P, Ridker PM, Maseri A. Inflammation and Atherosclerosis. Circulation. 2002;105(9):1135–43.
3. Ridker PM. High-sensitivity C-reactive protein: potential adjunct for global risk assessment in the primary prevention of cardiovascular disease. Circulation. 2001;103:1813–8.
4. Ridker PM. Clinical Application of C-Reactive Protein for Cardiovascular Disease Detection and Prevention. Circulation. 2003;107(3):363–9.
5. Flier JS. The adipocyte: Storage depot or node on the energy information superhighway? Cell. 1995;80(1):15–8.
6. Mohamed-Ali V, Pinkney JH, Coppack SW. Adipose tissue as an endocrine and paracrine organ. Int J Obes Relat Metab Disord. 1998;22(12):1145–58.
7. Purohit A, Ghilchik MW, Duncan L, Wang DY, Singh A, Walker MM, et al. Aromatase activity and interleukin-6 production by normal and malignant breast tissues. J Clin Endocrinol Metab. 1998;83:847–50.
8. Ali VM, Goodrick S, Rawesh A. Subcutaneous adipose tissue releases interleukin-6 but not tumour necrosis factor-α in vivo. J Clin Endocrinol Metab. 1997;82:4196–200.
9. Fried SK, Bunkin DA, Greenberg AS. Omental and subcutaneous adipose tissues of obese subjects release interleukin-6. J Clin Endocrinol Metab. 1999;80(10):3052–8.
10. Rani PR, Maheshwari R, Namburi RP, Ponnala AR, Karthik TS. A study on metabolic variables and its association with high sensitive C-reactive protein in obese children and adolescents. Indian J Endocr Metab. 2013;17(7):360–2.
11. Allison DB, Fontaine KR, Manson JE, Stevens J, VanItallie TB. Annual deaths attributable to obesity in the United States. JAMA. 1999;282:1530–8.
12. Willett WC, Dietz WH, Colditz GA. Guidelines for Healthy Weight. *N Engl J Med*. 1999;341(6):427–34. doi:10.1056/nejm199908053410607.

13. Ridker PM, Buring JE, Shih J, Matias M, Hennekens CH. Prospective Study of C-Reactive Protein and the Risk of Future Cardiovascular Events AmongApparently Healthy Women. *Circulation*. 1998;98(8):731–3. doi:10.1161/01.cir.98.8.731.

14. Koenig W, Sund M, Frohlich M, Fischer HG, Löwel H, Döring A, et al. C-reactive protein, a sensitive marker of inflammation, predicts future risk of coronary heart disease in initially healthy middle-aged men. *Circulation*. 1999;99:237–42.

15. Aronson D, Bartha P, Zinder O, Kerner A, Markiewicz W, Avizohar O, et al. Obesity is the major determinant of elevated C-reactive protein in subjects with the metabolic syndrome. *Int J Obest*. 2004;28(5):674–9. doi:10.1016/j.ijb.2004.09.002.

16. Frohlich M, Imhof A, Berg G, Hutchinson WL, Pepys MB, Boeing H, et al. Association between C-reactive protein and features of the metabolic syndrome: a population-based study. *Diabetes Care*. 2000;23(12):1835–9. doi:10.2337/diacare.23.12.1835.

17. Festa A, D’Agostino R, Howard G, Mykkänen L, Tracy RP, Haffner SM, et al. Chronic Subclinical Inflammation as Part of the Insulin Resistance Syndrome. *Circulation*. 2000;102(1):42–7. doi:10.1161/01.cir.102.1.42.

18. Hak AE, Stehouwer CDA, Bots ML, Polderman KH, Schalkwijk CG, Westendorp ICD, et al. Associations of C-Reactive Protein With Measures of Obesity, Insulin Resistance, and Subclinical Atherosclerosis in Healthy, Middle-Aged Women. *Arterioscler Thromb Vasc Biol*. 1999;19(8):1986–91. doi:10.1161/01.ATV.19.8.1986.

19. Yudkin JS, Stethouwer CD, Emes J, Coppock SW. C-reactive protein in healthy subjects: associations with obesity, insulin resistance, and endothelial dysfunction: a potential role for cytokines originating from adipose tissue? *Arterioscler Thromb Vasc Biol*. 1999;19:972–8. doi:10.1161/01.ATV.19.8.1986.

20. Nishide R, Ando M, Funabashi H, Yoda Y, Nakano M, Shima M, et al. Association of serum hs-CRP and lipids with obesity in school children in a 12-month follow-up study in Japan. *Environ Health Prev Med*. 2015;20(2):116–22. doi:10.1007/s12097-015-9312-6.

21. Tchernof A, Nolan A, Sites CK, Ades PA, Pselhman ET. Weight Loss Reduces C-Reactive Protein Levels in Obese Postmenopausal Women. *Circulation*. 2002;105(5):564–9. doi:10.1161/01.cir.105.5.564.

22. Lemieux I, Pasco A, Prud’homme D, Almeras N, Bogaty P, Nadeau A, et al. Elevated C-reactive protein: another component of the atherothrombotic profile of abdominal obesity. *Arterioscler Thromb Vasc Biol*. 2001;21:961–7.

23. Christian LM, Glaser R, Porter K, Malarkey WB, Beversdorf D, Kiecolt-Glaser JK, et al. Poorer self-rated health is associated with elevated inflammatory markers among older adults. *Psychoneuroendocrinology*. 2011;36(10):1495–504. doi:10.1016/j.psyneuen.2011.04.003.

24. Heinrich PC, Castell JV, Andus T. Interleukin-6 and the acute phase response. *Biochem J*. 1990;265(3):621–36. doi:10.1042/bj2650621.

25. Meyer AA, Kundt G, Steiner M, Schuff-Werner P, Kienast W. Impaired flow-mediated vasodilation, carotid artery intima-media thickening, and elevated endothelial plasma markers in obese children: The impact of cardiovascular risk factors. *Pediatrics*. 2006;117:1500–7.

Author biography

Ch Bhadra Reddy, Associate Professor

Kunachgi Preeti Nagkumar, Associate Professor

M Hima Bindu, Associate Professor

Chinthaparthi Mallikarjuna Reddy, Associate Professor