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Original Research Article

Association of CRP (C-Reactive Protein) Level with Body Mass Index in Overweight and Obese Persons

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Abstract

Background: Obesity affect people in both developed and developing countries. According to reports, there are about 250 million adults suffering from obesity. In particular, obesity is considered a strong factor in controlling the concentration of circulating CRP concentrations because adipose tissue is involved in the regulation of cytokines. Inspite of being healthy**,** increased adipose tissue depots in overweight and obese persons are associated with subclinical inflammation that leads to slightly increased serum CRP level.

Objectives: This study was conducted to evaluate the association of serum CRP level with BMI in overweight and obese healthy persons as compare to persons having normal BMI.

Methods: Determination & comparison of serum CRP was done between 50 Cases & 50 healthy controls aged from 18 to 45 years. Along with BMI, biochemical parameter CRP analysis was done using immunoassay techniques. Statistical comparison was done, results were expressed as Mean ± SD, $p < 0.05$ was considered to be statistically significant.

Results: All groups were statistically matched in age and sex, means there was no significant difference in age and sex distribution in all groups. Serum CRP concentrations in cases & controls were (2.77 ± 1.36mg/L) & (1.07± 0.59 mg/L) respectively, showing p-value **<0.0001**. Mean CRP concentration in males and females was found to be (2.01±1.30mg/L) and (1.85±1.39mg/L) respectively, showing p value=0.566, i.e. (p >0.05).

Interpretation and conclusion: Although CRP level of both groups was within the normal reference range but significant increases in overweight and obese individuals as compare to controls. A comparatively elevated CRP level in overweight and obese persons as compare to normal persons is an indication of low grade systemic inflammation.

Keywords: Obesity, cytokines, inflammation, CRP (C-reactive protein).

Introduction

Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health. Fundamental cause of obesity and overweight is an energy imbalance between calories consumed and calories expended. Obesity affect people in both developed and developing countries [1]. According to reports, across the world there are about 250 million adults suffering from obesity. [2]

Obesity has become a major global health problem and is associated with risk of type 2 diabetes [3], hypertension and dyslipidemia [4], cardiovascular disease [5] and all cause mortality. [6]

According to WHO data; since 1980, there has been a doubling in the number of obesity around the world. According to the 2016 WHO estimate, 39% of the adult population in the world over the age of 18 is overweight and 13% are obese.

Body mass index (BMI) provides a simple numeric measure of a person's thickness or thinness, allowing health professionals to discuss weight problems more objectively with their patients. **BMI** is a value derived from the mass (weight) and height of a person. The BMI is defined as the body mass divided by the square of the body height and is expressed in units of kg/m^2, resulting from mass in kilograms and height in meters. [7]

The distribution of adipose tissue in different anatomic depots also has substantial implications for morbidity. Specifically, intra-abdominal and abdominal subcutaneous fat have more significance than subcutaneous fat present in the buttocks and

lower extremities. Release of free fatty acids into the portal circulation has adverse metabolic actions, especially on the liver. Adipokines and cytokines that are differentially secreted by adipocyte depots may play a role in the systemic complications of obesity. [8]

C-reactive protein (**CRP**) is found in blood plasma, whose circulating concentrations rise in response to inflammation. It is an acute-phase protein of hepatic origin that increases following interleukin-6 secretion
by macrophages and T cells. Its physiological role is to bind to lysophosphatidylcholine expressed on the surface of dead or dying cells (and some types of bacteria) in order to activate the complement system via C1q. [9]

In particular, obesity is considered a strong factor in controlling the concentration of circulating CRP concentrations because adipose tissue is involved in the regulation of cytokines. Adipose tissue previously was considered a passive storage depot for fat but is now known to play an active role in metabolism. Among the recently discovered compounds expressed in human adipose tissue is the pro inflammatory cytokine interleukin (IL-6). Moreover, IL-6 produced in adipose tissue of healthy humans is released into circulation. Because of the inflammatory properties of IL-6, including the stimulation of acute phase protein production in the liver, the release of IL-6 from adipose tissue may induce low grade systemic inflammation in persons with excessive body fat. [10]

Obesity is a global problem affecting people of all ages. Obesity itself is not a disease but it leads to many health problems in future. There have been many studies related to obesity but only few studies regarding the relationship of CRP and obesity have been conducted. In India there haven't been done significant researches related to this. So it seems to be a subject of concern for research purpose.

Material and Methods:

The community based comparative study was carried out on 100 healthy adults from the community at Jhalawar city, aged from 18 to 45 years and having no acute or chronic disease at that time. They were divided into two categories of groups, group-I comprised of 50 adults of overweight and obesity and group-II as control who were non obese and had normal BMI. Both groups were matched for age and sex. Participants having history of any acute or chronic inflammatory disease and persons who were chronic alcoholics and who were on chronic use of any anti-inflammatory drugs were excluded from the study. Along with BMI of all participants, CRP level was estimated using immunoassay technique. History and other clinically relevant data was collected from the participants. Statistical analysis of data was done by using SPSS software (version 23.0). Chi – square test and unpaired-t test, were used in data analysis. The data in the study was expressed as mean ± SD, and p value < 0.05 was considered as statistically significant.

Body weight was measured by digital weighing machine in kilograms and height was measured in meters using standard non-stretchable tape. BMI was taken by standard procedures as weight divided by height in meters squared.

According to WHO classification of BMI, underweight (BMI< 18.5 kg/m^2), normal weight (BMI=18.5 to 24.9), overweight (BMI=25 to 29.9), and obese (BMI more than or equal to 30) was taken as standard criteria for group distribution.

Whole venous blood was used for quantitative estimation of CRP**.** EDTA was the anticoagulant used for CRP test. Five milliliter (5 mL) of venous blood sample was drawn under aseptic precautions in sterile tubes. An estimation of CRP level was done by **Micro-point Mlab** in biochemistry laboratory, Jhalawar Medical College, Jhalawar (Rajasthan). CRP test is based on dual antibody sandwich reaction and fluorescent immunoassay.

Results

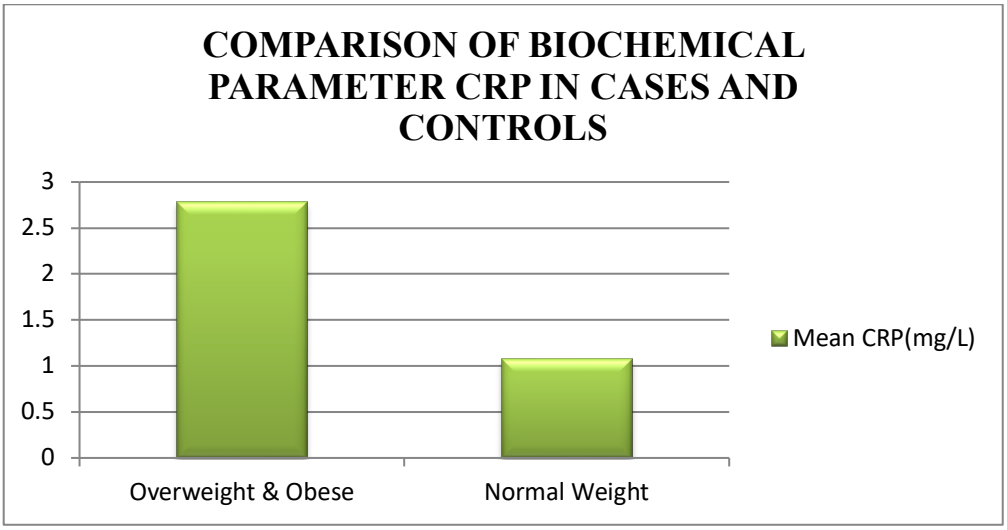
Comparison of age in cases and controls was statistically analyzed using unpaired – t test. The mean age in cases was found to be (35.44 ± 7.42 years). The mean age in controls was found to be (35.70 ± 7.20 years). Statistical analysis showed that p – value was 0.859 i.e. (p > 0.05) therefore the age difference in both groups was statistically insignificant.

Comparison of sex in cases and controls was statistically analyzed using chi – square test. The percentage of males in case group was 48%, whereas the percentage of females was 52%. The percentage of males in control group was 44%, whereas the percentage of females was 56%. Statistical analysis showed that p – value was 0.688, i.e. (p > 0.05) therefore the difference in sex distribution in both groups was statistically insignificant.

Comparison of biochemical parameter CRP concentration in cases and controls (shown in table-1 and graph-1) was statistically analyzed using unpaired – t test. The mean biochemical parameter CRP concentration in Cases was found to be (2.77 ± 1.36mg/L). The mean biochemical parameter CRP concentration in controls was found to be (1.07± 0.59 mg/L). Statistical analysis showed that p – value was **0.0001**, i.e. (p < 0.05) therefore the difference in biochemical parameter CRP concentration in both groups was statistically significant.

Table 1: Comparison of serum CRP between Group - I and Group – II

Biochemical parameter	Group	N	Mean	Std. Deviation	T value	P value
CRP(mg/L)	Overweight & Obese	50	2.7766	1.36364	8.092	**<0.0001**
	Normal Weight	50	1.0748	0.59344		

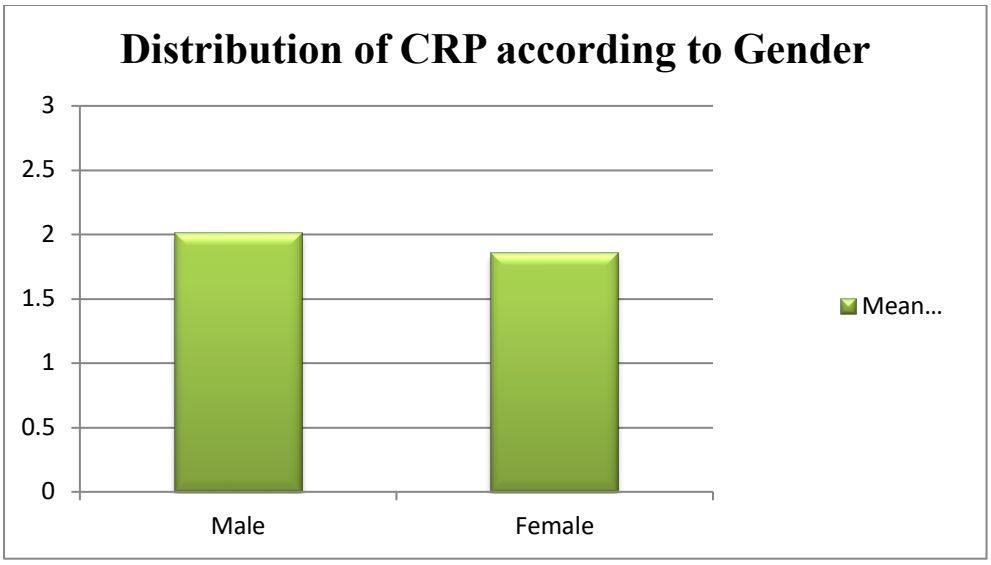


Graph 1: Comparison of biochemical parameter CRP between Group – I and Group – II

Comparison of CRP concentration in male and female (shown in table-2 and graph-2) was statistically analyzed using unpaired – t test. The mean biochemical parameter CRP concentration in male was found to be (2.01±1.30mg/L). The mean biochemical parameter CRP concentration in female was found to be (1.85±1.39mg/L). Statistical analysis showed that p – value was 0.566, i.e. (p >0.05) therefore the difference in CRP concentration in male and female was statistically insignificant.

Table 2: Distribution of CRP according to Gender

Gender	N	Mean CRP(mg/L)	Std. Deviation	T value	P value
Male	46	2.0102	1.30717		
Female	54	1.8537	1.39592	0.575	0.566



Graph 2: Distribution of CRP according to Gender

Discussion

The present observation shows that both cases and controls were statistically matched in age and sex distribution. The mean biochemical parameter CRP concentration in Cases (group I) was found to be (2.77 ± 1.36mg/L) and in controls (group II) was found to be (1.07± 0.59 mg/L). Statistical analysis showed that p–value was **0.0001**, i.e. ($p<0.05$) therefore the difference in biochemical parameter CRP concentration in both groups was statistically significant.

Thus, it was found that overweight and obese persons (BMI >24.9) have higher biochemical parameter CRP concentration than healthy controls (BMI-18.5 to 24.9), and the difference was statistically significant. Although the mean value of CRP was higher for group–I as compare to group-II but the concentration was within the reference interval of biochemical parameter CRP (<10mg/L) for both groups. Moreover difference in mean CRP value of males and females in both groups was statistically insignificant, with p value of 0.566 (p value>0.05).

Obesity was linked to CRP in a large number of cross sectional studies and narrative reviews. [11] Adipose tissue is an active endocrine organ that releases a variety of hormones and cytokines that contribute to CRP elevation. [12] Varying degrees of association between obesity and CRP have been noted in populations of different sex, ethnicity and age.

There are evidences for the presence of CRP in human adipose tissue [13,14] and growing evidence that adipose tissue can induce chronic low-grade inflammation by producing proinflammatory cytokines such as interleukin-6. [15]

Marjolein Visser et al in 1999 did a study to test whether overweight and obesity are associated with low grade systemic inflammation as measured by serum CRP level. Their results also support our study, they found that both overweight (BMI-25-29.9 kg/m^2) and obese (BMI.-more than30kg/m^2) persons were more likely to have elevated CRP levels than their normal weight counterparts. [16]

Results similar to our study were also seen by **Isao Saito and kunio Yonemasu** in 2003 in their study done in Japan. They examined the association of 4 inflammation markers with BMI, body fat, and weight gain and found close relationships of CRP with the obesity indicators in a general Japanese population. The synthesis of CRP is regulated by the pro-inflammatory cytokine IL-6 in the liver and IL-6 is released by the adipose tissue, which is associated with BMI. [15]

Findings similar to our study were also seen in a cross-sectional study conducted during January 2012 to November 2014 by **Shraddha Chakraborty et.al**, Significant increase in the plasma concentrations of leptin and CRP was observed with increased adiposity among adolescents from various schools of Delhi, India. [17]

Similar findings were also seen in a study by **Ch. Bhadra Reddy et.al. in 2021**, it was found that 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. [18]

Researchers have found for every 1 kg loss of weight in adults obtained through surgical, lifestyle, dietary or exercise interventions the mean change in CRP level was -0.13 mg L^{-1}.[19] Weight loss could directly lead to reductions in CRP levels by reducing the excess lipids stored in adipocytes, which are hypertrophied in obesity [20]. All these studies suggest the strong association between CRP and obesity. [21-24]

Conclusion

Biochemical parameter CRP concentration in overweight and obese persons was found to be higher than that of healthy controls having normal BMI and the difference was statistically significant. However, in both groups the biochemical parameter CRP concentration was within the normal limit of reference interval (<10 mg/L) but level was high in overweight and obese as compare to persons having normal BMI. Moreover CRP concentration in males and females of both groups had no significant differences showing no relationship of CRP with sex in either group.

Therefore, from the results of this study, we have concluded that biochemical parameter status of CRP in overweight and obese persons plays a significant role in evaluation of the state of health. A comparatively elevated CRP level in overweight and obese persons as compare to normal persons is an indication of low grade systemic inflammation that can lead to other health problems in future and hence being overweight is not a status of good health. Regular monitoring of biochemical parameter status is an unavoidable step towards achieving a holistic approach to health**.**

The main limitation of our study is the use of limited laboratory indexes. Other inflammatory parameters such as interleukin-6 (IL-6), and tumor necrosis factor alpha (TNF-alpha) etc should be studied as well in the future. Also studies with greater sample size are recommended.

References

1. Kannel WB, D'Agostino RB, Cobb JL: Effect of weight on cardiovascular disease. Am J Clin Nutr 1996, 63(Suppl 4):19-22.

2. Carroll KK: Obesity as a risk factor for certain types of cancer. Lipids 1998, 33:1055-1059.
3. Alberti KG, Zimmet PZ: Definition, diagnosis and classification of diabetes mellitus and its complications. Part 1: diagnosis and classification of diabetes mellitus provisional report of a WHO consultation. Diabet Med 1998, 15:539-553.
4. Kuczmarki RJ, Flegal KM, Campbell SM, Johnson CL: Increasing prevalence of overweight among US adults. The National Health and Nutrition Examination Surveys, 1960 to 1991. JAMA 1998, 22:39-47.
5. Seidell JC, Verschu Ren WM, Van Leer EM, Kromhout D: Overweight, underweight, and mortality: a prospective study of 48,287 men and women. Arch Intern Med 1996, 14:1132-1143.
6. Chan JM, Rimm EB, Colditz GA, Stampfer MJ, Willett WC (1994) Obesity, fat distribution, and weight gain as risk factors for clinical diabetes in men. *Diabetes Care* 17: 961-969.
7. Brown CD, Higgins M, Donato KA, Rohde FC, Garrison R, et al. (2000) Body mass index and the prevalence of hypertension and dyslipidemia. *Obes Res* 8: 605-619.
8. Guh D, Zhang W, Bansback N, Amarsi Z, Birmingham CL, et al. (2009) The incidence of comorbidities related to obesity and overweight: a systematic review and meta-analysis. *BMC Public Health* 9: 88-107.
9. Visscher T, Seidell J, Molarius A, Van Der Kuip D, Hofman A, et al. (2001) Comparison of body mass index, waist-hip ratio and waist circumference as predictors of all-cause mortality among the elderly: the Rotterdam study. *Int J Obes Relat Metab Disord* 25: 1730-1735.
10. "Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee" (htt p://whqlibdoc.who. int/trs/ WHO_ TRS_854.pdf) (PDF). World Health Organization Technical Report Series. 854: 1–452. 1995. PMID 8594834 (https://pubmed. ncbi.nlm. nih.gov/8594834).Archived (https:// web.archive.org/web/20070210134151/http://whqlibdoc.who.int/trs/WHO_TRS_854.pdf) (PDF) from the original on 2007-02-10.
11. Harrison's principles of internal medicine, 20th edition; chaper 394; Pathobiology of Obesity; Jeffrey S. Flier, Eleftheria Maratos-Flier. page no. 2837-2843.
12. Thompson D, Pepys MB, Wood SP (February 1999). "The physiological structure of human C-reactive protein and its complex with phosphocholine". *Structure*. **7** (2):169–77. doi:10.1016/S0969-2126(99)80023-9. PMID 10368284
13. Marjolein Visser et al. Elevated C-reactive protein levels In overweight and obese adults.jama 1999-12-8. Vol 282 no 22. 2131-2135.
14. Brooks GC, Blaha MJ, Blumenthal RS. Relation of C-reactive protein to abdominal adiposity. Am J Cardiol 2010; 106: 56–61.
15. Van Gaal LF, Mertens IL, De Block CE. Mechanisms linking obesity with cardiovascular disease. Nature 2006; 444: 875–880.
16. Ouchi N, Kihara S, Funahashi T, et al. Reciprocal association of C-reactive protein with adiponectin in blood stream and adipose tissue. Circulation 2003; 107: 671-674.
17. Calabro P, Chang DW, Willerson JT, Yeh ET. Release of C-reactive protein in response to inflammatory cytokines by human adipocytes: linking obesity to vascular inflammation. J Am Coll Cardiol 2005; 46: 1112-1113.
18. Bastard JP, Jardel C, Delattre J, Hainque B, Bruckert E, Oberlin F. Evidence for a link between adipose tissue interleukin-6 content and serum C-reactive protein concentrations in obese subjects. Circulation 1999; 99: 2221-2222.
19. Chakdoufi , S., Moumen, A., & Guerboub, A. (2023). Dyslipidemia and Diabetic Retinopathy in Moroccans Type 2 Diabetics Patients: A Cross-Sectional Study. Journal of Medical Research and Health Sciences, 6(3), 2471–2479. https://doi.org/10.52845/JMRHS/2023-6-3-1
20. Selvin E, Paynter NP, Erlinger TP. The effect of weight loss on C-reactive protein: a systematic review. Arch Intern Med 2007; 167: 31–39.
21. Shraddha Chakraborty et al ;Comparison of plasma adipocytokines & C-reactive protein levels in healthy schoolgoing adolescents from private & government-funded schools of Delhi, India. Indian J Med Res 151, January 2020, pp 47-58 DOI: 10.4103/ijmr.IJMR_1631_18
22. 18. Ch Bhadra Reddy et al, Association between obesity and c reactive protein among patients with risk factors for cardiovascular disease. https://doi.org/10.18231/j.ijirm. 2021.026 2581-4214/© 2021.
23. Baumann H, Gauldie J. The acute phase response. Immunol Today 1994; 15: 74–80.
24. Tuck CH, Holleran S, Berglund L. Hormonal regulation of lipoprotein(a) levels: effects of estrogen replacement therapy on lipoprotein(a) and acute phase reactants in postmenopausal women. Arterioscler Thromb Vasc Biol 1997; 17: 1822–1829.