Effects of obesity on inflammation and lipid profile of obese women

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Obesity is known to be a contributing factor through inflammatory mediators to a wide array of disease, ranging from decreased life expectancy to cardiac disease, diabetes, and metabolic syndrome (MS). The chronic low-grade systemic inflammatory response is a major health concern in the life of obese patients. Adipose tissue is responsible for the secretion of cytokines, also known as adipokines, including tumor necrosis factor-alpha (TNF-α) and interleukin-6 (IL-6). The c-reactive protein (CRP) is another adipokine associated with obesity. Several studies have found that the inflammation present in obesity is associated with a significantly increased CRP level in obese people compared to non-obese people.[1] There are many theories on how CRP becomes elevated in obese individuals; one of these is the increased endogenous secretion of TNF-α, IL-6, and other cytokines secreted from adipose tissue are the cause of increased CRP level in obese individuals.[1] The CRP has been associated with an increase risk of cardiovascular disease, stroke, myocardial infarction, and peripheral arterial disease.[2,3]

Elevated CRP stimulates the uptake of low-density lipoproteins (LDL), induces complement activation, enhances infiltrations of monocytes, and stimulates tissue factor production, each of which contributes to the risk of thrombosis and generation of atherosclerotic lesions. The CRP has been proven to decrease after weight loss, or after increased physical activity, which also correlates with a decrease in IL-6 secretion. Both TNF-α and IL-6 have been found to induce insulin resistance in the adipose tissue by inhibiting insulin signaling.[1] Studies found significant increases in TNF-α in circulation as the BMI increased from <30 to ≥30 kg/m^2.[3] Elevated TNF-α induces elevated IL-6 secretion and high levels of IL-6, then induce increased CRP production in the liver.[3]

One study found that obese people had significantly higher serum TNF-α, triglyceride (TG), insulin, and CRP levels than the non-obese people. Elevated plasma levels of TNF-α have also been associated with the presence of the MS, due to its negative effects on insulin signaling. The MS is a disorder that comprises a group of symptoms such as insulin resistance, obesity, dyslipidemia, and hyperuricemia.[4] To confirm the existence of obesity-induced inflammation and dyslipidemia, in this study we investigated the CRP, TNF-α, and lipid profile (TG, cholesterol) in obese women, so the aim of the present study was to determine if obese women have higher circulating CRP and IL-6, compared to non-obese individuals.

This study includes 36 obese (BMI ≥30), and 34 non-obese women (body mass index [BMI] <27), age 35-50 years from Motahari Clinic in Shiraz, Iran from October to December 2007. The exclusion criteria of this study was the presence of any disease such as infection, diabetes mellitus, endocrinology disorders, hereditary diseases, or systemic inflammatory diseases, and smoking, or using any regular medication. The BMI was calculated as the weight (kg) divided by the square of height in meters. After obtaining the consent of the participants, serum concentrations of the CRP, IL-6, TNF-α, total cholesterol, and TG were measured after 12 hours fasting. Serum concentrations of the CRP, IL-6, and TNF-α was measured using a commercially available ELISA kit (Immuno-Biological Laboratories kit for CRP and Biosource kits for IL-6 and TNF-α). Plasma concentration of total cholesterol and TG was also measured by enzymatic methods (by the use of biosystem kits).

Data analysis was carried out using t-test with $p<0.05$ being significant (95% confidence interval) by SPSS software version 11, and data are presented as the mean ± standard error of mean (SEM).

The result showed that the median concentrations of CRP, TG, and cholesterol levels in plasma were all significantly higher in the obese than in the non-obese women, but there were no significant differences between the IL-6 and TNF-α concentration in the 2 groups (**Table 1**). Obesity, the state of the body carrying excess weight contributes to the increased risk of a wide range of health problems among these are cardiovascular disease, hypertension, diabetes, cancer, and so forth. Obesity also induces an inflammatory state in the body by increasing secretion of inflammatory markers such as TNF-α and IL-6, as adipose tissue acts as an endocrine organ by releasing these adipokines. It would follow that

Table 1 - Biochemical parameters in the obese and non-obese groups.

Parameters	Non-obese group (n=34)	Obese group (n=36)	*P*-value
Cholesterol (mg/dl)	160.1 ± 23	208.3 ± 27.7	0.025*
Triglyceride (mg/dl)	137 ± 93.6	210 ± 70	0.026*
CRP (μg/ml)	1.94 ± 1.92	2.86 ± 2.08	0.015*
TNF- α (pg/ml)*	3.6 ± 1.2	3.9 ± 1.5	0.792
IL-6 (pg/ml)*	2.19 ± 0.9	2.7 ± 1.1	0.595

CRP - c-reactive protein, TNF-α – tumor necrosis factor-alpha, IL-6 interleukin-6, *pico gram/ml

the more adipose tissue that is present, the higher the secretion of TNF-α and IL-6, and the opposite effect if weight loss occurred with concurrent loss of adipose tissue.[5] Khaodhiar et al[3] found that as BMI increased so did TNF-α and IL-6 serum circulation. In this study, we found that CRP concentration was higher in obese than in non-obese individuals, on the other hand, we showed higher TG and cholesterol levels in the obese group.

Inflammation plays a role in the progression and initiation of atherothrombotic disease and CRP, IL-6 and TNF-α, that are inflammation markers which induces complement activation, enhances infiltrations of monocytes, and stimulates tissue factor production, thus enhancing the risk of thrombosis, and the generation of atherosclerotic lesions. High TG and cholesterol levels are risk factors for cardiovascular disease, and major epidemiological studies in adults have established a strong positive association between total and LDL cholesterol levels and the incidence of coronary artery disease' (CAD) morbidity and mortality. On the other hand, the clearance, or metabolism of cholesterol, or TG may be impaired secondary to obesity, however, the current study does not allow for a determination of the mechanism of this. Elevated cholesterol and TG are 2 key factors of MS, and the presence of these 2 factors in obese individual indicates a trend toward, but not entirely having MS.

Finally, BMI was used to classify obese and non-obese individuals. Although BMI is a good measure for obesity, one needs to be aware of its limitations as an indirect measure of fat mass, and it was better that we use waist to hip ratio, and skin fold measurements with BMI, to determine obese and non-obese individuals.

In summary, obese women demonstrated significantly higher serum concentrations of CRP, TG, and cholesterol compared with non-obese participants, however, further investigation, including feeding obese individuals low caloric diet, measurement of physical activity, blood glucose levels, and the inflammatory markers and other obesity-associated peptides such as, adiponectin and leptin are required to fully explain these outcomes.

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