

The Effects of the Mediterranean Diet vs. a Low Carbohydrate Diet on C-Reactive Protein Levels

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Introduction

Obesity is on the rise in the United States population, and severe obesity is commonly associated with high plasma c-reactive protein levels [1]. C-reactive protein (CRP) is a nonspecific plasma protein produced in the acute response to any sort of systemic inflammation, infection, or damage to tissues. In particular, *high-sensitivity* c-reactive protein is the best and most clinically useful measurement of inflammation [2, 3].

High levels of plasma CRP are recognized to be an independent risk factor for cardiovascular disease (CVD) [2, 4, 5-9] and play a direct role in atherosclerosis [1, 8, 10-11]. According to the American Heart Association and the Center for Disease Control, a plasma CRP level of <1.0 mg/L is classified as low risk for CVD. A CRP of 1.0-3.0 mg/L is considered average risk for CVD while values of >3.0 mg/L of CRP in the plasma are considered high risk for CVD [2].

Currently, the primary treatment for reducing CRP levels has been diet induced weight loss [5]. The Mediterranean diet (MD), a diet recommending increased intakes of foods such as fruits, vegetables, walnuts, whole grains, and olive oil, has been shown to significantly decrease CRP levels and improve endothelial function [12]. The MD has recently been recognized by the American Heart Association to have impressive effects on the progression of cardiovascular disease [12]. Also, low carbohydrate diets (LCD) are gaining popularity and have been examined for their effects on elevated CRP [1].

Both the Mediterranean diet and low carbohydrate diets have been studied separately, however, a collective analysis of all studies involving the use of these diets to lower CRP levels has not been completed. In this study, a systematic review of the studies examining these two diets and their effects on CRP levels will be performed. The outcomes will determine which diet is more effective in reducing CRP levels and, thus, reducing the incidence of cardiovascular disease in patients with high levels of plasma CRP.

Methods, Results, Discussion, Significance

A systematic review of the literature available between October 2004 and June 2005 regarding the Mediterranean diet and low carbohydrate diet and their effects on CRP levels was conducted. The review included the databases Medline, PubMed, and FirstSearch using the terms c-reactive protein, diet, low carbohydrate diet, Mediterranean diet, ketogenic diet, and inflammatory markers.

Articles were chosen for inclusion in the review if CRP plasma levels were used as an endpoint with either the Mediterranean diet or a low carbohydrate diet as an intervention. The category of low carbohydrate diet was further divided into very low carbohydrate diet (VLCD) meaning <10% total daily calories coming from carbohydrates or <35 grams of carbohydrates daily and low carbohydrate was defined as >10% but <46% total calories from carbohydrates or >35 grams but <160 grams of carbohydrate daily. The results were obtained and additionally separated based on gender of the sample studied.

Twelve studies were found that examined either the MD or LCD and their effects on serum CRP. Four studies examined the MD while the other eight involved a LCD or VLCD. Half of the articles for the Mediterranean diet showed significant decrease in CRP after dietary change ($p=0.01$) whereas the other half showed no significant change in plasma CRP levels. Three articles studied VLCDs. One showed no effect on CRP while another showed significant reduction with adherence to the diet ($p<$ or $= 0.005$). The third revealed no effect on CRP overall, but a significant reduction in those with a high risk CRP levels at the beginning of the study. This study is thus classified in Figure 1 as showing a significant reduction in CRP. Two articles examined what would be classified as a VLCD for a few weeks and then increased carbohydrate intake to meet the

classifications for a LCD. For the purposes of this study these two articles are considered LCD studies. Thus, four articles showed significant reduction in CRP with adherence to the LCD diet ($p < 0.05$), while one revealed no evident change. (Figure 1).

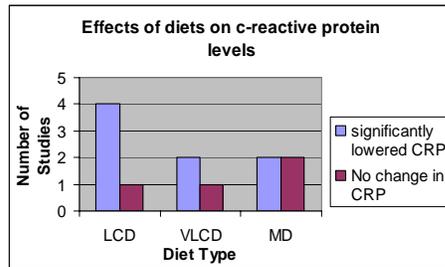


Figure 1: Low carbohydrate diet (LCD), Very low-carbohydrate diet (VLCD),

Mediterranean diet (MD), c-reactive protein (CRP)

Gender did not affect the response of CRP to either diet. Only two articles examined men alone. In one, a VLCD was shown to significantly decrease CRP. The other, involving the MD, concluded no significant change in CRP in men (Figure 2).

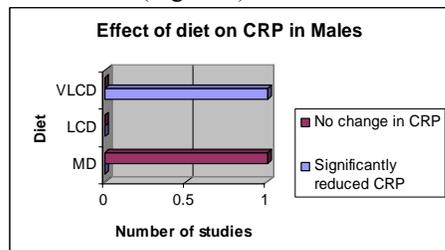


Figure 2

Four articles addressed CRP's response to diet in women. One article showed significant reduction in CRP in females with adherence to the MD. Three articles examined either the LCD or VLCD. LCD was found to significantly decrease CRP in two articles while the lone article examining a VLCD revealed no change in CRP levels in women (Figure 3).

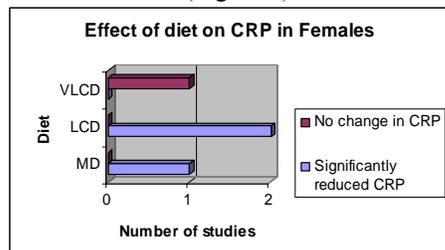


Figure 3

Limitations to this study include recent recognition of this issue and, therefore, fewer studies available, inability to measure adherence to each diet in the studies used, failure to control for body mass index (BMI) or weight loss from the diets, and misinterpretation of the results portrayed by the authors of studies used.

Conclusion

At this time, very-low carbohydrate diet appears to most significantly and quickly lower CRP levels in obese individuals. No benefit of any of the three diets was observed in healthy individuals with normal BMI values. No recommendations can be made for either gender as far as which diet is more effective at lowering plasma CRP levels. No recommendations for safety of diets long-term can be made.

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