EFFECTS OF TWO DIETARY APPROACHES COMBINED WITH EXERCISE ON LIPID LEVELS

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Abstract: Objectives: The purpose of this study was to compare the effects of a high carbohydrate diet and a higher protein diet on lipid levels in young, normolipidemic, and previously sedentary participants. Methods: Ninety-seven sedentary participants who had been inactive for the previous three months were randomly assigned to one of four diet groups and followed recommended exercise prescriptions. Results: Significant differences were found between diet and HDL levels. Conclusions: The findings of this study demonstrate that a diet with higher levels of protein, lower levels of carbohydrate and fat, when combined with exercise, may help to improve the risk profile of participants.

Americans are increasingly becoming overweight and following diets that promise quick and easy solutions. The unknown health risks that might result from these various dietary approaches are a concern for many scientists. The most popular diet today is one that is high in protein and low in carbohydrates. Many dieters that follow high protein diets similarly consume high amounts of fat increasing the difficulty of understanding the health effects of substituting protein for carbohydrate in the diet. Given that dietary fat plays the greater role in disease progression as opposed to protein, diets that have increased protein while maintaining fat levels need to be studied.

The potentially positive health effects of low-fat diets are well established, yet controversy still exists regarding the effects of low-fat dieting among individuals with elevated triglyceride levels (Noakes & Clifton, 2004). Though the American Heart Association’s recommended diet (55% carbohydrate, <30% fat, 15% protein) has been an accepted means of controlling lipid levels, it has also been associated with elevated triglyceride levels (American Heart Association, 2002). A review conducted by Weinberg (2004) concluded that reducing fat in the diet could reduce LDL levels, but because of high carbohydrate content in most low-fat diets, there is a decrease in HDL levels and an increase in triglyceride. Additionally, a decrease in triglyceride is thought to be a key determinant in LDL particle size (Dumesnil et al., 2001). Because of these and other findings, triglyceride is now considered an independent risk factor for coronary artery disease (CAD) by the National Cholesterol Education Program (NCEP) and any increase in triglyceride levels could result in increased risk for CAD (NCEP, 2002).

Another concern regarding a greater concentration of carbohydrates in the diet is the possibility of decreased clearance for very low-density lipoproteins (VLDL) which causes an increase in triglyceride levels due to decreased efficiency of lipoprotein lipase. Finally, though the role of elevated serum cholesterol...
and triglyceride in CAD is well established, the findings in the role of diet in both prevention and treatment of the disease is equivocal and somewhat controversial (Weinberg, 2004).

Conversely, high fat and high protein diets were first introduced in the United States in the 1960's (Vigilante & Flynn, 2000). They have recently become popular again with many people following them in the short and long-term. Recent studies have been conducted revealing findings that seem to contradict accepted thought regarding the effects on lipid levels. Bravata et al. (2003) found no overall positive or negative changes in plasma LDL-cholesterol, triglyceride or HDL-cholesterol levels in diets that contained low amounts of carbohydrates in dietary studies published from 1966 to early 2003. Meckling et al. (2002) had participants follow a very low carbohydrate 8-week dietary intervention in which saturated fat levels did not change. LDL-cholesterol level fell by 1.2 mmol/l with no change in HDL-cholesterol, and triglyceride levels decreased by 0.6 mmol/l.

The Atkins diet is one of the more popular commercial diets that purport the efficacy of a high protein, low carbohydrate diet. Westman et al. (2003) concluded that LDL, triglyceride and HDL were relatively unchanged after participants followed the Atkins diet for 6 months. In another controlled trial, elevations of blood lipids were observed in participants adhering to the Atkins diet (Johnston, Tjonn, & Swan, 2004). These findings suggest the need for further study.

Similarly, Brehm et al. (2003) found no difference in LDL in low-fat and very low carbohydrate diets. Triglyceride levels decreased in the very low carbohydrate group, with HDL increasing in both groups. The authors of one review (Noakes & Clifton, 2004) found very-low carbohydrate diets have favorable effects on lipid levels. The most notable changes were a substantial lowering of triglyceride levels with increases in HDL levels. Low-density lipoprotein levels were equivocal with changes dependent more on whether it was measured during active weight loss or balance. The effects were better than those in low-fat diets over the "medium" term. Layman et al. (2003) compared high protein and high carbohydrate diet groups. Both groups had a 10% reduction in total cholesterol with the high protein group having a 21% reduction in triglyceride levels.

An earlier study conducted by Wolfe and Giovannetti (1991) found that low-fat, low cholesterol, and high protein diets provide lipid-lowering effects. More recently, Westman et al. (2002) concluded that a low carbohydrate, high protein diet during a six month trial reduced serum cholesterol by 11mg/dL, LDL by 10 mg/dL and triglyceride by 56 mg/dL. HDL increased by 8 mg/dL improving the lipid profile and theoretical lowering the risk of CAD.

Diets high in protein (30%), low in fat (<30%) and moderate in carbohydrate (40%) have been effective in reducing total cholesterol, LDL, and triglyceride (2004). Johnston, Tjonn, and Swan (2004) found diets with moderate protein (15%) and high protein (30%) did not adversely affect blood lipid profiles. Wolfe and Piche (1999) found significant reductions in fasting total cholesterol and triglyceride concentrations and reduction in the ratio of total cholesterol to HDL cholesterol. Conversely, Fleming and Body (2000) discovered an increase in serum lipids when participants followed a high protein diet.

Numerous study authors have demonstrated an improvement in lipid profiles after engaging in aerobic exercise (Thompson et al., 2004; Wegge et al., 2004; Woo et al., 2004). It is widely accepted that aerobic exercise improves lipid profiles primarily through increased HDL levels, lowered LDL levels and improved TC/HDL cholesterol ratios.

High carbohydrate diets can increase triglyceride levels while high protein diets have demonstrated both improvements and decrements in lipid profiles. There have been few studies that have looked at how replacing carbohydrate with protein in diets of healthy individuals would influence lipoprotein levels (Wolfe & Piche, 1999). Secondly, no studies were found by the authors of the present study that used young (under 23 years of age) healthy, normolipidemic, previously sedentary participants. Few studies were found that discussed both diet and exercise, especially ones that covered higher protein levels and exercise. Therefore, the purpose of this study was to compare the effects of a high carbohydrate, low-fat, moderate protein diet and a higher protein, low-fat, low-carbohydrate diet on lipid levels in young, normolipidemic, and previously sedentary participants.

METHODOLOGY

PARTICIPANTS
A cohort of university students (N=120) volunteered to participate in a diet and exercise study. The 120 volunteers were screened and excluded from participation if they had metabolic disorders (e.g., known electrolyte abnormalities; heart disease, arrhythmias, diabetes, thyroid disease, hypogonadism) and a history of hypertension or other pertinent diseases (i.e., hepatorenal, musculoskeletal, autoimmune, or neurological disease). The volunteers were also excluded from participation if they were taking thyroid, hyperlipidemic, hypoglycemic, anti-hypertensive, or androgentic medications; or had taken ergogenic levels of nutri-
tional supplements that may affect muscle mass, anabolic/catabolic hormone levels, or weight loss, within three months prior to the start of the study. Volunteers were not allowed to participate in the study if they had engaged in any form aerobic exercise or strength training within three months prior to the study. Initial screening of volunteers eliminated twelve people for a total of 108 participants at the beginning of the study. Eleven participants did not complete all requirements for the study reducing the participants to 97 sedentary university students enrolled in a university health education class at end of the 12-week study period. Volunteers meeting eligibility criteria at the beginning of the study period were informed of the requirements of the study and signed informed consent statements in compliance with the university guidelines for treatment of human subjects. Participants were oriented to the experimental protocols during baseline testing.

LIPID ANALYSIS

Approximately 20 ml of blood was collected from each participant after fasting for 12 hours using standardized venipuncture techniques in the antecubital vein in the bend of the elbow. Blood was donated at baseline (week 0) and at 12-weeks. Blood analyses included total cholesterol, HDL, LDL, triglyceride and total cholesterol/HDL ratio.

Whole blood samples were sent to Quest Diagnostics (Dallas, TX) for assay of a standard clinical lipid profile (triglycerides, total cholesterol, HDL, LDL, and TC/HDL ratio). Lipid analysis was conducted using an AU 5400 clinical chemistry analyzer. The AU 5400 uses spectrophotometry which operates by passing a beam of light through a sample and measuring the intensity of light reaching a detector. Use of a spectrophotometer makes cholesterol estimations very convenient and reliable, particularly for obtaining rapid results on a relatively small numbers of samples.

BODY COMPOSITION MEASUREMENT AND WEIGHT

Body composition was determined using a calibrated Hologic (Hologic Inc., Waltham, MA, USA) 4500W dual-energy x-ray absorptiometry device (DEXA) by qualified personnel with x-ray technology training. The DEXA body composition test involved having the participant lie down on his/her back in a standardized position in a pair of shorts/t-shirt or a gown. A low dose of radiation was used to scan the participants for approximately six minutes. The DEXA segments regions of the body (right arm, left arm, trunk, right leg, and left leg) into three compartments for determination of fat, soft tissue (muscle), and bone mass. The amount of absorbed energy from the x-ray source is used to determine body fat percentage. Additionally, body fat levels were obtained from the manufacturer's ready report that had been adjusted for participant gender, race, and age. Body fat was determined by measuring differential attenuation of bone, fat and lean tissue between the lower and higher energy of the x-ray beam. Quality control calibration procedures were performed on a spine phantom (Hologic X-CALIBER Model DPA/QDR-1 anthropometric spine phantom) prior to the testing session. In addition, weekly calibration procedures are performed on a density step calibration phantom. The DEXA is also calibrated on-site, twice a year by the manufacturer and had been calibrated four weeks prior to testing. Weight was measured in a laboratory setting with trained technicians using a balance scale to the nearest 0.1 pound.

RANDOMIZATION AND DIETARY INTERVENTION

All participants received five hours of instruction (first two weeks of class) concerning appropriate dietary and exercise behaviors in their health education class. The courses were taught by two Masters level graduate teaching assistants who had training in healthy approaches to dietary and exercise habits, and were regularly supervised by a Ph.D. level teaching coordinator. The two instructors used a standardized curriculum and received pre-service instructions on those specific lectures by a senior faculty member with expertise in diet, nutrition and exercise. Both the American Heart Association diet and a higher protein diet were presented as part of the classroom instruction.

Classroom instructors also covered the specifics of the U.S. Surgeon General’s report on appropriate levels of activity (i.e. frequency, intensity, and duration). All participants followed the U.S. Surgeon General’s exercise recommendations of 30 minutes a day, 4-6 times a week. Participants were allowed to choose the type of exercise in which they engaged from a list of pre-approved aerobic exercises (jogging, swimming, walking, stationary cycling, cycling, and aerobic dance). Participants engaged in aerobic activity that was between 60-85% of their maximum heart. Basal Metabolic Rate (number of calories needed for normal daily functioning) was calculated using the Harris-Benedict equation (Frankenfield, Muth, & Rowe, 1998).

Participants were first divided into two groups (≥ 30% and <30% body fat) based on baseline measures of body fat percentage of total body weight measured by DEXA. The participants whose body fat percentage was less than 30% at baseline were randomly assigned to one of two diets, one that followed the Ameri-
can Heart Association recommendations for nutrient balance (AHA diet: 15% protein, 30% fat, 55% carbohydrates) and one that represented a higher protein/lower carbohydrate ratio (high protein/low carbohydrate diet: 25% protein, 30% fat, 45% carbohydrates). On both diets, participants were asked to maintain the total caloric intake they were reportedly consuming at baseline. The participants whose baseline body fat percentage measures were equal to or above 30% were also randomly assigned to the AHA diet and high protein/low carbohydrate diet, but were also asked to consume 500 fewer total calories per day than they were reportedly consuming at baseline.

Figure 1 illustrates the group sizes and differing protocols of each of the resulting four experimental groups. As indicated in the figure, the four groups were labeled as Diet 1 (AHA recommended balance, <30% body fat/no change in total calories), Diet 2 (AHA recommended balance, ≥30% body fat/500 fewer total calories), Diet 3 (high protein/low carbohydrate, <30% body fat/no change total calories), and Diet 4 (high protein/low carbohydrate, ≥30% body fat/500 fewer total calories).

Participants in all four groups used a log book to record minutes of exercise each day throughout the 12-week study period. The participants recorded their energy intake using NutriFit software (available to all classroom participants) by downloading into a database specific foods eaten each day during the entire study period. Dietary intake was recorded three days a week, two days during the week, and one weekend day for each week for the entire twelve weeks. The three days of recording dietary intake were consecutive, either falling on a Thursday, Friday, Saturday, or Sunday, Monday, Tuesday. Caloric levels of each macronutrient from each recorded day were averaged from the 12-week study period to formulate the percent of total calories for carbohydrates, fats, and proteins for each participant (completed by the Nutrifit software).

COUNSELING SESSIONS

Participants had a twenty-minute session with a counselor every two weeks for the entire 12-week study period for a total of six visits. The counselor checked how well each participant was following the dietary and exercise recommendations and suggested changes to better fit those recommendations as necessary. The counselor also monitored dietary and exercise data entry, specifically looking for program adherence. Removal from the study occurred if participants failed to complete all nutrition and exercise logs, failed to follow dietary specifics for their assigned group, and/or failed to exercise aerobically based on the established protocol. Consensus was ascertained between the principle investigators, co-investigators, and counselors as to which participants would be removed from the study.

DATA ANALYSIS

Analysis of covariance (ANCOVA) was used to analyze changes in blood profiles. Data were considered statistically significant when the probability of type I error was 0.05 or less. If a significant group, treatment and/or interaction alpha level was observed, least significant differences (LSD) post-hoc analyses were performed to determine where the significance was obtained. Analysis of variance (ANOVA) was used to analyze differences in blood profiles, exercise levels, and age at baseline. Again, data were considered statistically significant when the probability of type I error was 0.05 or less. Descriptive statistics were also calculated to ascertain means and standard deviations for study variables.

RESULTS

A convenience sample of sedentary college students clustered by body fat levels (N=108) from introductory health classes at a southern university were selected to participate and randomized into experimental groups. Eleven participants did not complete the entire 12-weeks reducing the sample size of participants who completed all aspects of the study to ninety-seven (N=97). The sample consisted of 64 females (65.96%) and 33 males (34.04%). Participants averaged 19.89 years of age (SD=1.41) for Diet 1, 20.35 years (2.08) for Diet 2, 19.68 years (1.15) for Diet 3, and 20.36 years (1.47) for Diet 4 with no statistically significant age differences detected between groups (p=.27).

There were no statistically significant differences in baseline values for TC, HDL, LDL, triglycerides and TC/HDL ratio between groups. ANCOVA revealed a significant difference for diet and HDL cholesterol (p=.0407) at posttest. HDL levels in Diet 4 (59.364, SD=20.891) were significantly different than Diets 1 (54.258, 12.220), 2 (52.303, 8.929) and 3 (57.676, 12.538) at posttest and are presented in Table 1.

Additionally, Diet 4 had the greatest amount of change in HDL levels (+5 mg/dL) when compared to Diet 1 (-1.581 mg/dL), 2 (+0.308 mg/dL) and 3 (+0.029 mg/dL). An ANCOVA revealed no significant differences in pretest and posttest triglyceride measures (p=.9296), TC (p=.1748), TC/HDL ratio (p=.0567) and LDL (p=.2311).

There were no significant differences in exercise minutes per week between groups. Diet 1 exercised 129.87 (SD=106.13) minutes per week, Diet 2 exercised 133.37 (78.23) minutes per week, Diet 3 exercising...
cised 133.44 (94.34) minutes per week, and Diet 4 exercised 122.27 (74.64) minutes per week. Diet 1 maintained their weight during the course of the study, while Diet 2 and Diet 4 both averaged a two pound loss at the end of the 12-weeks. Diet 3 averaged a 1.5 pound gain at the end of the 12-weeks.

Final analysis of diet groups revealed that each group followed the protocol guidelines suggested for their group. The Diet 1 group averaged 16.03% (SD=2.82%) of calories from protein, 51.12% (5.19%) calories from carbohydrates, and 32.72% (5.28%) of calories from fat. The Diet 2 group averaged 15.62% (2.33%) of calories from protein, 53.92% (6.33%) calories from carbohydrates, and 30.54% (6.31 %) of calories from fat. The Diet 3 group averaged 25.06% (SD=5.91%) of calories from protein, 41.21% (7.38%) calories from carbohydrates, and 33.71% (6.75%) of calories from fat. The Diet 4 group averaged 26.64% (SD=5.35%) of calories from protein, 42.73% (6.31%) calories from carbohydrates, and 30.64% (5.30%) of calories from fat.

**DISCUSSION**

These findings demonstrate that diets with higher amounts of protein, low-fat and reduced carbohydrates does not negatively effect lipid profiles and may, when combined with exercise help to improve HDL levels. These findings in healthy subjects are consistent with previous studies that demonstrate an improved HDL level (Yancey et al., 2004), while contradicting others (Baba et al., 1999; Wolfe, & Piche, 1999). Diet 4 (higher protein/low carbohydrate; 500 calorie deficit) had the only significant changes in HDL levels (+5 mg/dL) demonstrating that when combined with exercise, HDL will improve with higher protein content while holding fat at the level recommended by the AHA.

| Table 1. Lipid and Lipoprotein (mg/dL) levels at Baseline and 12-weeks. (Mean values and standard deviations) |
|--------------------|---------------|---------------|---------------|
|                    | Baseline Mean | Baseline SD   | 12-weeks Mean | 12-weeks SD  |
| Diet 1 (n=35)      |               |               |               |               |
| Total Cholesterol  | 170.76        | 29.79         | 165.97        | 35.11         |
| LDL                | 101.49        | 29.15         | 96.74         | 32.18         |
| HDL                | 55.67         | 12.17         | 54.26         | 12.22         |
| TC/HDL ratio       | 3.197         | 0.888         | 3.171         | 0.841         |
| Triglyceride       | 68.70         | 19.76         | 74.87         | 26.76         |
| Diet 2 (n=14)      |               |               |               |               |
| Total Cholesterol  | 179.54        | 42.60         | 162.00        | 28.08         |
| LDL                | 107.77        | 31.93         | 91.31         | 19.98         |
| HDL                | 52.00         | 12.13         | 52.31         | 8.93          |
| TC/HDL ratio       | 3.523         | 0.637         | 3.131         | 0.479         |
| Triglyceride       | 98.77         | 52.34         | 92.23         | 47.43         |
| Diet 3 (n=36)      |               |               |               |               |
| Total Cholesterol  | 173.76        | 35.62         | 170.94        | 36.93         |
| LDL                | 100.38        | 32.38         | 96.18         | 33.56         |
| HDL                | 57.38         | 13.51         | 57.68         | 12.54         |
| TC/HDL ratio       | 3.168         | 1.009         | 3.076         | 0.984         |
| Triglyceride       | 80.08         | 34.93         | 84.85         | 30.32         |
| Diet 4 (n=12)      |               |               |               |               |
| Total Cholesterol  | 172.64        | 37.76         | 169.00        | 35.53         |
| LDL                | 100.18        | 30.83         | 91.09         | 31.03         |
| HDL                | 54.36         | 19.52         | 59.36         | 20.89         |
| TC/HDL ratio       | 3.400         | 0.987         | 3.055         | 0.990         |
| Triglyceride       | 90.73         | 31.07         | 92.64         | 44.48         |
Diet 3 (higher protein/low carbohydrate; no change in calories) followed the same diet and exercised approximately the same amount but did not reduce caloric consumption by 500 calories a day. Lipid profiles have been found to improve during active weight loss (Vigilante & Flynn, 2000) but tend to reflect a more accurate change when profiles are improved without weight loss. This study, by nature of non-significant change of HDL in the higher protein and non-caloric restricted group (Diet 3), demonstrates that HDL cholesterol can be improved with a higher protein diet even when statistically significant active weight loss does not occur.

Various study authors have reported improvements in TC/HDL ratios when following a high protein diet (Noakes & Clifton, 2004; Dumesnil et al., 2001). The results of this study do not support these findings but, instead, imply a potentially different trend that warrants discussion. The approaching significance of the ANCOVA analysis (p=.0567) demonstrated that the Diet 2 (high carbohydrate/low protein, 500 less calories) and Diet 4 (higher protein, 500 less calories) groups experienced the greatest improvement in TC/HDL ratios. These two groups differed in their dietary protein and carbohydrate intake percentages but shared the commonality of caloric restriction and weight loss, which implies that overall caloric restriction may more significantly influence TC/HDL ratios than protein/carbohydrate percentages. Follow-up studies with larger sample sizes should compare high carbohydrate and high protein groups combined with exercise to ascertain if active weight loss regardless of diet content may improve TC/HDL ratios.

Other researchers have demonstrated that triglyceride levels can be improved through increased protein and decreased carbohydrate in the diet (Yancey et al., 2004). Normally, increasing dietary intake of carbohydrate can induce an increase in triglyceride levels, while increasing protein and decreasing carbohydrate tends to decrease triglyceride levels (Wolfe & Piche, 1999). The present study did not support these findings. Triglyceride levels were unchanged during the twelve week study and were not significantly changed when following a higher protein and lower carbohydrate diet. These changes may not have occurred due to the length of the study period (12 weeks). Twelve weeks may have not been enough time to cause an inhibitory effect of fatty acids on lipogenesis (Wolfe & Piche). Secondly, higher protein diets (30%) may have more affects on triglyceride levels than this study (25%) and needs to be explored.

LDL-cholesterol is generally lowered with active weight loss (Vigilante & Flynn, 2000) and with diets that increase protein content (Jenkins et al., 2001). The present study did not support these findings. Triglyceride levels are a function of VLDL production and secretion (Wolfe & Piche, 1999) which in turn affect the level of LDL cholesterol via cholesterol transport. Because both triglyceride and LDL levels were unchanged through dietary manipulation and exercise in the high protein groups, it can be reasonably assumed that VLDL levels where unchanged (less production and secretion) even though they were not measured. These findings demonstrated that increased protein content in the diet with a concomitant decrease in carbohydrates combined with exercise did

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**Figure 1. Four Experimental Groups Distinguished by Diet and Baseline Body Fat % Levels.**

<table>
<thead>
<tr>
<th>Experimental Group</th>
<th>Body Fat % at Baseline*</th>
<th>Daily Dietary Protocol</th>
<th>Nutrient Percentages**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet 1 (n=35)</td>
<td>&lt;30%</td>
<td>500 calories less than baseline</td>
<td>15% protein 55% carbohydrates</td>
</tr>
<tr>
<td>Diet 2 (n=14)</td>
<td>≥30%</td>
<td>No change (Equal to baseline)</td>
<td>15% protein 55% carbohydrates</td>
</tr>
<tr>
<td>Diet 3 (n=36)</td>
<td>&lt;30%</td>
<td>500 calories less than baseline</td>
<td>25% protein 40% carbohydrates</td>
</tr>
<tr>
<td>Diet 4 (n=12)</td>
<td>≥30%</td>
<td>No change (Equal to baseline)</td>
<td>25% protein 40% carbohydrates</td>
</tr>
</tbody>
</table>

* Baseline: Measured body fat % and Nutrifit software reported total caloric intake at pretest.
** Percentage of fat intake for all groups = 30%
not affect LDL cholesterol levels negatively. The assumption of many researchers regarding the AHA diet is that higher protein diets may increase cardiovascular risk due to changes in LDL. Yet, these changes in fact may be due to increases in fat content in the diet rather than protein. The authors of the present study suggest that a diet that follows AHA guidelines for fat content and increases protein content in the diet may not have a negative effect on LDL cholesterol values. Still, even if blood lipids are improved or remain unchanged with increased protein in the diet combined with exercise, it is not clear if cardiovascular disease risk is changed.

A few limitations existed in the study. First, a convenience sample of healthy, sedentary college students enrolled in introductory health courses was used and therefore caution should be used in generalizing these results. Second, the participants were young (males and females averaged 20.32 and 19.65 years of age respectively) and fairly healthy. Lastly, the sample group consisted of predominately white (non-Hispanic) individuals. Further studies examining lipid management, dietary and exercise habits in other ethnic groups would expand the data needed to understand the impact of increased protein in the diet on lipid levels. Future research should focus on large prospective cohort trials that focus on reducing fat content while increasing protein content in the diet.

In conclusion, the findings of this study demonstrate that a diet with higher levels of protein (25-26%) and lower levels of carbohydrate (41-42%) and fat (30-32%) when combined with exercise may help to improve the CAD risk profile of participants. High-density lipoprotein cholesterol levels were improved when following a diet with higher protein. Though not significant, changes in TC/HDL warrant further investigations. Finally, triglyceride and LDL levels were unchanged following a higher protein diet. Consequently, LDL did not increase following a diet with higher protein possibly making fat content more suspect in disease progression. The present discussion and research surrounding moderate and higher protein diets may actually need to focus more on fat content as a risk factor for CAD since risk may be due in part to fat content in the diet as opposed to the protein content.

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**REFERENCES**


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CHES AREAS
Responsibility I – Assessing Individual and Community Needs for Health Education
Responsibility III – Implementing Health Education Programs
Responsibility IV – Evaluating Effectiveness of Health Education Programs

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