THE AMERICAN JOURNAL OF Clinical Nutrition

JUNE 1963 VOLUME 12, NUMBER 6

Original Communications

Weight Reduction and Serum Cholesterol Levels

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THE relationship between obesity and weight change, and serum lipid levels and the implications that both play roles in atherogenesis and clinical atherosclerosis are areas which need further evaluation. Studies on necropsy material undertaken by Wilens[1] demonstrated a relationship between the state of nutrition and the degree of atherosclerosis. In that study, approximately twice the incidence of severe atherosclerosis was noted in the obese group as in the group of subjects classified as poorly nourished. Using the electrocardiograph as a measure of morbidity, Short[2] studied 1,000 men who were undergoing a periodic health examination and found twice the incidence of electrocardiographic abnormalities in men 25 per cent above the ideal weight as in an underweight group. A study of New York Metropolitan Life Insurance clerical workers yielded similar results.[3] The Framingham study data supports this by showing that particularly among the more obese men there are higher morbidity and mortality rates of coronary heart disease. A risk factor of 1.7 times the expected was found in men 20 per cent or more overweight.[4]

The means by which obesity operates to enhance coronary heart disease is not well understood. Gofman and Jones[5] and Walker,[6] using data from the Framingham study,[7] demonstrated a significant relationship between serum cholesterol and obesity. Lawry et al.[8] studied a large group of healthy adults age twenty-five to seventy-four years; they did not find a significant correlation between serum cholesterol levels and relative body weight. A cooperative study of lipoproteins and atherosclerosis examined the relationships between lipid levels and weights in over 13,000 subjects.[9] While statistically significant, the level of correlation of various lipids with relative weight was low. It was highest for lipoproteins in the class Sf 20–100 and lowest for cholesterol. Stamler et al.,[10] in a survey of

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This investigation was supported in part by a Public Health Service Research Grant No. H-5905 from the National Heart Institute of the National Institutes of Health, and in part by a Grant-in-Aid No. D170 from the New Jersey State Department of Health.

TABLE I
Weight Reduction Diet

Average Daily Food Allowance	Calories	Protein (gm.)	Fat (gm.)	Carbohydrates
Skim milk (1 pint)	180	18	...	26
Meat, fish, poultry (4 ounces)*	285	29	15.5	2
Egg (1)	80	6	6.0	...
Fat (1/2 ounce)	100	...	11.0	...
Skimmed cottage cheese (1/4 cup)	50	10	0.5	1
Fruit (3 servings, at least 1 citrus)	150	3	...	40
Vegetables (4 servings)†	100	6	...	20
Bread or substitute (4 servings)‡	300	8	7.6	52
Total	1,245	80	40.6	141
Total calories (%)	100	25	29	45

* Values obtained are averages for the composition of the various meats employed in the diet, as derived from current tables of food composition.[19,20]
† Some are leafy green, some yellow and some raw.
‡ Five saltines or one potato or one serving cereal (a half cup cooked or one cup dry) equals one substitute.

Chicago utility workers, found overweight to be associated with significantly higher values of serum cholesterol and increased prevalence of hypercholesterolemia.

This relationship between overweight and cholesterol, although weak, has been demonstrated repeatedly. The effect of weight loss alone on cholesterol levels, however, has been inconstant, except when weight loss was accompanied by changes in the quality of food.[11] Significant correlation between weight loss and serum cholesterol levels was not noted by Olson[12] in a group of sixty-one subjects with a mean weight loss of 27 pounds. He did observe transient decreases in serum cholesterol values, however, during the early phase of diet therapy; there was a return to pretreatment levels when the subjects reached caloric equilibrium at new and lower weight plateaus. Walker and Weir[13] found both increases and decreases in cholesterol values in twenty-seven subjects who experienced rapid weight loss using low fat diets not modified by the use of unsaturated fats. This early study indicated a downward trend of serum cholesterol in a majority of subjects but was carried on for only four weeks. A more protracted study by Walker et al.[14] failed to show significant decreases in cholesterol values in thirty-nine subjects on a diet providing 36 per cent of the calories as fat, primarily as saturated fatty acids. Anderson et al.[15] studied the converse of the problem with healthy men and positive caloric balance and found significant increases in cholesterol values during the first ten weeks of weight gain. Stabilization occurred, however, despite additional weight gain over a longer period of time. Serum cholesterol values increased in these same subjects after their weight returned to prior levels. The purpose of this report is to examine the isolated relationship between weight loss and serum cholesterol levels when qualitative changes in diet are not introduced.

METHODS

The background and aims of the Atherosclerosis Research Group in Montclair, New Jersey, have been presented in a previous report.[16] The experimental group consisted of men aged thirty to fifty (average age, 44.8 years) who had suffered one or more myocardial infarctions as proved by electrocardiogram. On each of these subjects a thorough history was taken, and physical examination was supplemented by roentgenograms of the soft tissue and laboratory studies including determinations of fasting blood sugar and blood urea nitrogen, complete blood count, urinalysis and electrocardiograph. Degree of obesity was determined by measurements for skinfold thickness and comparison with life insurance tables for ideal weight by height and body habitus. In this manner, seventy-three men who were 5 to 50 pounds above ideal weight were selected for study. They were primarily men in white-collar occupations.

Several of these men previously had lost some weight in hospitals or during convalescence. None had untreated congestive heart failure, rheumatic heart disease or poorly controlled diabetes mellitus.* These men generally were highly motivated in adhering to medical and nutritional advice and cooperative throughout the course of the experiment. The response of their cholesterol levels to diet is the subject of this study.

The baseline cholesterol value for each of the seventy-three men was established by averaging three weekly determinations, all carried out in duplicate by the Anderson-Keys modification of Abell's method.[17] Replicate determinations agreed within 6 mg. per 100 ml. Duplicate pooled serum samples were included within each run, and the

* Grounds for exclusion from the study are described fully in a previous publication.[16]

values obtained were within the 98 per cent confidence level.

Complete dietary analyses were obtained with a review of a seven day diet history provided by the subject. Overweight patients then were placed on individual diets designed to provide 1,200 calories daily. These were fitted by the nutritionist to the individual preferences and problems of each subject. Whenever possible, the patient's wife was included in the planning of the diet and instructed in its use. These diets contained approximately 25 per cent protein, 45 per cent carbohydrates, 30 per cent fats, and vitamins and minerals to meet the recommended dietary allowances of the National Research Council. It was thought that the fat level was moderately below that of the conventional American diet (Table I). The ratio of polyunsaturated to saturated fatty acids (P:S ratio) is estimated to have been 1:2.5, using standard reference tables.[19,20] While the 1,200 calorie weight reduction diet, if followed rigidly, was planned to achieve a 2 pound weekly weight loss, a loss of a half pound a week was considered to be the basis for success and the acceptable minimum.

The subjects were seen at four week intervals. Weight and physical condition were checked by the project physician at each visit. In addition, dietary adherence was reviewed thoroughly in a conference with the nutritionist, and serum cholesterol levels were determined.

RESULTS

The data are evaluations of all weight reduction experiences for the first twenty-four months of the operation of this program, the subjects having entered in groups of five to ten men at monthly intervals.

Eleven men dropped out of the original group of eighty-four within three months or less for varying reasons and are not included. Of the remaining seventy-three overweight men, 72 per cent reached their theoretic ideal weights at the end of the allotted time. Varying lengths of time were required for the weight loss, depending upon the amount of weight involved.

The course of reduction was generally gradual, with an average rate of 0.5 pounds per week. The results, summarized in Table II, show the number of successes and failures for men in the different weight categories. It is not surprising to note the far greater frequency of success among the less obese.

TABLE II
Results of Weight Reduction

Degree of Overweight (lb.)	Subjects (no.)	Successes (no.)	Partial Successes (no.)	Failures (no.)
0–10	11	8	3	0
11–20	41	27	6	8
21–30	12	7	...	5
31–40	3	0	...	3
Over 40	6	2	...	4
Total	73	44	9	20

The close personal attention each patient received and the opportunity to ask questions and receive information about nutrition were major factors in contributing to successful weight reduction. Each patient's diet was handtailored, and likes, dislikes and living habits carefully considered. Despite this careful "handtailoring" of the diet and close supervision, there were twenty patients who could not or would not lose weight. Some of the factors which appeared to prevent weight loss in the group were (1) personal problems creating tension; (2) nibbling habits developed by cigarette smokers deprived of tobacco; (3) high alcohol consumption due to business and/or social drinking; (4) poor motivation due to experiencing little pain during the acute episode; and (5) less physical activity due to physician's advice or job change in some cases.

In each case, the final cholesterol value was determined at the time ideal weight was reached. Figure 1 illustrates the remarkable diversity of cholesterol changes that occurred in men who had lost weight successfully. Statistical analysis of this data did not show significant correlation between weight loss and change in cholesterol level. Cholesterol changes also were summarized for the men with failure or partial success. The patients listed as partial successes are those still losing weight within the accepted rates but who have not yet reached ideal weight. These, too, were analyzed for degree of correlation and are summarized in Table III. The ranges of variation and the results of statistical tests for significance illustrate that serum cholesterol values were independent of changes in weight in this group.

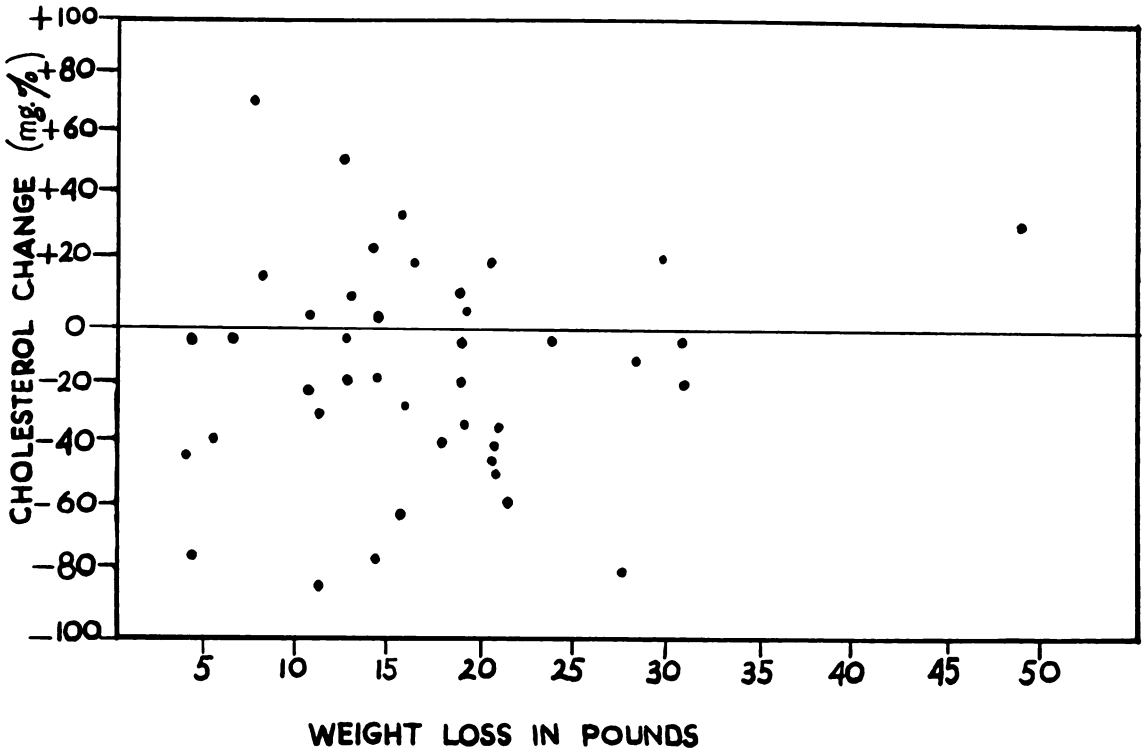

FIG. 1. Cholesterol changes which occurred in men who had successfully lost weight.

COMMENTS

The decrease in serum cholesterol values sometimes observed in subjects during short-term reduction studies was not seen in this group. The lack of any predictable effect of weight loss on serum cholesterol in the present study corroborates the experience of Olson[12] and Walker et al.[14] In view of the known relationship between serum cholesterol and obesity in epidemiologic studies, it is somewhat surprising to discern no trend in cholesterol response to the correction of obesity. The record of weight reduction in this group of out-patients, with a majority of seventy-three men reaching their ideal weights, is a noteworthy achievement in itself. Despite the independence of serum cholesterol levels, caloric reduction and weight loss are rational goals of medical therapy. The over-all importance of obesity to coronary heart disease has been pointed out, particularly the marked increase of risk with extreme obesity. The possibility exists that differences in cholesterol observed in population studies are the result of food preferences or some other systematic variable rather than a reflection of obesity *per se*.

TABLE III
Over-all Results in Weight Loss and Associated Cholesterol Levels

Results	No.	Range of Cholesterol Change (mg. %)	Correlation Coefficient	Significance (@ 95% Level)
Successes...	44	−85–+71	0.015	none
Partial successes....	9	−15–+6	0.24	none
Failures....	20	−44–+58	0.39	none
Total	73	...	0.17	none

The great diversity of cholesterol changes which were found in individual subjects, both in magnitude and direction, leads to a consideration of the factors apart from diet which may be of importance. Environmental stress and exercise are such possible variables,[18,21] but since not carefully evaluated in this study, will not be further considered. These data show a lack of any regular effects by weight loss on serum cholesterol.

Modifying individual patterns of stress and exercise has been suggested and is a rational

step. The alteration of fat saturation has been advocated by Jolliffe et al.[11] In this experimental group, results show that the correction of obesity alone appears to have no significant effect on serum cholesterol.

SUMMARY

Serum cholesterol levels were measured in seventy-three obese middle-aged male subjects with previous myocardial infarctions undergoing weight reduction over a twenty-four month period. Of this group 72 per cent reached their theoretic ideal weights during the period of study. No correlation between serum cholesterol and weight change was found in this group.

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