

A STUDY OF DIETARY CHOLESTEROL IN RELATION TO BLOOD  
CHOLESTEROL AND ARTERIOSCLEROSIS

by

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## TABLE OF CONTENTS

CHAPTER		PAGE
I.	INTRODUCTION.....	1
	Purpose.....	2
	Review of Literature.....	2
II.	PROCEDURE.....	8
III.	DISCUSSION OF RESULTS.....	11
IV.	SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS	66
	Summary and Conclusions.....	66
	Recommendations.....	69
	BIBLIOGRAPHY.....	70
	APPENDIX.....	71

LIST OF TABLES

TABLE	PAGE
I. Age in Relation to Cholesterol Dietary Intake for Twenty-seven Female Subjects.....	12
I.A. Age in Relation to Cholesterol Dietary Intake for Twenty-seven Male Subjects.....	13
II. Weight in pounds in Relation to Cholesterol Dietary Intake for Twenty-seven Female Subjects..	14
II.A. Weight in pounds in Relation to Cholesterol Dietary Intake for Twenty-seven Male Subjects....	15
III. Percentage of Weight Variation From Normal in Relation to Cholesterol Dietary Intake for Twenty-seven Female Subjects.....	17
III.A. Percentage of Weight Variation From Normal in Relation to Cholesterol Dietary Intake for Twenty-seven Female Subjects.....	18
IV. Daily Caloric Consumption in Relation to Cholesterol Dietary Intake for Twenty-seven Female Subjects.....	19
IV.A. Daily Caloric Consumption in Relation to Cholesterol Dietary Intake for Twenty-seven Male Subjects....	20
V. Daily Fat Consumption in Relation to Cholesterol Dietary Intake for Twenty-seven Female Subjects..	22
V.A. Daily Fat Consumption in Relation to Cholesterol Dietary Intake for Twenty-seven Male Subjects....	23
VI. Sex in Relation to Cholesterol Dietary Intake for Fifty-four Subjects.....	26
VII. Hereditary History of Heart-Disease in Relation to Cholesterol Dietary Intake for Twenty-seven Female Subjects.....	29
VII.A. Hereditary History of Heart Disease in Relation to Cholesterol Dietary Intake for Twenty-seven Male Subjects.....	30

LIST OF TABLES (Continued)

TABLE	PAGE
VIII. Individual Symptoms of Arteriosclerosis in Relation to Cholesterol Dietary Intake for Twenty-seven Female Subjects.....	32
VIII.A. Individual Symptoms of Arteriosclerosis in Relation to Cholesterol Dietary Intake for Twenty-seven Male Subjects.....	33
IX. Age in Relation to Cholesterol Levels of the Blood for Fourteen Female Subjects.....	37
IX.A. Age in Relation to Cholesterol Levels of the Blood for Fifteen Male Subjects.....	38
X. Weight in Pounds in Relation to Cholesterol Levels of the Blood for Fourteen Female Subjects.....	40
X.A. Weight in Pounds in Relation to Cholesterol Levels of the Blood for Fifteen Male Subjects	41
XI. Percentage of Weight Variation From Normal in Relation to Cholesterol Levels of the Blood for Fourteen Female Subjects.....	44
XI.A. Percentage of Weight Variation From Normal in Relation to Cholesterol Levels of the Blood for Fifteen Male Subjects.....	45
XII. Daily Caloric Consumption in Relation to Cholesterol Levels of the Blood for Fourteen Female Subjects.....	46
XII.A. Daily Caloric Consumption in Relation to Cholesterol Levels of the Blood for Fifteen Male Subjects.....	47
XII.B. Daily Caloric Consumption in Relation to Cholesterol Levels of the Blood for Twenty-nine Subjects.....	48

LIST OF TABLES (Continued)

TABLE		PAGE
XIII.	Daily Fat Consumption in Relation to Cholesterol Levels of the Blood for Fourteen Female Subjects.....	50
XIII.A.	Daily Fat Consumption in Relation to Cholesterol Levels of the Blood for Fifteen Male Subjects.....	51
XIV.	Sex in Relation to Cholesterol Levels of the Blood for Twenty-nine Subjects..	54
XV.	Hereditary History of Heart Disease in Relation to Cholesterol Levels of the Blood for Fourteen Female Subjects.	57
XV.A.	Hereditary History of Heart Disease in Relation to Cholesterol Levels of the Blood for Fifteen Male Subjects....	58
XVI.	Individual Symptoms of Arteriosclerosis in Relation to Cholesterol Levels of the Blood for Fourteen Female Subjects..	59
XVI.A.	Individual Symptoms of Arteriosclerosis in Relation to Cholesterol Levels of the Blood for Fifteen Male Subjects.....	60
XVII.	Cholesterol Blood Levels in Relation to Cholesterol Dietary Intake for Fifteen Male Subjects.....	63
XVII.A.	Cholesterol Blood Levels in Relation to Cholesterol Dietary Intake for Fourteen Female Subjects.....	64

## LIST OF CHARTS

CHART		PAGE
1.	The Relation of the Daily Caloric Consumption to Cholesterol Dietary Intake for Fifty-four Subjects.....	21
2.	The Relation of the Daily Fat Consumption to Cholesterol Dietary Intake for Fifty-four Subjects.....	24
3.	The Relation of Sex to Cholesterol Dietary Intake for Fifty-four Subjects.....	27
4.	The Relation of the Hereditary History of Heart Disease to Cholesterol Dietary Intake for Fifty-four Subjects.....	31
5.	The Relation of the Individual Symptoms of Arteriosclerosis to Cholesterol Dietary Intake for Fifty-four Subjects.....	34
6.	The Relation of Age to the Cholesterol Blood Levels for Twenty-nine Subjects.....	39
7.	The Relation of Weight in Pounds to Cholesterol Blood Levels for Twenty-nine Subjects.....	42
8.	The Relation of Daily Caloric Consumption to Cholesterol Blood Levels for Twenty-nine Subjects.....	49
9.	The Relation of Sex to Cholesterol Blood Levels for Twenty-nine Subjects.....	59
10.	The Relation of Individual Symptoms of Arteriosclerosis to Cholesterol Blood Levels for Twenty-nine Subjects.....	61

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## CHAPTER I

## INTRODUCTION

Arteriosclerosis, or hardening of the arteries, is one of the most outstanding diseases of the vascular system and complicates the search for its underlying causes by often showing its symptoms late in life. The increasing number of persons with heart disease is of wide spread concern today.

Much research is being done in hope that something will be found to prolong the lives of persons suffering from arteriosclerosis, if not cure this dreaded disease. These studies are complicated by the role of cholesterol in the body and its possible relation to heart disease. Cholesterol is a sterol, which is composed of alcohols and fatty acids. Much research seems to indicate that there is a definite relationship between arteriosclerosis and cholesterol. There are many inconsistencies in the findings of this research probably since individuals tend to show differences in their ability to utilize cholesterol in the body.

The investigator became interested in this study through her work as the therapeutic dietitian at the Jefferson Hospital, Roanoke, Virginia, where she observed many patients admitted with heart diseases. At the request of the Jefferson Hospital Pathologist, she, with other hospital personnel, engaged in an intensified study of the roll of cholesterol in heart disease. Some of the results of

this study are reported in this paper.

The purpose of this research was to study the relationship of cholesterol in the diet to the fasting levels of cholesterol in the blood and the possible relationship of dietary and blood cholesterol to the presence of arteriosclerosis and some related conditions.

Specifically, this study proposed:

1. To compare the average daily protein, fat, and carbohydrate intake to the dietary histories of hospital patients who acted as subjects in this study.
2. To determine the relationship between the cholesterol intake of the diet and the symptoms of arteriosclerosis.
3. To determine the fasting cholesterol blood level of the hospital subjects.
4. To study the association of medical history, dietary history, and hospital records to cholesterol intake, fasting blood cholesterol levels, and some related conditions.

#### Review of Literature

In 1949, Mann<sup>1/</sup> studied cholesterol metabolism and stated that the restriction of cholesterol in the diet is unjustified. He also stated that many patients who would require restrictions are obese people that have developed vascular disease.

In a recent digest concerning arteriosclerosis published by

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<sup>1/</sup>Mann, George W. M. D. "Dietary Aspects of Cholesterol Metabolism and Disease." Journal of American Dietetic Association, 25:389, 1949.

the National Dairy Council,<sup>2/</sup> it was reported that arteriosclerosis was produced in rabbits by feeding very high cholesterol diets. Elevated blood levels of cholesterol were also observed in some individuals with symptoms associated with arteriosclerosis. It was further reported that in healthy men the concentration of total cholesterol in blood serum did not vary with the habitual dietary intake of large quantities of cholesterol, and there seemed to be no relation between the dietary composition and the total blood cholesterol, of healthy adults.

Dock<sup>3/</sup> in 1950 made these statements concerning the role of cholesterol in arteriosclerosis - "Whatever the mechanism may be, the fact is obvious that in human arteriosclerosis, fat content of the diet, protein content of the diet, total caloric content, and cholesterol content are all important to that group of the population whose plasma cholesterol behaves more like that of the rabbit than of the dog. A small group of young people and far more middle-aged people, have high and unstable cholesterol values, sensitive to added cholesterol or to diets rich in fat and calories. Some others, like dogs, can maintain levels under 200 milligrams percent on rich diets. In many, with intermediate types of metabolism, high caloric, high cholesterol

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<sup>2/</sup> "Nutrition and Arteriosclerosis," National Council Review, 22: Digest 23, January, 1951.

<sup>3/</sup> Dock, W., "The Cause of Arteriosclerosis!" Bulletin New York Academy of Medicine, 26:182, 1950.

high fat diets merely provide the straw to break the camel's back-- the slight difference in tissue cholesterol level spells deposition rather than resolution."

It appears from reviewing the literature that there is no found evidence to prove that obesity is related to arteriosclerosis. Many statistical factors have pointed to a possible relationship, however. Faber and Lund<sup>4/</sup> found no relationship between obesity and arteriosclerosis although there was a clear cut relationship between obesity and hypertension.

Okey<sup>5/</sup> in studying the cholesterol content of food, found that there is evidence based on increased incidence of lesions involving cholesterol deposition in tissue that would lead one to believe that individuals with abnormal fat metabolism may not be as able to utilize cholesterol as normal persons.

Becker, Meyer, and Necheles<sup>6/</sup> found that there was a marked change in fat metabolism in the aged. They reported that a high-fat meal results in a markedly greater number of serum chylomicra, and a more prolonged chylomicronemia in the aged than in the younger person.

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<sup>4/</sup>Nutrition Reviews: "Arteriosclerosis, Cholesterol and Obesity." Nutrition Reviews, 8:41, 1942.

<sup>5/</sup>Okey, Ruth, "Cholesterol Content of Foods!" Journal of American Dietetic Association, 21:341, 1945.

<sup>6/</sup>Nutrition Reviews: "Arteriosclerosis in Relation to Fat Metabolism." Nutrition Reviews, 8:61, 1950.

A study as reported in Nutrition Reviews in 1950<sup>7/</sup> on serum cholesterol levels in human beings revealed that it is difficult to influence serum concentrations of cholesterol by feeding cholesterol, however, egg yolk powder had a pronounced effect in increasing serum cholesterol in man. These findings should encourage more research and indicate that isolation and identification of the active substance in eggs might provide an important new tool in the study of arteriosclerosis.

Cook<sup>8/</sup> made a study of cholesterol metabolism and reported that more than half of the lipoids in blood are cholesterol and that the deposition increases with increasing age. He further stated that the theory that over feeding produces arteriosclerosis has been built up mostly by studies done on experimental animals rather than on humans. In a study made by Reimer, Blecka, and Wilkerson<sup>9/</sup> in 1949, they concluded that the level of total blood cholesterol was unrelated to the amounts of carbohydrate, fat, protein, and cholesterol in the diet.

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<sup>7/</sup> Nutrition Reviews, "Serum Cholesterol Levels in Human Beings Fed Egg Yolk and Cholesterol." Nutrition Reviews, 8:341, 1950.

<sup>8/</sup> Cook, Robert P. "Cholesterol Metabolism." Nutrition Abstracts and Reviews, 12:1, 1942.

<sup>9/</sup> Reimer, A., Blecka, E., and Wilkinson, C. F., Jr., "Study of Essential Familial Hypercholesterolemia: Relationship of Diet and Blood Cholesterol Levels." Journal of American Dietetic Association, 25:842, 1949.

Moreton<sup>10/</sup> in 1948 reported a study which he had made on the effect of the physical state of the blood lipoids upon the development of vascular sclerosis. The substance of the report was concerned with a method which was intended to measure the particle size of the emulsified fat in the plasma. The hypothesis which the author presents states that the formation of atherosclerotic plaques is the result of the presence of abnormally large chylomicra in the plasma of the affected individuals after a fat meal. It is supposed that the vascular damage results from embolization of these "macro-chylomicra" in the vasa vasorum. Since the chylomicra are known to contain cholesterol, it is believed that the triglycerides and phosphatides are then easily reabsorbed leaving a deposit of cholesterol in the vessel wall. Although this is an interesting theory, there are as yet no significant data to support it.

Morison and Johnson<sup>11/</sup> studied the cholesterol content of the anterior descending branch of the left coronary artery in eleven patients who had died of acute coronary artery thrombosis and in a

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<sup>10/</sup>Moreton, J. R. "Diet and Arteriosclerosis," Science, 106:190, 1947, as reported in: Nutrition Abstracts and Reviews, 6:99, 1948.

<sup>11/</sup>Morison, L. M., and Johnson, D., "Cholesterol Content of Coronary Arteries and Blood in Acute Coronary Artery Thrombosis." American Journal of Medicine, 39:31, 1951

comparable group of fourteen patients who died of causes other than coronary thrombosis. They studied the cholesterol and ester levels in both of these groups. The observations suggested that a disturbance in lipid metabolism is a factor in the pathogenesis of arteriosclerosis.

The literature, as reviewed, indicates the following points pertinent to this study:

(1) Arteriosclerosis is related to the feeding of high cholesterol diets in experimental animals, especially rabbits.

(2) The levels of cholesterol in the blood of human beings have been increased by feeding egg powder.

(3) The deposition of cholesterol is increased with increasing age.

(4) The levels of blood cholesterol are unrelated to the cholesterol intake from the diet.

(5) Obesity is unrelated to arteriosclerosis but obesity is related to hypertension.

(6) Individuals with abnormal fat metabolism may not be able to utilize cholesterol as normal persons and there is a marked change in fat metabolism in the aged.

## Chapter II

### PROCEDURE

This study was limited to patients who came to the Jefferson Hospital, Roanoke, Virginia, for treatment of various conditions. The fifty-four subjects were chosen from the age group of forty to sixty years, since many patients in that age range are admitted to the hospital with varied heart diseases. The subjects, as finally selected, included twenty-seven women and twenty-seven men. They were chosen one a day, Monday through Friday, until fifty-four subjects had been obtained. This selection of subjects began on June the eighth, 1950 and was completed on the thirtieth of September, 1950. The factors considered in the choice of subjects other than age and sex were: (1) physical conditions of the subject, (2) freedom from nervous disorders, (3) hereditary history indicating heart disease, (4) history of the subject indicating heart disease, (5) the willingness of the subject to cooperate in the study, (6) unrestricted diet order of the subject when released from the hospital, (7) accuracy of the subject in reporting usual food patterns.

Each subject was personally interviewed in his hospital room by the investigator, and the subject's willingness to cooperate in the study was obtained. When the purpose of this investigation had been explained to the subject, the investigator, by interview technique, recorded on schedules especially planned for this study

(1) the food habits of the subject as shown in the type diet usually consumed (see Appendix, page 1, 2) and (2) his habits of eating high cholesterol foods (see Appendix, page 3 ). In order to check the accuracy of data collected by this interview each subject was asked to keep a detailed record of all foods, including amounts, that he consumed for a one-week period immediately after his release from the hospital. A copy of this schedule is included in the Appendix page 6 . If the diet of the subject was restricted in any food for any reason, this restriction eliminated the subject from the study. If the data collected by the interview schedule did not favorably correspond to the data recorded by the subject over a one-week period, the subject was eliminated from the study. This was done to protect the reliability of collected data.

At the time of the interview the investigator gave the subject a stamped, self-addressed envelope for use in returning the food records to the hospital. If the subject failed to return his food record on schedule time, he was eliminated from the study.

When the food records had been collected the investigator calculated the total protein, fat, carbohydrate, and cholesterol consumed daily by each subject. A daily average of protein, fat, and carbohydrate<sup>1/</sup> was obtained from this seven-day record (see Appendix, pages 7,8). A daily record of cholesterol consumed was obtained

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<sup>1/</sup>For calculation of food nutrients food values were used as given by:

Barber, Edith M., Mitchell, Helen S., Cooper, Lenna, F.,  
Nutrition in Health and Disease, Philadelphia: J. B. Lippincott,  
1947.

by combining the usual type diet with the actual food record and then by computing the daily cholesterol content of this combination.<sup>2/</sup>

At the time the subject consented to cooperate in this study, he also agreed to return to the hospital at a later date agreeable to the laboratory technicians to contribute a fasting blood sample to be used in blood cholesterol analysts. The subject in preparing himself to donate a fasting blood sample returned to the hospital early on the morning designated by the investigator after having eaten no food for the previous sixteen hours. Twenty-nine of the fifty-four subjects returned to the hospital and contributed this sample.

The analysis of the cholesterol was made according to the method as reported by J. C. Forbes in the Journal of Clinical Medicine. A copy of this procedure is included in the Appendix, pages 9 and 10. All analyses were made by one individual, the head laboratory technician at the Jefferson Hospital. This was done in the hope that, by limiting the laboratory analysis to one person, any error due to varying technique could be limited to a minimum. All of the laboratory analyses for blood cholesterol of these twenty-nine subjects were made in February 1951. The results of these analyses are shown on the page 11 of the Appendix.

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<sup>2/</sup>In computing cholesterol consumption figures were used as given by: Okey, Ruth. "Cholesterol Content of Foods." Journal of American Dietetic Association, 21:341, 1945.

## CHAPTER III

## DISCUSSION OF RESULTS

When all data were collected they were analyzed to see if there were any relation of dietary cholesterol to any of the following: (1) age, (2) weight in pounds, (3) percentage of variation from normal weight, (4) daily caloric consumption, (5) daily fat consumption, (6) sex, (7) hereditary history of heart disease, (8) individual symptoms of arteriosclerosis. Tables I through VIII-A show the results of these comparisons.

Table I and I-A, pages 12, 13 show no significant relationship between age and the amount of cholesterol consumed daily in either the females or the males included in this study. In other words, if this is a representative group, individuals seem to have little tendency to increase their consumption of cholesterol foods as they grow older.

As shown in Tables II and II-A, pages 14 and 15, in this study weight alone seems to have little or no relationship to the cholesterol intake in either sex. This would seem to indicate that weight is not important in studying the effect of dietary cholesterol in the body unless the subject tends toward extreme overweight. From a study of the diets of these males and females, weight above normal, however, does seem to show a slight relation-

TABLE I

Age in Relation to Cholesterol Dietary Intake For Twenty-seven Male Subjects

Age	Cholesterol Intake Mg				Total
	0-500	500-1000	1000-1500	1500-2000	
40-44	2	6	1	0	9
45-49	0	3	0	0	3
50-54	2	2	1	1	6
55-60	2	6	1	0	9
Total	6	17	3	1	27

$$\chi^2 = 4.60$$

$$P = > .80$$

TABLE I-A.

Age in Relation to Cholesterol Dietary Intake For Twenty-seven Female Subjects

Age	Cholesterol Intake Mg				Total
	0-500	500-1000	1000-1500	1500-2000	
40-44	5	1	0	0	6
45-49	3	5	0	0	8
50-54	6	4	0	0	10
55-60	3	0	0	0	3
Total	17	10	0	0	27

$$X^2 = 3.61$$

$$P = > .30$$

TABLE II

Weight in Pounds in Relation to Cholesterol Dietary Intake For Twenty-seven Male Subjects

Weight	Cholesterol Intake Mg				Total
	0-500	500-1000	1000-1500	1500-2000	
0-100	0	0	0	0	0
100-150	2	4	1	1	8
150-200	3	10	2	0	15
200-250	1	3	0	0	4
Total	6	17	3	1	27

$$\chi^2 = 6.707$$

$$P = > .30$$

TABLE II-A.

Weight in Pounds in Relation to Cholesterol Dietary Intake For Twenty-seven Female Subjects

Weight	Cholesterol Intake Mg				Total
	0-500	500-1000	1000-1500	1500-2000	
0-100	1	0	0	0	1
100-150	13	7	0	0	20
150-200	2	2	0	0	4
200-250	1	1	0	0	2
Total	17	10	0	0	27

$$\chi^2 = 1.860$$

$$P = > .50$$

ship to the cholesterol intake. This is shown in Tables III and III-A, pages 17 and 18. The term normal weight as used in this study was established by charts secured from the Metropolitan Life Insurance Company. Copies of the charts obtained from the Metropolitan Life Insurance Company are included in the Appendix on pages 12, 13, 14 and 15.

One might be able to explain the association of excess weight above normal and the cholesterol intake in food by the fact that when an individual increases his caloric intake he usually increases the amount of fat consumed, and this, in some cases, increases cholesterol consumption. If a person increases his body weight by added food consumption rather than decreased physical activities, this added amount of food in the diet usually carries with it added fat consumption. Especially, if this increase in fat consumption is derived from animal sources, the cholesterol intake will be markedly increased.

The total number of calories consumed daily and the total daily fat intake seem to be very definitely related to the cholesterol intake in the diet in both men and women. Tables IV, IV-A, V, and V-A show the results of this analysis. It is difficult to greatly increase the calories consumed daily without also increasing the daily fat consumption. The increase of cholesterol would depend upon the kind of fat consumed, since animal fats rank high as cholesterol foods. The results obtained in this study indicate that the consumption of animal fats is greater than the consumption of vegetable fats. Therefore, most increases in calories from animal sources would

TABLE III

Normal Weight in Relation to Cholesterol Dietary Intake For Twenty-seven Male Subjects

Percentage of Weight	Cholesterol Intake Mg				Total
	0-500	500-1000	1000-1500	1500-2000	
Over 30% Above Normal	0	4	0	0	4
20 -29% Above Normal	1	2	0	0	3
10 - 19% Above Normal	1	2	2	0	5
9% Above Normal to 9% Below Normal	2	3	1	1	7
10 - 19% Below Normal	3	5	0	0	8
20% or More Below Normal	0	0	0	0	0
Total	7	16	3	1	27

$$X^2 = 15.90$$

$$P = < .20$$

TABLE III-A.

Normal Weight in Relation to Cholesterol Dietary Intake For Twenty-seven Female Subjects

Percentage of Weight	Cholesterol Intake Mg				Total
	0-500	500-1000	1000-1500	1500-2000	
Over 30% Above Normal	0	2	0	0	2
20-29% Above Normal	1	0	0	0	1
10-19% Above Normal	2	0	0	0	2
9% Above Normal to 9% Below Normal	3	2	0	0	5
10 - 19% Below Normal	9	6	0	0	15
20% or More Below Normal	2	0	0	0	2
Total	17	10	0	0	27

$$X^2 = 7.5187$$

$$P = < .20$$

TABLE IV

Daily Calorie Consumption in Relation to Cholesterol Dietary Intake  
For Twenty-seven Male Subjects

Calories per day	Cholesterol Intake Mg				Total
	0-500	500-1000	1000-1500	1500-2000	
1000 to 2000	1	0	0	0	1
2100 to 3000	3	5	0	0	8
3100 to 4000	1	8	0	0	9
4100 to 5000	1	3	2	0	6
5100 to 6000	0	1	1	1	3
Total	6	17	3	1	27

$$\chi^2 = 22.74$$

$$P = < .02$$

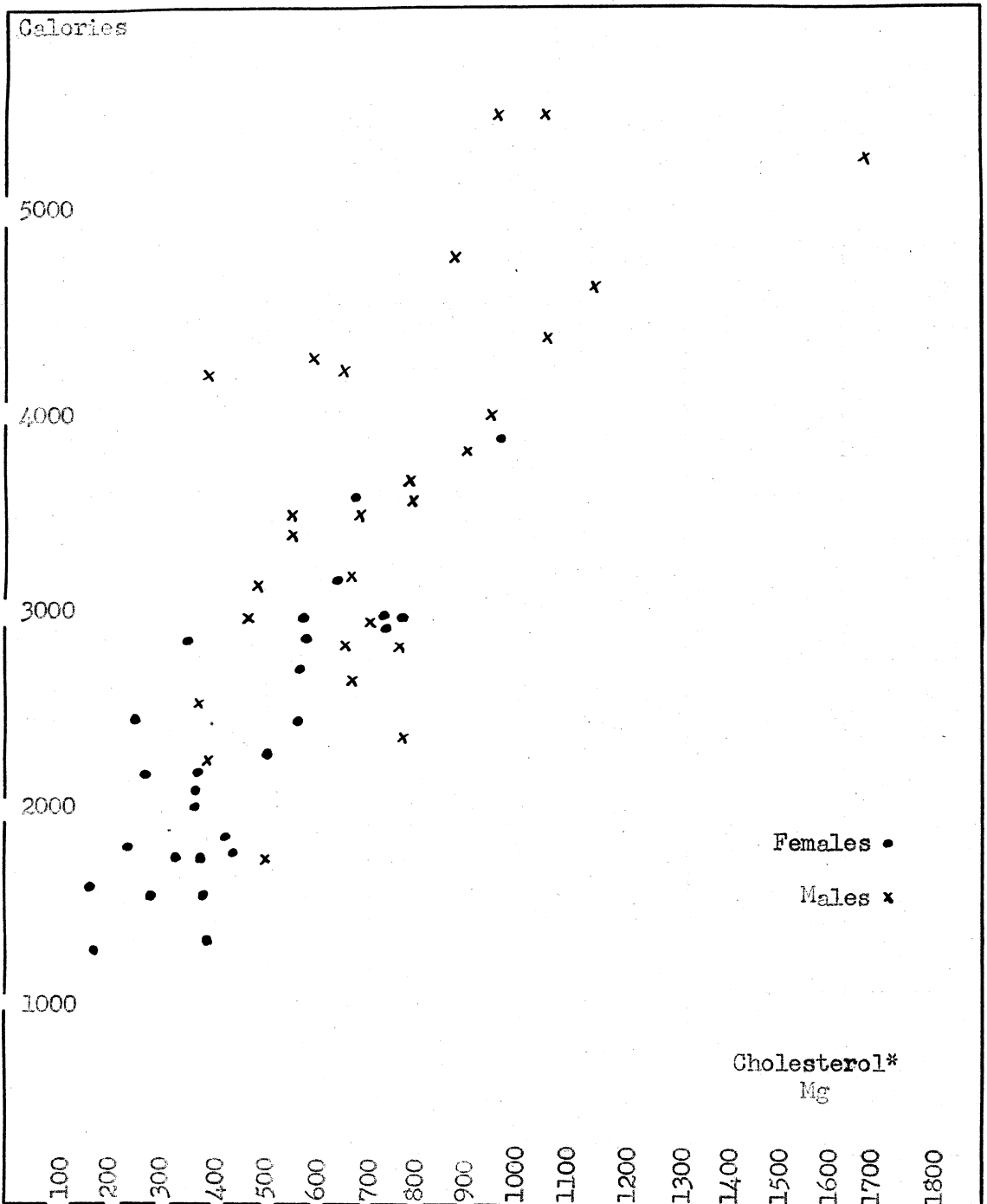
TABLE IV - A.

Daily Caloric Consumption in Relation to Cholesterol Dietary Intake  
For Twenty-seven Female Subjects

Calories Per day	Cholesterol Intake Mg				Total
	0-500	500-1000	1000-1500	1500-2000	
1000 to 2000	10	0	0	0	10
2100 to 3000	6	8	0	0	14
3100 to 4000	0	3	0	0	3
4100 to 5000	0	0	0	0	0
5100 to 6000	0	0	0	0	0
Total	16	11	0	0	27

$$X^2 = 11.71$$

$$P = < .01$$



\*See Appendix, page 7, 8 for order of cholesterol mg in the diet

The Relation of the Daily Caloric Consumption to Cholesterol

Dietary Intake for Fifty-four Subjects

CHART 1

TABLE V

Daily Fat Consumption in Relation to Cholesterol Dietary Intake For  
Twenty-seven Male Subjects

Fat Intake gms	Cholesterol Intake Mg				Total
	0-500	500-1000	1000-1500	1500-2000	
0-99	0	0	0	0	0
100-199	6	12	0	0	18
200-299	0	5	1	0	6
300-400	0	0	2	1	3
Total	6	17	3	1	27

$$\chi^2 = 23.41$$

$$P = < .01$$

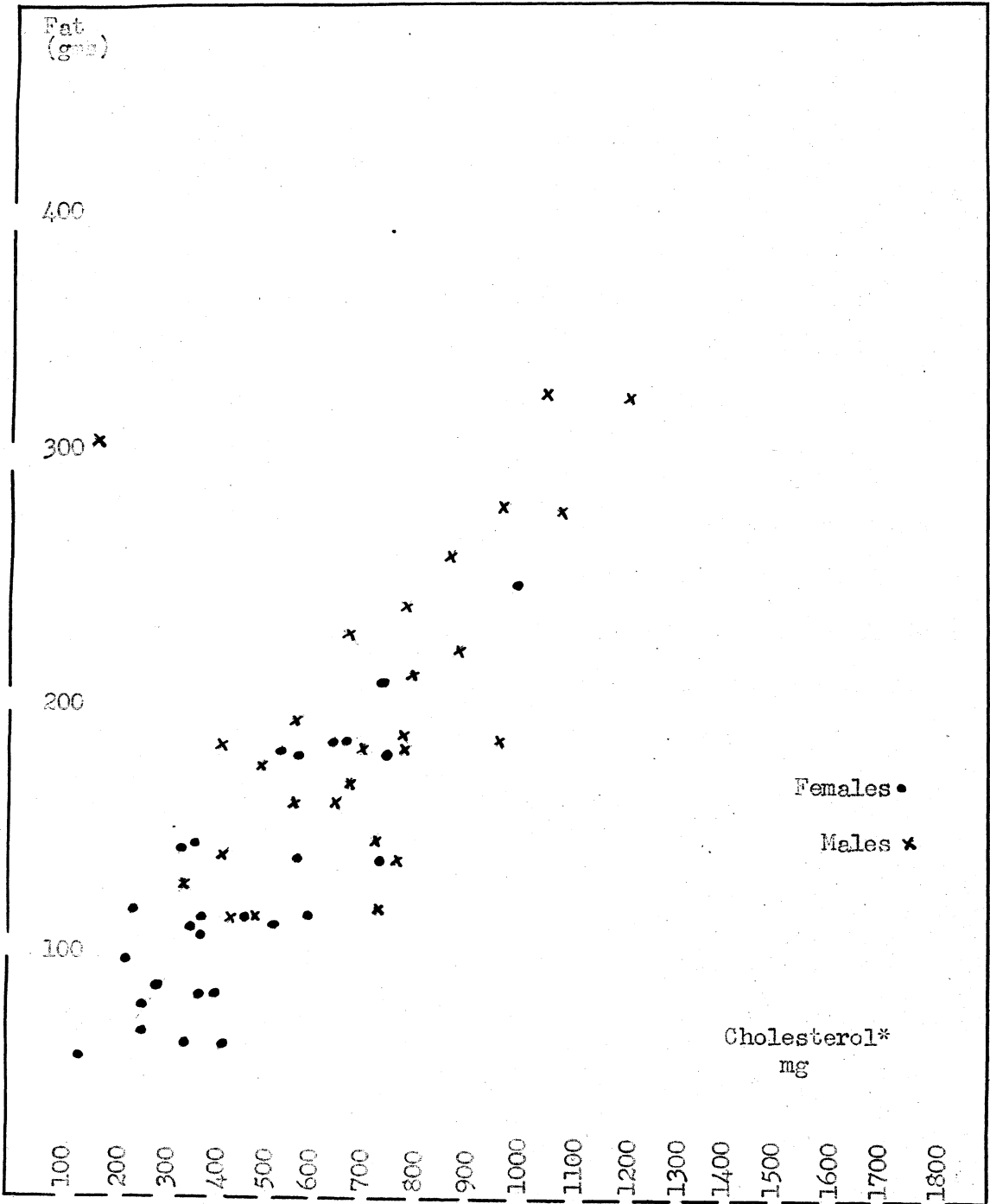
TABLE V-A.

Daily Fat Consumption in Relation to Cholesterol Dietary Intake For  
Twenty-seven Female Subjects

Fat Intake gms	Cholesterol Intake Mg				Total
	0-500	500-1000	1000-1500	1500-2000	
0-99	9	0	0	0	9
100-199	8	8	0	0	16
200-299	0	2	0	0	2
300-400	0	0	0	0	0
Total	17	10	0	0	27

$$X^2 = 9.80$$

$$P = < .05$$



\*See Appendix, page 7,8 for order of cholesterol mg in the diet

The Relation of Daily Fat Consumption to Cholesterol Dietary

Intake for Fifty-four Subjects

CHART 2

also increase fat consumption and thus increase cholesterol consumption. The placement of subjects is shown in Charts 1 and 2, pages 21 and 24.

The cholesterol intake seems to be, in this study at least, very definitely related to sex. The twenty-seven men used in this investigation consumed more cholesterol daily than the twenty-seven women studied. The average daily cholesterol consumption for the men was 738.5 milligrams, while the average cholesterol consumption for the women studied was only 446.2 milligrams. This relationship of cholesterol intake and sex might probably be attributed either to the fact that women are more likely to restrict their diets in a desire to maintain or regain a slim figure, or that the usual physical activities of men might demand a higher food intake than the activities of women. Table VI, page 26, shows the results. A scatter-graph showing the arrangements of the subjects studied may be found on page 27, Chart 3.

If in this study the average daily food intake of the women had equalled the daily food consumption of the men, and if the weights of the men and women studied had been identical, then, the investigator might have been able to determine whether total food consumption, weight, or sex is the factor most nearly related to total cholesterol consumption.

It seems, from the findings of this study that, for these subjects, at least, history and individual symptoms of arteriosclerosis are related to cholesterol intake. These results may be seen in

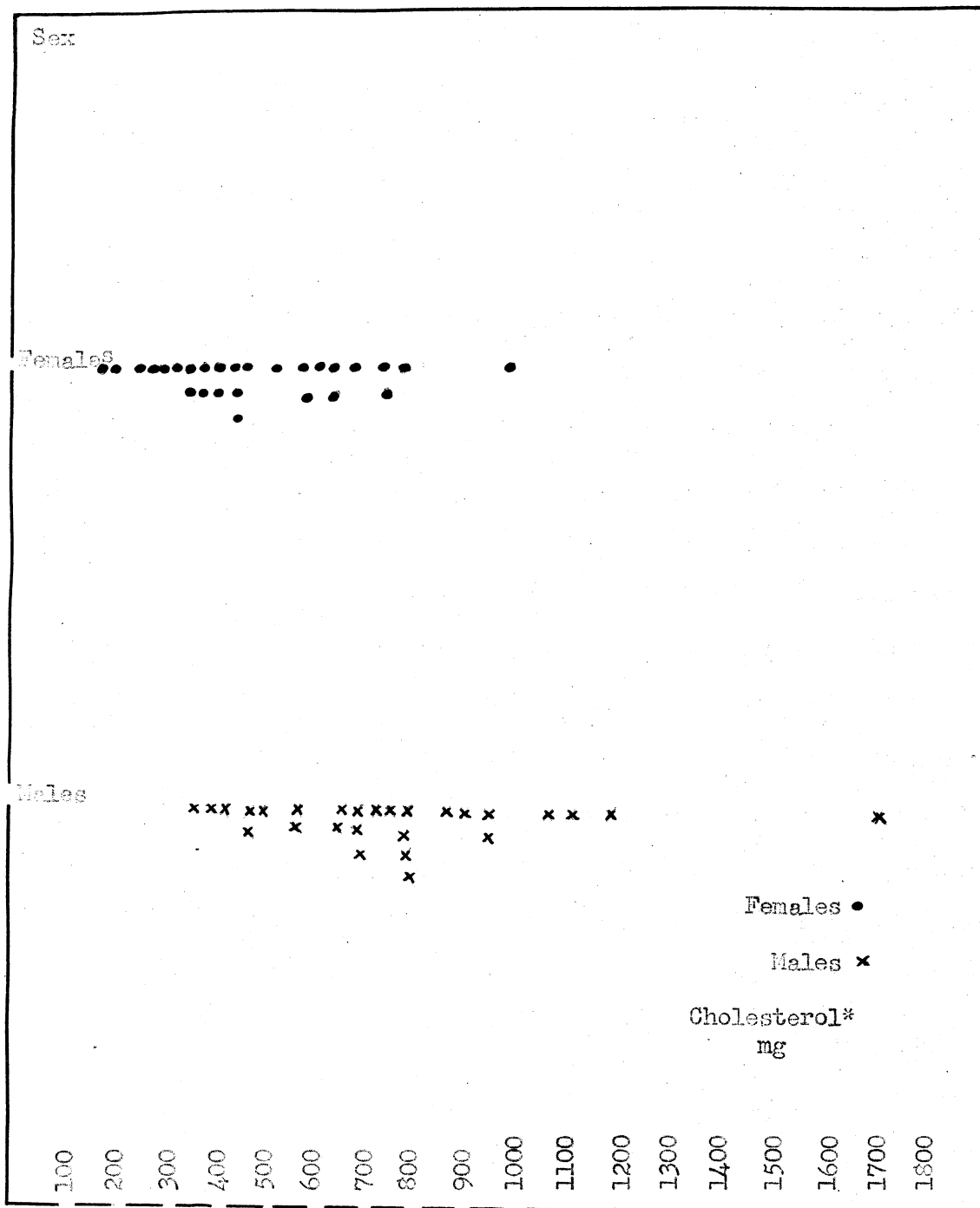
TABLE VI

Sex in Relation to Cholesterol Dietary Intake For Fifty-four Subjects

Sex	Cholesterol Intake Mg				Total
	0-500	500-1000	1000-1500	1500-2000	
Females	15	12	0	0	27
Males	6	17	3	1	27
Total	21	29	3	1	54

$$\chi^2 = 10.61$$

$$P = < .02$$



\*See Appendix, page 7,8 for order of cholesterol mg in the diet

The Relation of Sex to Cholesterol Dietary Intake for Fifty-four

Subjects

CHART 3

Tables VII, VII-A, VIII, and VIII-A, pages 29,30,32 and 33.

Most of the subjects had histories of heart disease; however, comparatively few subjects showed any symptoms that would lead to a safe conclusion that they now have heart disease themselves, either in early or more developed stages. It is interesting to note that there seems to be some relationship between hereditary history of heart disease, symptoms of arteriosclerosis, and cholesterol intake. It is quite possible, however, that this relationship might not apply to another or larger group of subjects. Could it be that the eating patterns of some families include high cholesterol foods as food preferences and that in passing these preferences along from one generation to the next some leading symptoms of heart diseases also follow? In other words if there is any relationship between the diet and arteriosclerosis, the hereditary factor may not be passed on as the tendency toward the disease itself but by the food preferences that are handed down from one generation to another. The arrangement of the subjects showing relationship between the hereditary history of heart disease, symptoms of arteriosclerosis, and cholesterol intake from the diet is shown in Charts 4 and 5 on pages 31 and 34.

Mann<sup>1/</sup> reported from a study of cholesterol that the restriction of cholesterol in the diet is unjustified and many patients who would

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<sup>1/</sup>Mann, George V. M. D. "Dietary Aspects of Cholesterol Metabolism and Disease." Journal of American Dietetic Association, 25:389, 1949.

TABLE VII

History of Arteriosclerosis in Relation to Cholesterol Dietary Intake  
For Twenty-seven Male Subjects.

History of Arteriosclerosis	Cholesterol Intake Mg				Total
	0-500	500-1000	1000-1500	1500-2000	
Unknown History	1	0	0	0	1
History of Original Family	1	1	0	0	2
History of Immediate Family	3	12	2	0	17
No History	1	4	1	1	7
Total	6	17	3	1	27

$$X^2 = 14.85$$

$$P = < .10$$

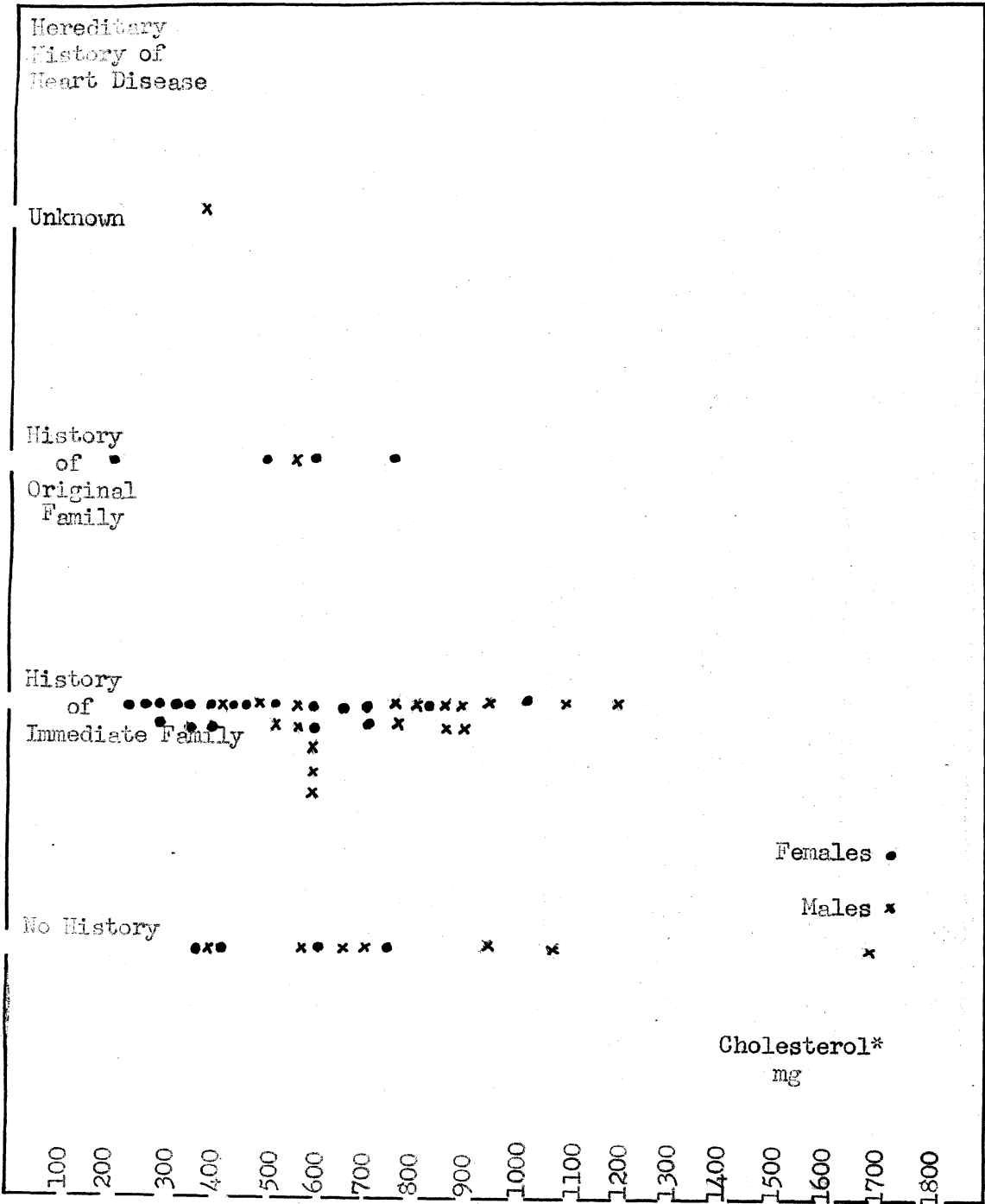
TABLE VII-A

History of Arteriosclerosis in Relation to Cholesterol Dietary Intake  
For Twenty-seven Female Subjects

History of Arteriosclerosis	Cholesterol Intake Mg				Total
	0-500	500-1000	1000-1500	1500-2000	
Unknown History	0	0	0	0	0
History of Original Family	1	2	0	0	3
History of Immediate Family	14	6	0	0	20
No History	2	2	0	0	4
Total	17	10	0	0	27

$$\chi^2 = 3.27$$

$$P = < .20$$



\*See Appendix, page 7,8 for order of cholesterol mg in the diet

The Relation of Hereditary History of Heart Disease to Cholesterol Dietary Intake for Fifty-four Subjects

CHART 4

TABLE VIII

Symptoms of Arteriosclerosis<sup>1/</sup> in Relation to Cholesterol Dietary Intake for Twenty-seven Male Subjects

Symptoms of Arteriosclerosis	Cholesterol Intake Mg				Total
	0-500	500-1000	1000-1500	1500-2000	
Unknown Diagnosis	0	0	1	0	1
Known Arteriosclerosis	0	2	1	0	3
Leading Symptoms of Arteriosclerosis	2	3	0	0	5
No Symptoms of Arteriosclerosis	3	13	1	1	18
Total	5	18	3	1	27

<sup>2/</sup> Symptoms of arteriosclerosis derived from hospital records of individual subjects.

$$\chi^2 = 15.43$$

$$P = < .10$$

TABLE VIII

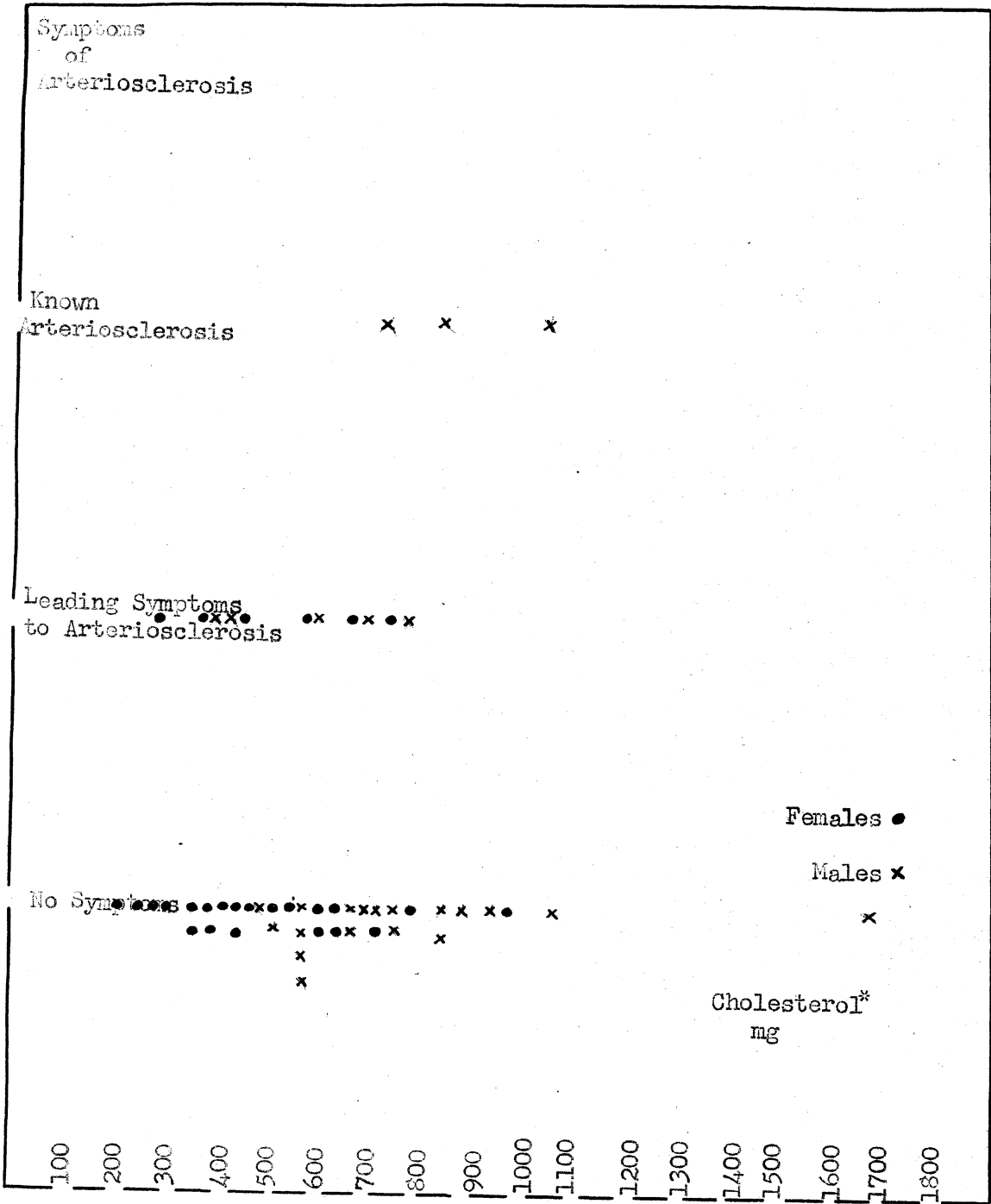
Symptoms of Arteriosclerosis<sup>1/</sup> in Relation to Cholesterol Dietary Intake for Twenty-seven Female Subjects

Symptoms of Arteriosclerosis	Cholesterol Intake Mg				Total
	0-500	500-1000	1000-1500	1500-5000	
Unknown Diagnosis	0	0	0	0	0
Known Arteriosclerosis	0	0	0	0	0
Leading Symptoms of Arteriosclerosis	3	3	0	0	6
No Symptoms of Arteriosclerosis	14	7	0	0	21
Total	17	10	0	0	27

<sup>1/</sup> Symptom of arteriosclerosis derived from hospital records of individual subjects.

$$X^2 = 1.654$$

$$P = < .20$$



"See Appendix, page 7, 8 for order of cholesterol mg in the diet

The Relation of Individual Symptoms of Arteriosclerosis to the Cholesterol Dietary Intake for Fifty-four Subjects

CHART 5

require restriction are already obese and have developed heart disease. If the individuals likely to develop vascular or heart disease could be identified in early life the restriction of cholesterol food might prevent the onset of the disease or delay the development of arteriosclerosis in those individuals. Whether it could be said that cholesterol in the diet is related to arteriosclerosis in only certain individuals would demand further study.

The results obtained in this study seem to indicate a significant relationship of cholesterol intake to total calories consumed daily, total fat consumed daily, and sex. These results also indicate a slight relationship of weight above normal, hereditary history of heart disease, and individual symptoms of arteriosclerosis to the intake of cholesterol daily. There seems to be no significant relationship between cholesterol intake from the diet and age or weight in pounds.

Using twenty-nine of the fifty-four male and female subjects from the cholesterol intake study, the cholesterol levels of the blood were analyzed and data from these analyses were studied to determine the relationship of cholesterol blood levels to the following:

(1) age, (2) weight in pounds, (3) percentage of variation from normal weight, (4) daily caloric consumption, (5) daily fat consumption, (6) sex, (7) hereditary history of heart disease, (8) individual symptoms of arteriosclerosis. These were the same factors that were studied in relation to cholesterol intake.

In this study increasing age seems to be slightly related to the cholesterol levels of the blood in both males and females, and the relation is greater in the women than in the men. This relationship is shown in Tables IX and IX-A, pages 37 and 38. The Chart 6, page 39, also shows the arrangement of the subjects by scattergraph. The findings of this study are in agreement with those of Robert P. Cook<sup>4/</sup> who found that more than half of the blood lipid is cholesterol and that the deposition increases with increasing age. It appears that the association between these two factors is gradually progressive.

When the results of analyses of blood cholesterol of the male subjects were studied, it was found that the amount of cholesterol found in the blood was only slightly related to weight. This finding regarding the slight increase of blood cholesterol with increased weight was not duplicated when the weights of the female subjects were compared with the blood cholesterol levels. However, since the average weight of the women was lower than the average weight of the men, this factor may have contributed to the nonconformity of results. This investigation showed that male subjects of this study had a higher intake of calories, of fat, and of cholesterol from the diet than the females. The relationship of weight to cholesterol blood levels is shown in Tables X and X-A, on pages 40 and 41. A scattergraph of the arrangement of the subjects is

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<sup>4/</sup>Cook, Robert P.: "Cholesterol Metabolism." Nutrition Abstracts and Reviews, 12: 1, 1942.

TABLE IX

Age in Relation to Cholesterol Blood Level For Fifteen Male Subjects

Age	Cholesterol Blood Levels Mg%			Total
	100-200	200-300	300-400	
40 to 44	2	1	0	3
45 to 49	2	1	0	3
50 to 54	1	3	0	4
55 to 60	1	4	0	5
Total	6	9	0	15

$$X^2 = 5.940$$

$$P = < .20$$

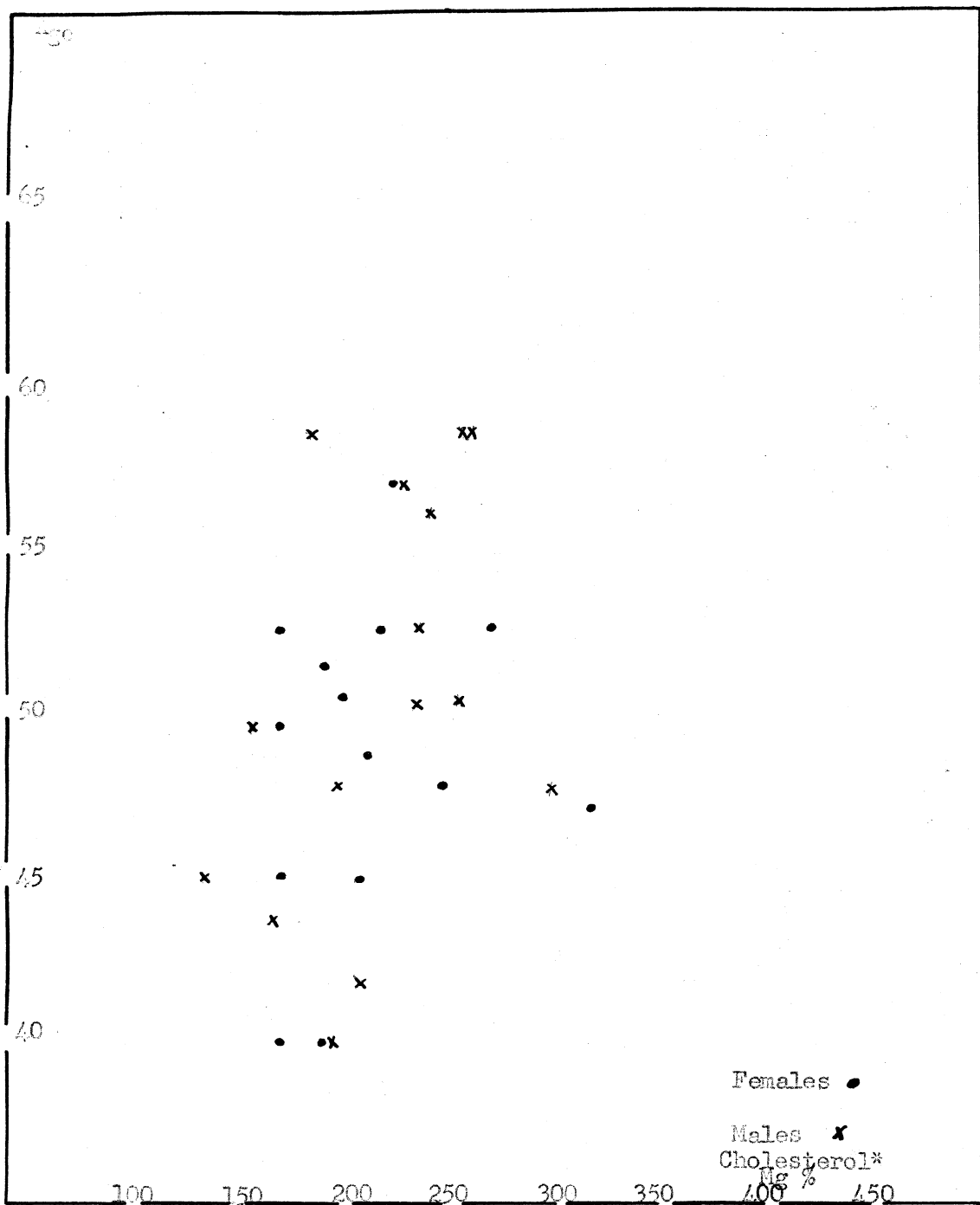
TABLE IX-A

Age in Relation to Cholesterol Blood Level For Fourteen Female Subjects

Age	Cholesterol Blood Levels Mg%			Total
	100-200	200-300	300-400	
40 to 44	2	0	0	2
45 to 49	1	4	0	5
50 to 54	5	1	0	6
55 to 60	0	1	0	1
Total	8	6	0	14

$$\chi^2 = 7.35$$

$$P = < .10$$



\*See Appendix, page 11, for order of cholesterol Mg % in the blood

The Relation of Age to Cholesterol Blood Levels for Twenty-nine  
Subjects

CHART 6

TABLE X

Weight in Pounds in Relation to Cholesterol Blood Level For Fifteen Male Subjects

Weight Pounds	Cholesterol Blood Levels Mg%			Total
	100-200	200-300	300-400	
0-100	0	0	0	0
100-150	3	1	0	4
150-200	4	5	0	9
200-250	0	2	0	2
Total	7	8	0	15

$$\chi^2 = 3.16$$

$$P = >.20$$

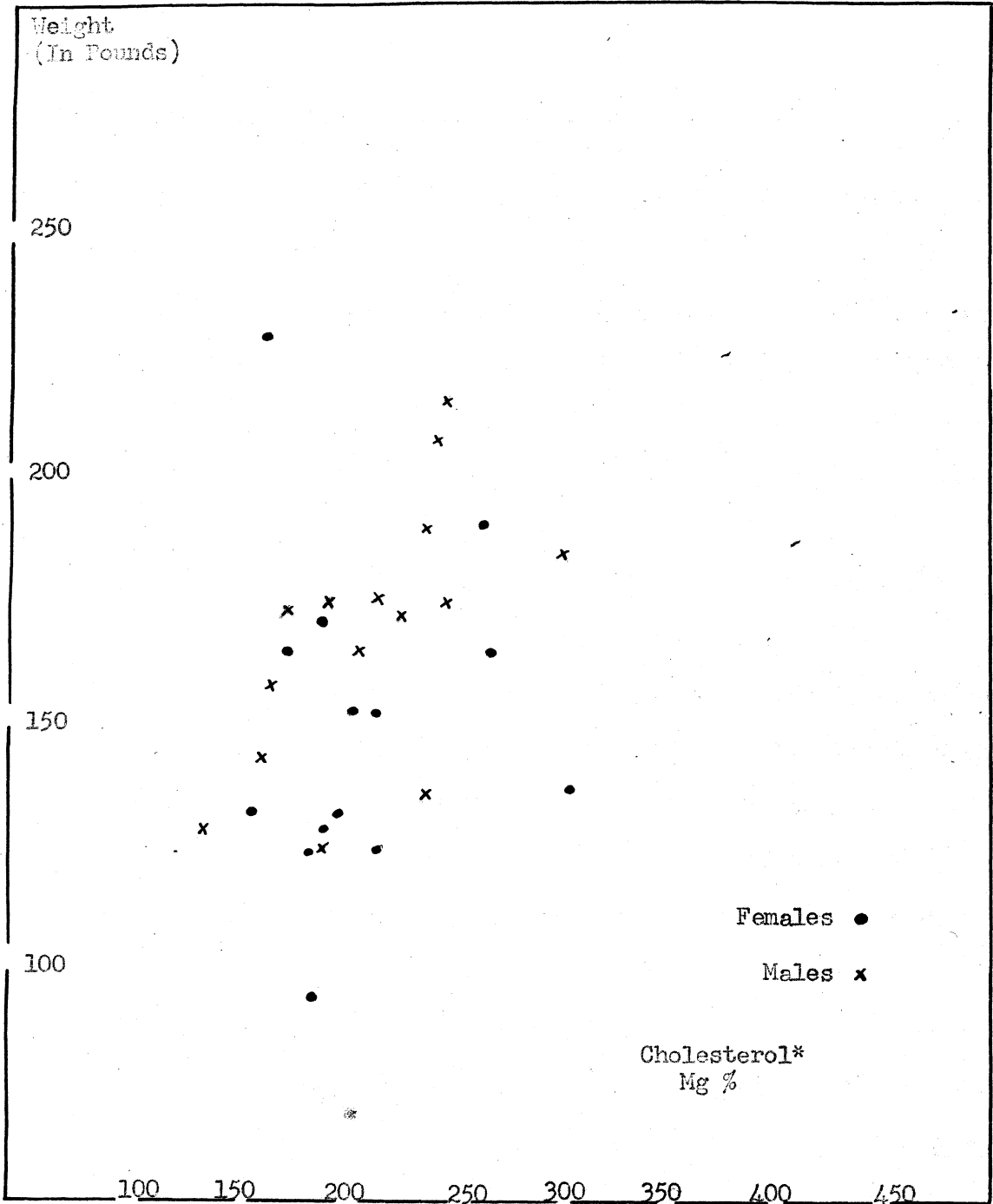
TABLE X-A

Weight in Pounds in Relation to Cholesterol Blood Level For Fourteen Female Subjects

Weight Pounds	Cholesterol Blood Levels Mg%			Total
	100-200	200-300	300-400	
0-100	1	0	0	1
100-150	6	1	1	8
150-200	2	2	0	4
200-250	1	0	0	1
Total	10	3	1	14

$$X^2 = 3.31$$

$$P = > .70$$



found in Chart 7, page 42.

No relationship was found between deviation from normal weight and cholesterol content of the blood. Results from the analysis are shown in Tables XI and XI-A, pages 44 and 45.

Data collected regarding the daily caloric consumption of men and women when analyzed for relation to blood cholesterol levels, gave conflicting results. Total daily caloric intake of the male subjects was slightly related to the level of cholesterol found in the blood, whereas the amount of food eaten by the females showed little or no relationship to the blood cholesterol. Tables XII, XII-A, and XII-B, pages 46, 47, 48. The arrangement of the subjects is given in Chart 8, page 49. Dock<sup>5/</sup> reported that in certain individuals the caloric intake would be related to the blood cholesterol levels. The findings of Dock are not in agreement with the results of this study.

Daily fat consumption showed little or no relationship to blood cholesterol levels as shown in Tables XIII and XIII-A, pages 50 and 51. It may be fair to assume that though the amount of fat is not important, the kind of fat consumed whether animal or vegetable, and the ability of the subjects to utilize the fat may have a relationship to the cholesterol level of the blood. The role of fat as related to arteriosclerosis is not clear. Studies reviewed reveal that increasing

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<sup>5/</sup>Dock, W.: "The Cause of Arteriosclerosis." Bulletin New York Academy of Medicine, 26:182, 1950.

TABLE XI

Normal Weight in Relation to Cholesterol Blood Level For Fifteen Male Subjects

Percentage of Weight	Cholesterol Blood Levels Mg %			Total
	100-200	200-300	300-400	
Over 30% Above Normal	0	0	0	0
20 - 29% Above Normal	0	3	0	3
10 - 19% Above Normal	1	3	1	5
9% Above Normal to 9% Below Normal	2	0	0	2
10 - 19% Below Normal	2	1	0	3
20% or More Below Normal	1	1	0	2
Total	6	8	1	15

$$\chi^2 = 6.38$$

$$P = > .50$$

TABLE XI-A

Normal Weight in Relation to Cholesterol Blood Level For Fourteen Female Subjects

Percentage of Weight	Cholesterol Blood Levels Mg %			Total
	100-200	200-300	300-400	
Over 30% Above Normal	1	0	0	1
20 - 29% Above Normal	0	0	0	0
10 - 19% Above Normal	1	1	0	2
9% Above Normal to 9% Below Normal	1	3	0	4
10 - 19% Below Normal	3	2	1	6
20% or More Below Normal	1	0	0	1
Total	7	6	1	14

$$\chi^2 = 5.51$$

$$P = > .70$$

TABLE XII

Daily Calorie Consumption in Relation to Cholesterol Blood Level For Fifteen Male Subjects

Calories per day	Cholesterol Blood Levels Mg %			Total
	100-200	200-300	300-400	
1000 to 2000	0	1	0	1
2100 to 3000	2	3	0	5
3100 to 4000	3	0	0	3
4100 to 5000	1	5	0	6
5100 to 6000	0	0	0	0
Total	6	9	0	15

$$\chi^2 = 6.53$$

$$P = < .10$$

TABLE XII-A

Daily Calorie Consumption in Relation to Cholesterol Blood Levels  
For Fourteen Female Subjects

Calories	Cholesterol Blood Levels Mg %			Total
	100-200	200-300	300-400	
1000 to 2000	3	1	0	4
2100 to 3000	3	5	0	8
3100 to 4000	1	1	0	2
4100 to 5000	0	0	0	0
5100 to 6000	0	0	0	0
Total	7	7	0	14

$$\chi^2 = 1.50$$

$$P = >.30$$

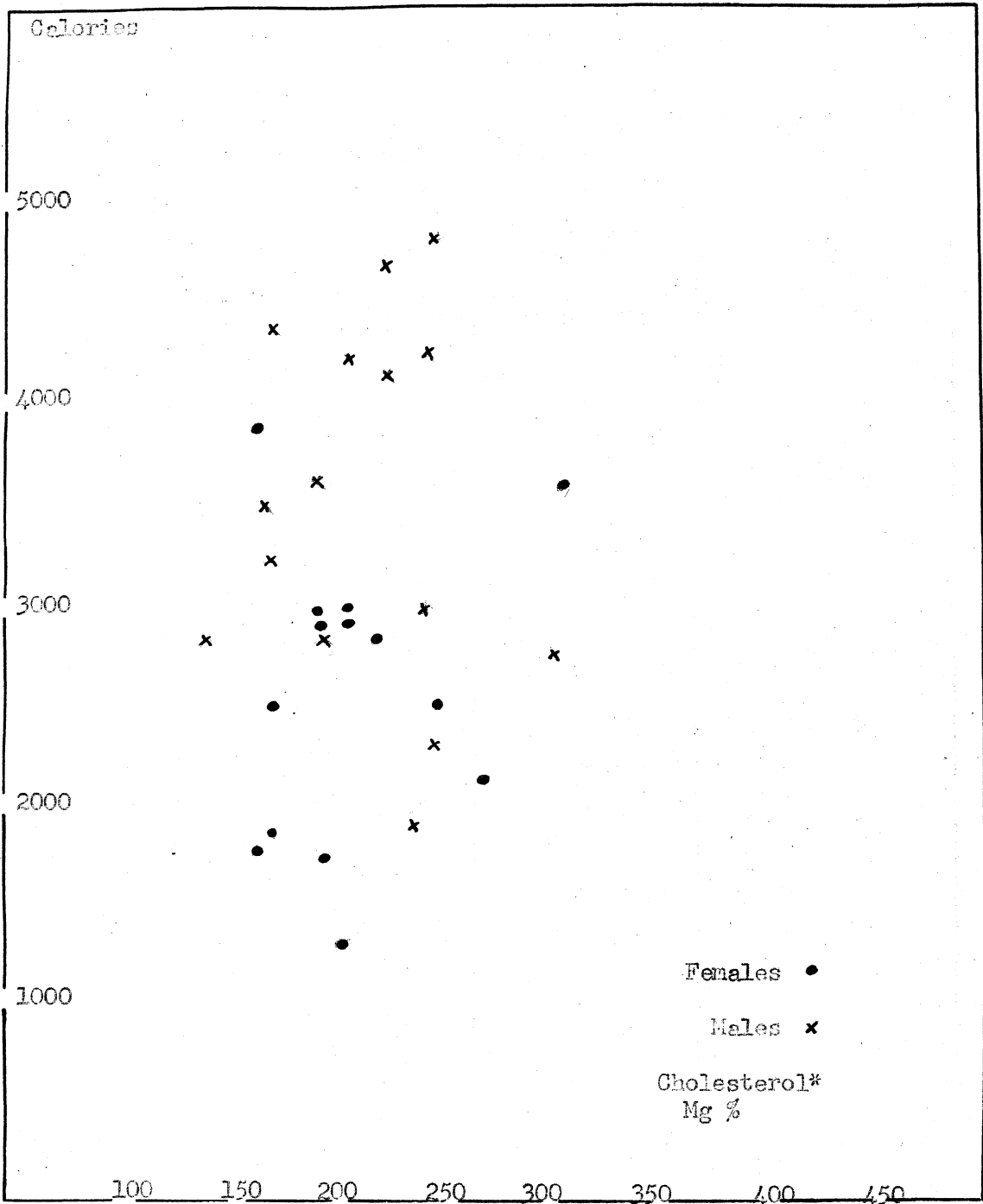
TABLE XII-B

Daily Calorie Consumption in Relation to Cholesterol Blood Levels For  
Twenty-nine Female and Male Subjects

Calories	Cholesterol Blood Levels Mg %			Total
	100-200	200-300	300-400	
1000 to 2000	3	2	0	5
2100 to 3000	5	8	0	13
3100 to 4000	4	1	0	5
4100 to 5000	1	5	0	6
5100 to 6000	0	0	0	0
Total	13	16	0	29

$$\chi^2 = 5.56$$

$$P = > .20$$



\*See Appendix, page 11 for order of cholesterol Mg % in the blood

The Relation of Daily Caloric Consumption to Cholesterol Blood

Levels for Twenty-nine Subjects

CHART 8

TABLE XIII

Daily Fat Consumption in Relation to Cholesterol Blood Levels For Fifteen Male Subjects

Fat Intake grams	Cholesterol Blood Levels Mg%		Total
	100-200	200-300	
0-99	0	0	0
100-199	5	4	9
200-299	1	4	5
300-400	0	1	1
Total	6	9	15

$$\chi^2 = 2.40$$

$$P = > .50$$

TABLE XIII-A

Daily Fat Consumption in Relation to Cholesterol Blood Levels For  
Fourteen Female Subjects

Fat Intake grams	Cholesterol Blood Levels Mg%		Total
	100-200	200-300	
0-99	1	1	2
100-199	5	5	10
200-299	1	0	1
300-400	1	0	1
Total	8	6	14

$$X^2 = 1.89$$

$$P = > .50$$

the fat in the diet of experimental animals, rabbits, can bring on advanced arteriosclerosis.<sup>6/</sup>

Although there is no significant relationship between fat consumption and the cholesterol level of the blood in this study one must consider that blood samples were collected from fasting subjects. One widely accepted theory concerning fat metabolism should be kept in mind. This theory, as pointed out by Harry J. Derrel, Jr.<sup>7/</sup> is known as the lipolytic theory which postulates that fat is split completely by the action of the pancreatic enzyme, steapsin, to fatty acids and glycerol before absorption can take place. The fatty acids are absorbed as fatty acids and glycerol through the assistance of bile acids with which they form water--soluble complexes. It is thought that some of the fatty acids are absorbed as water--soluble soaps. When these water-soluble soaps arrive within the epithelial cell they are promptly resynthesized to neutral fats. In the form of neutral fats they are transported to the liver and tissues. According to this theory fat absorption results only when such hydrolysis has occurred. If this theory is accepted and if this theory is true, it may be assumed that there is a disturbance in the metabolism of fat in individuals with arteriosclerosis. It would also necessitate the assumption that fat definitely plays a role in arteriosclerosis.

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<sup>6/</sup>Leary, T.: "Arteriosclerosis." Bulletin. New York Academy of Medicine, 17:887-897, 1941.

<sup>7/</sup>Derrel, Harry J. Jr., "Lipid Metabolism," California Medicine, April, 1950.

Okey<sup>8/</sup> accepted this theory of fat metabolism and agrees that in arteriosclerosis a disturbance of the metabolism of fat occurs in individuals. She collected evidence that showed increased incidence of lesions involving cholesterol deposition in tissues. Okey further states, that as a result of this study, she is led to believe that individuals with abnormal fat metabolism are not able to utilize cholesterol as normal persons. Since in this study there is no significant relationship between fat metabolism and cholesterol level of the blood and if one accepts the aforementioned theory of fat metabolism, one would assume that the subjects included in this present study would be classified as normal when related to fat metabolism. If these assumptions are correct, the results of this study are in agreement with the results of the Okey study.

In this study sex showed a very definite relationship to cholesterol levels of the blood. This is shown in Table XIV, page 54 Chart 9, page 55, gives the arrangement of the subjects. If these data are representative, men tend to have a higher cholesterol blood content than do women.

The hereditary history regarding heart disease of the twenty-nine male and female subjects did not seem to show any significant relationship to the cholesterol level of the blood. Tables XV

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<sup>8/</sup>Okey, Ruth: "Cholesterol Content of Foods." Journal of American Dietetic Association, 21:341-344, 1945.

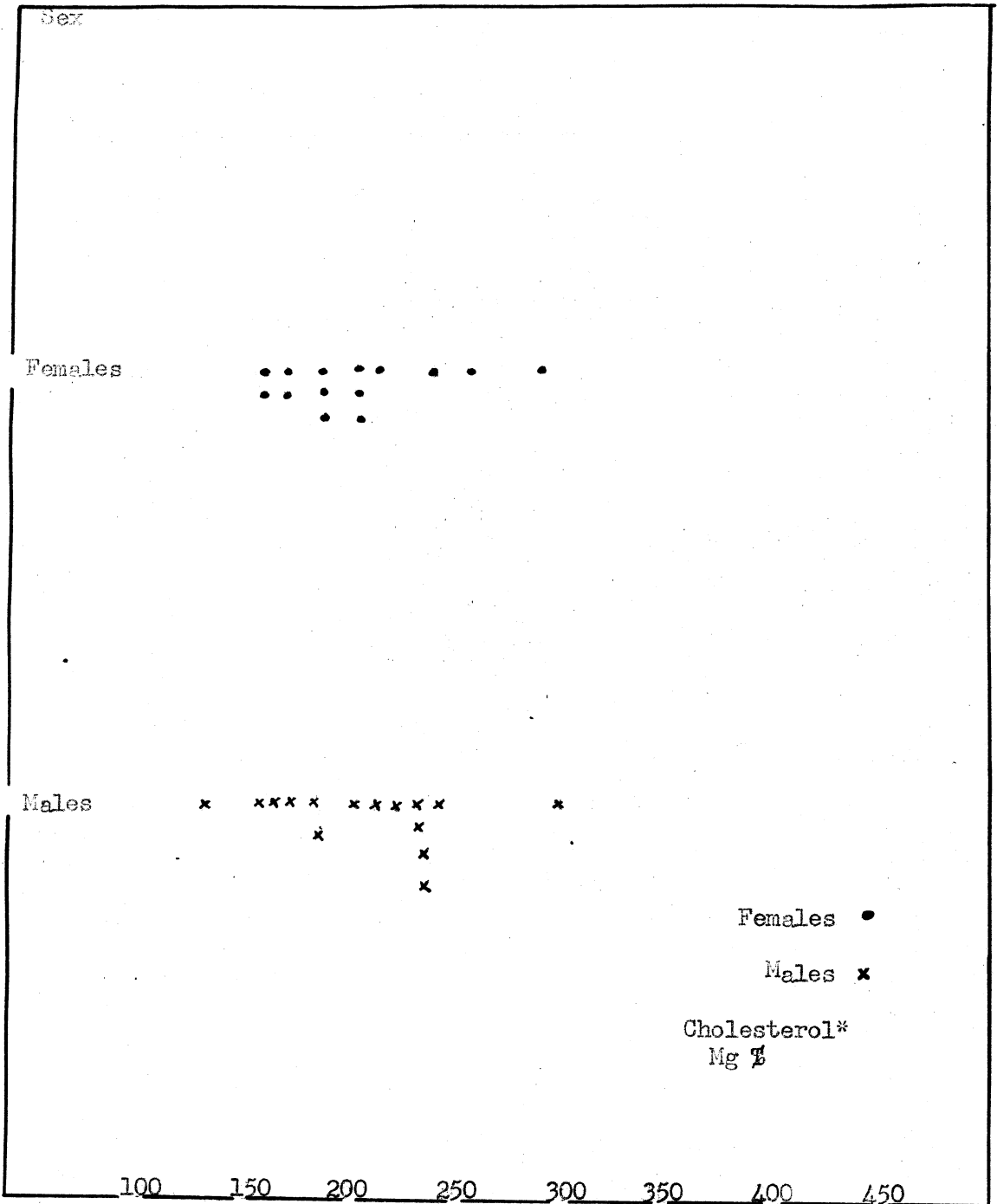
TABLE XIV

Sex in Relation to Cholesterol Blood Levels For Twenty-nine Subjects

Sex	Cholesterol Blood Levels Mg%			Total
	100-200	200-300	300-400	
Females	9	5	0	14
Males	7	8	0	15
Total	16	13	0	29

$$\chi^2 = 26.07$$

$$P = < .01$$



\*See Appendix, page 11 for order of cholesterol Mg % in the blood

The Relation of Sex to Cholesterol Levels of the Blood for Twenty-nine Subjects

CHART 9

and XV-A, pages 57 and 58 will show the results. If one assumes that the findings of this study are accurate and representative and that blood cholesterol is related to arteriosclerosis, then in searching for the real cause of this disease, one should be encouraged by the lack of relationship of these factors.

The symptoms of arteriosclerosis as shown in the individual subject used in this study seems to indicate that there is little relationship between the presence of leading symptoms to arteriosclerosis and the level of cholesterol in the blood. The relationship, if any, seems to lean more to the females than to the males. These findings may have become evident because of the limited number of subjects and the variety of symptoms shown. The results may be observed in Tables XVI and XVI-A, pages 59 and 60. Chart 10 on page 61 shows the arrangement of the subjects. These data may be compared with those of Moreton.<sup>9/</sup> He offers the theory that in some individuals the cholesterol is deposited in the vessel wall and he states that this theory has, as yet, not been proved. Could it be that the subjects of this study did not show more relationship between the symptoms of arteriosclerosis and the level of cholesterol in the blood because the physical state of the blood lipids was good? Could it also be that the subjects of this study would not develop arterio-

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<sup>9/</sup>Moreton, J. R.: "Diet and Arteriosclerosis."  
Science, 106:190, 1947.

TABLE XV

History of Arteriosclerosis in Relation to Cholesterol Blood Level  
For Fifteen Male Subjects

History of Arteriosclerosis	Cholesterol Blood Levels Mg%			Total
	100-200	200-300	300-400	
Unknown	0	1	0	1
History of Original Family	1	0	0	1
History of Immediate Family	4	7	0	11
No History	1	1	0	2
Total	6	9	0	15

$$X^2 = 1.81$$

$$P = > .50$$

TABLE XV-A

History of Arteriosclerosis in Relation to Cholesterol Blood Level  
For Fourteen Female Subjects

History of Arteriosclerosis	Cholesterol Blood Levels Mg%			Total
	100-200	200-300	300-400	
Unknown	0	0	0	0
History of Original Family	0	1	0	1
History of Immediate Family	7	4	1	12
No History	1	0	0	1
Total	8	5	1	14

$$\chi^2 = 2.77$$

$$P = > .80$$

TABLE XVI

Symptoms of Arteriosclerosis<sup>10/</sup> in Relation to Cholesterol Blood Levels  
For Fifteen Male Subjects

Symptoms of Arteriosclerosis	Cholesterol Blood Levels Mg%		Total
	100-200	200-300	
Unknown Diagnosis	0	1	1
Known Arteriosclerosis	0	1	1
Symptoms of Arteriosclerosis	1	3	4
No Symptoms of Arteriosclerosis	5	4	9
Total	6	9	15

<sup>10/</sup> Symptoms of arteriosclerosis derived from hospital records of individual subjects

$$\chi^2 = 3.319$$

$$P = > .30$$

TABLE XVI-A

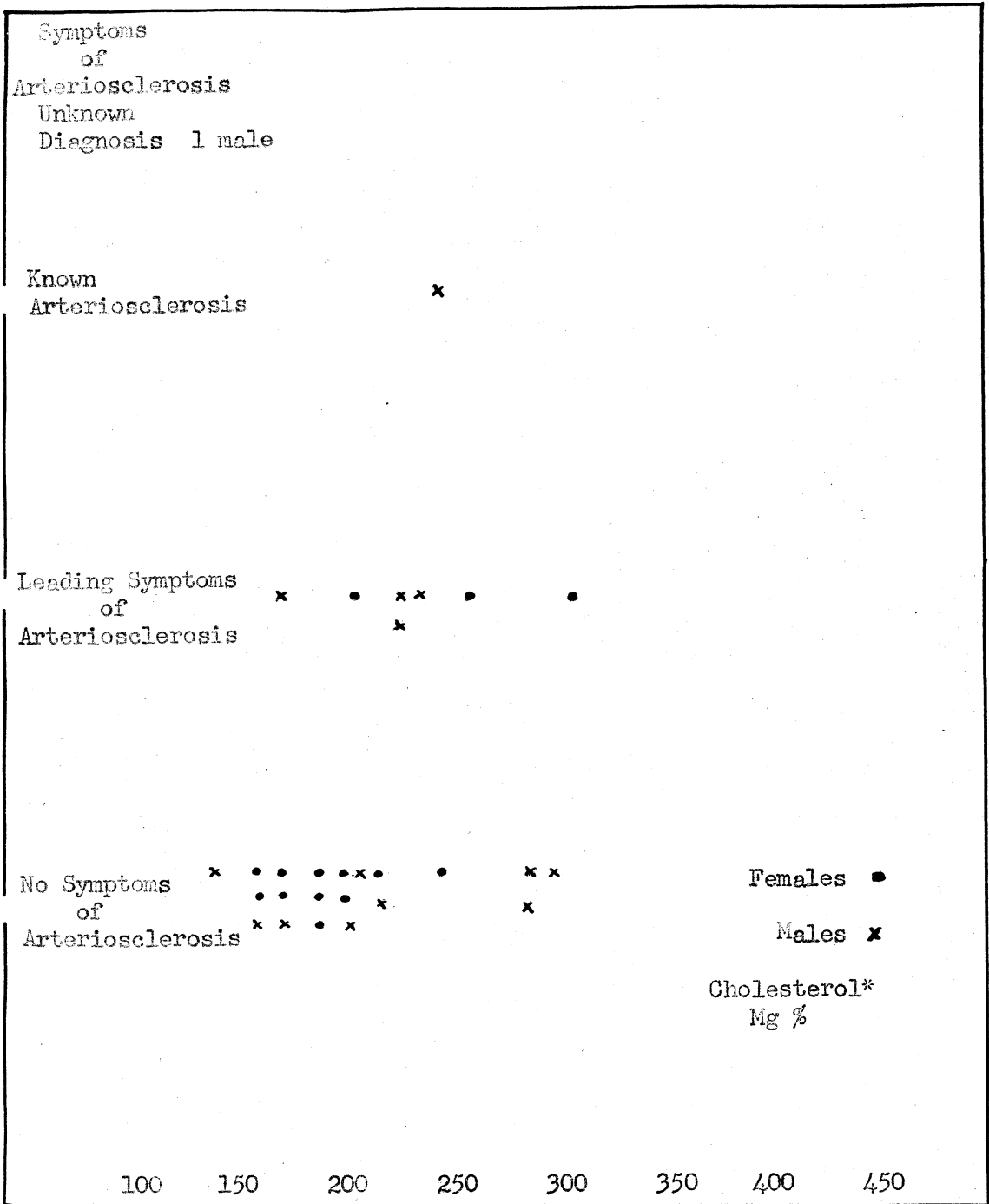
Symptoms of Arteriosclerosis<sup>11/</sup> in Relation to Cholesterol Blood Levels For Fourteen Female Subjects

Symptoms of Arteriosclerosis	Cholesterol Blood Levels Mg%		Total
	100-200	200-300	
Unknown Diagnosis	0	0	0
Known Arteriosclerosis	0	0	0
Symptoms of Arteriosclerosis	0	3	3
No Symptoms of Arteriosclerosis	8	3	11
Total	8	6	14

<sup>11/</sup> Symptoms of arteriosclerosis derived from hospital records of individual subjects

$$\chi^2 = 1.18$$

$$P = > .20$$



\*See Appendix, page 11, for order of cholesterol in the blood

The Relation of Individual Symptoms of Arteriosclerosis to Cholesterol  
Blood Levels for Twenty-nine Subjects

sclerosis unless some disturbance developed in the lipoids of the blood?

After all these factors had been studied, the cholesterol intake from the diet was compared with the level of cholesterol in the blood. Table XVII, and XVII-A, pages 63 and 64, shows little relationship between amounts of cholesterol consumed and the amount of cholesterol found in the blood. These findings are in agreement with those reported by Reimer, Blecha, and Wilkinson<sup>12/</sup>, and with other investigations as reviewed in Nutrition Reviews,<sup>13/</sup> 1950. The total blood cholesterol in these two studies was reported to be unrelated to the cholesterol in the diet. Studies seem to verify these results showing that the dietary intake does not seem to have any relationship to the levels of cholesterol in the blood of persons with normal, fat metabolic abilities. It might be that the dietary intake of cholesterol and the levels of cholesterol in the blood are only related when there is a disturbance of fat metabolism or through aging when the arteries lose elasticity, giving rise to an added number of floating fat molecules. If this is true there probably is no positive relationship of cholesterol dietary intake

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<sup>12/</sup> Reimer, A., Blecha, E. and Wilkinson, C. F. Jr: " Study of Essential Familial Hypercholesterolemia Relationship of Diet and Blood Cholesterol Level." Journal of American Dietetic Association, 25:842:844, October, 1949.

<sup>13/</sup> Nutrition Reviews, "Arteriosclerosis in Relation to Fat Metabolism." Nutrition Reviews, 8:61, 1950.

TABLE XV-A

Cholesterol Blood Levels in Relation to Cholesterol Dietary Intake  
For Fifteen Male Subjects

Cholesterol Blood Levels Mg %	Cholesterol Intake Mg %			Total
	0-500	500-1000	1000-1500	
100-199	1	4	1	6
200-299	4	4	1	9
300-400	0	0	0	0
Total	5	8	2	15

$$\chi^2 = 1.25$$

$$P = < .50$$

TABLE XVII-A

Cholesterol Blood Levels in Relation to Cholesterol Dietary Intake  
For Fourteen Female Subjects

Cholesterol Blood Levels Mg %	Cholesterol Intake Mg			Total
	0-500	500-1000	1000-1500	
100-199	4	3	0	7
200-299	3	3	0	6
300-400	0	1	0	1
Total	7	7	0	14

$$X^2 = 1.142$$

$$P = < .50$$

to cholesterol blood levels in subjects other than those with abnormal fat metabolism or those with some advanced arteriosclerosis, as it seems that generalized arteriosclerosis may not reveal its symptoms until it becomes advanced.

## CHAPTER IV

## SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Fifty-four patients of the Jefferson Hospital, Roanoke, Virginia, ranging in age from forty to sixty years, served as subjects for this study. During the period from June 8 through September 30, 1950, each subject kept a seven day food consumption record. The investigator secured schedules from the subjects concerning their usual habits of eating high cholesterol foods. All other data used in this study were obtained from hospital records. Twenty-nine of the fifty-four subjects, after a sixteen hour fast, furnished a blood sample for blood cholesterol determinations. Total protein, fat, and carbohydrate consumed by the subjects were calculated from figures furnished by Cooper, Barber, and Mitchell;<sup>1/</sup> total cholesterol intake was calculated from figures furnished by Okey;<sup>2/</sup> and blood cholesterol determinations were made by the method as outlined by J. C. Forbes.<sup>3/</sup>

From analysis of the data thus collected it was found that:

- (1) There was a definite relationship between cholesterol content of the diet and daily caloric consumption, daily fat consumption, and sex. As food intake increased, total fat

<sup>1/</sup>Cooper, Lenna F., Barber, Edith M., and Mitchell, Helen S., Nutrition in Diet and Disease. Eleventh Edition. J. B. Lippincott Company, Philadelphia, Pa.

<sup>2/</sup>Okey, Ruth, "Cholesterol Content of Foods." Journal of American Dietetic Association, 21:341, 1945.

<sup>3/</sup>J. C. Forbes, "Cholesterol Determination." Journal of Laboratory and Clinical Medicine, 61:520, 1931.

consumption increased. Likewise, through preference to animal fats, cholesterol consumption increased. Male subjects consumed more calories than females and in this way, males also consumed decidedly more cholesterol than female subjects.

(2) There was a slight relationship in cholesterol intake in food and variation in the weight from normal, hereditary history of heart disease, and individual symptoms of arteriosclerosis. The slight relationship of cholesterol intake to variation from normal weight might be due to excessive food intake which causes increased cholesterol intake and, if continued, leads to excess weight. The slight relationship of hereditary history of heart disease, individual symptoms of arteriosclerosis and cholesterol might also be due to established food preferences for high cholesterol foods in families being passed from one generation to the next.

(3) There was no significant relationship between age and cholesterol content of the diet or weight in pounds.

(4) There was a definite relationship between sex and cholesterol blood level, and males tended to have higher blood cholesterol levels than females. Sex was the only factor studied that seemed to be associated both with the amount of cholesterol eaten and levels of cholesterol in the blood.

(5) There seemed to be a slight association between the level of cholesterol in the blood and age, daily caloric con-

sumption, and symptoms of arteriosclerosis. Although in both sexes these relationships were slight, age in the male subjects was less related to cholesterol blood levels than age in female subjects; daily caloric consumption in female subjects was less related than in male subjects; while symptoms of arteriosclerosis showed less association to cholesterol blood levels in males than in females. This variation from the normal pattern in caloric consumption of female subjects might be due to self inflicted diets of women. Weight of male subjects tended to show some slight relationship to blood cholesterol levels.

(6) There seemed to be little or no relationship between cholesterol blood levels and percentage of variation from normal weight, daily fat consumption, and hereditary history of heart disease.

(7). Cholesterol intake was only slightly related, if at all, to the level of cholesterol in the blood. If cholesterol intake is unrelated to cholesterol blood levels and if the level of cholesterol in the blood is related to arteriosclerosis then the dietary practice of reducing cholesterol foods in treatment of arteriosclerosis is of little or no importance.

Although it has long been assumed that the factors included in this study are directly or indirectly related to cholesterol and any contribution of cholesterol to arteriosclerosis, it is most difficult to determine which of these factors exerts the first and

most important influence either on cholesterol metabolism or diseases of the heart. Before any definite conclusions can be made regarding cholesterol metabolism and its relation to arteriosclerosis, or even the relationship of dietary cholesterol to cholesterol metabolism, much research should be done on all related factors with many age ranges and on subjects with and without any symptoms of heart disease.

Recommendations:

(1) If the results of this study are significant and representative, if sex is related to blood cholesterol, and if age, amount of food consumed daily, symptoms of arteriosclerosis, and weight are slightly related to levels of cholesterol in the blood, these factors should be studied further in an effort to determine what can be done in the prevention of arteriosclerosis.

(2) If sex, age, weight, daily caloric consumption, and symptoms of arteriosclerosis are in any way related to blood cholesterol levels emphasis should be placed early in adult life on those approved dietary practices of adults, especially men, that prevent excessive weight above normal rather than in attempting to reduce consumption of cholesterol foods after symptoms of arteriosclerosis have appeared.

(3) Much research should be done on all related factors with many age ranges and on subjects with and without any symptoms of heart disease.

79

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APPENDIX

INDIVIDUAL PERSONAL  
RECORD  
OF  
SUBJECT STUDIED  
IN  
JEFFERSON HOSPITAL

Name \_\_\_\_\_ Hospital Room \_\_\_\_\_

Home Address \_\_\_\_\_

Age \_\_\_\_\_ Sex \_\_\_\_\_

Weight \_\_\_\_\_ Height \_\_\_\_\_

Place in family \_\_\_\_\_

Record of Hereditary Diseases

Record of Individual's Diseases

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Diagnosis of present illness: \_\_\_\_\_

Present diet order \_\_\_\_\_

Cholesterol reading, fasting \_\_\_\_\_

Length of stay in hospital \_\_\_\_\_

Comment on condition after treatment \_\_\_\_\_



Food List Used for Checking Habits of Eating Cholesterol Foods for Hospital Subjects

Food List	Best Liked	2nd Best Liked	Liked the Least
Liver      Calf Pork Beef			
Pork			
Oysters			
Sweetbreads			
Beef			
American cheese			
Swiss cheese			
Velveeta cheese			
Butter			
Eggs			
Milk			
Cream			
Cooking fats:			
Fat meat			
Cooking oil			
Butter			

Habits of Eating High Cholesterol Foods—<sup>1/</sup> Based on Average Servings for Twenty-seven Female Subjects

Subject Number	Liver	Pork	Oysters	Sweet-breads	Beef	Cheese			Butter		Eggs	Milk		Cream	Cooking Fat	
						American	Swiss	Vel-veeta	Animal	Vegetable		Sweet	Bitter		Animal	Vegetable
1	4	30	1	-	4	4	-	-	4	60	60	-	1	10	30	90
2	-	30	0	-	4	2	-	-	90	-	30	30	-	30	90	-
3	1	30	-	-	2	-	-	-	60	-	30	30	-	-	15	8
4	1	30	1	-	2	-	-	-	120	-	30	30	-	1 cup	90	-
5	4	30	2	-	15	8	-	-	30	-	15	30	-	20	60	-
6	-	30	-	-	2	-	-	-	30	- 30	no yolk	-	-	-	15	30
7	2	15	2	-	15	4	4	-	-	60	15	4	-	10	30	-
8	4	15	-	-	8	8	8	8	90	-	30	4	-	-	90	-
9	8	15	2	-	2	2	-	-	90	-	15	-	30	-	8	-
10	00	60	1	-	4	-	-	-	30	-	30	-	-	4 cups	60	-
11	1	30	-	-	30	4	-	8	90	-	60	90	-	10	8	-
12	4	15	1	1	15	-	-	-	60	-	30	120	-	-	15	-
13	-	30	1	-	15	15	4	-	90	-	30	30	-	1/4 cup day	30	-
14	2	30	-	-	15	4	-	-	90	-	-	60	-	1/2 cup	60	-
15	4	30	2	1	8	8	-	-	90	-	30	-	4	-	8	-
16	4	30	1	-	15	4	-	-	120	-	30	120	-	-	15	-
17	-	30	-	-	8	4	-	-	90	-	4	60	-	10	8	-
18	2	30	4	-	4	4	-	4	90	-	4	30	-	-	30	-
19	2	15	1	-	8	8	-	-	-	60	15	30	-	-	8	-
20	2	-	1	2	4	30	-	-	60	-	4	-	30	-	30	-
21	4	30	2	-	8	30	2	-	90	-	30	60	-	-	30	-
22	1	30	2	0	2	4	2	1	60	0	30	8	-	-	60	-
23	1	30	8	-	1	1	-	-	90	-	15	-	15	10	90	-
24	4	30	4	-	2	8	4	4	90	-	30	30	-	1/2 cup	60	-
25	2	30	1	-	4	-	-	-	90	-	15	-	-	10	15	-
26	8	4	2	-	4	1	-	-	30	-	4	30	-	-	15	-
27	-	2	1	-	8	4	4	-	90	-	-	60	-	-	4	-

The frequency of foods consumed are coded as follows:

- 120 = Four times a day
- 90 = Threetimes a day
- 60 = Two times a day
- 30 = Every day
- 15 = Every two days or three times a week
- 8 = Twice a week
- 4 = Once a week
- 2 = Once every two weeks
- 1 = Once a month
- 0 = Once every two months
- 00 = Once every three months
- = Never

<sup>1/</sup>When large quantities of cream were consumed daily the amount consumed is given in cups instead of tablespoons as specified in the code.

Habits of Eating High Cholesterol Foods-- Based on Average Servings for Twenty-seven Male Subjects

Subject Number	Liver	Pork	Oysters	Sweet-breads	Beef	Cheese			Butter		Eggs	Milk		Cream	Cooking Fat	
						Ameri-can	Swiss	Vel-veeta	Animal	Vege-table		Sweet	Bitter		Animal	Vege-table
28	1	30	-	1	15	2	-	-	120	-	30	-	-	40	4	60
29	-	30	2	-	8	30	-	-	90	-	30	120	-	40	30	-
30	2	15	2	-	4	1	-	-	-	60	60	120	-	30	8	-
31	-	30	8	-	15	15	1	-	90	-	60	120	-	30	4	-
32	0	30	-	-	4	8	-	-	90	-	90	120	-	40	60	-
33	4	30	-	-	8	4	30	-	90	-	30	4	-	30	120	-
34	2	30	2	-	15	2	-	-	90	-	60	120	-	40	15	-
35	4	30	-	-	15	4	-	-	90	-	30	30	-	-	30	-
36	4	30	-	-	4	4	-	-	90	-	60	30	-	3	60	-
37	-	15	1	-	8	-	-	-	90	-	60	90	-	-	60	-
38	-	-	-	-	-	2	-	-	90	-	90	60	-	30	90	-
39	2	30	0	-	15	8	-	-	90	-	60	180	-	-	15	-
40	4	30	-	-	30	4	-	-	-	60	90	90	-	-	90	-
41	-	60	4	-	4	4	-	-	90	-	60	120	-	-	90	-
42	8	30	4	15	8	-	-	-	90	-	60	120	-	5	60	-
43	2	30	4	-	15	30	-	-	90	-	30	60	-	60	8	-
44	8	30	-	2	15	-	-	-	90	-	90	120	-	-	60	-
45	2	30	1	-	8	4	1	-	90	-	30	30	-	30	30	8
46	1	30	2	30	4	4	-	-	90	-	30	90	-	30	60	-
47	1	30	1	-	4	2	-	2	90	-	30	30	-	-	60	30
48	2	30	8	-	4	8	-	-	-	90	90	2	-	-	30	-
49	0	30	1	-	15	4	-	-	90	-	90	4	-	-	4	-
50	1	30	1	-	4	4	-	-	90	-	180	15	90	-	90	15
51	-	8	-	-	15	30	8	-	90	-	60	30	-	60	60	-
52	1	2	15	-	15	30	-	-	90	-	30	4	4	-	60	8
53	-	30	1	-	8	15	-	-	90	-	30	30	-	30	30	30
54	8	30	8	15	4	2	-	-	90	-	90	15	-	-	30	-

The frequency of foods consumed are coded as follows:

- 120 = Four times a day
- 90 = Three times a day
- 60 = Two times a day
- 30 = Every day
- 15 = Every two days or three times a week
- 8 = Twice a week
- 4 = Once a week
- 2 = Once every two weeks
- 1 = Once a month
- 0 = Once every two months
- 00 = Once every three months
- = Never

Sample Dietary Pattern for Individual Foods Habits as Given by  
Subject

Food List	Approx. Measures	Pro	Fat in gms	Cho	Approx. Caloric Intake	Cholesterol Intake mg
<u>Breakfast</u>						
Am. Cheese	1 x wk					11.40
Cereal	1/2 C	2.0	-	12.0		
Sugar	1 tsp			6.0		
Milk	1/2 C	3.5	3.9	5.0		12.00
Eggs (fried)	2	12.0	15.0	-		280.80
Bread	2 sl.	4.0	1.0	30.0		
Butter	2 pats	-	20.0	-		28.00
Coffee	2 C					
Sugar	2 tsp			12.0		
Milk	1/4 C	1.7	1.8	2.5		6.00
<u>Dinner</u>						
Liver	2 x wk					45.60
Meat	1 sl (med)	15.0	12.0	-		50.00
1 Starchy (veg)	1 C	4.0	20.0	36.0		56.00
1 Green Veg (10%)	1 C	4.0	20.0	20.0		56.00
1 Green Veg (5%)	1 C	4.0	20.0	12.0		56.00
Bread	1 slice	2.0	-	15.0		
Butter	1 pat	-	10.0	-		28.00
Coffee	2 C					
Sugar	2 tsp	-	-	12.0		
Milk	1/4 C	1.7	1.8	2.5		6.00
<u>Midafternoon</u>						
Candy	1 box	4.0	14.0	72.0		
Gingerale	1 bottle	-	-	12.5		
<u>Supper</u>						
Meat	1 slice (Med)	15.0	12.0	-		50.00
1 Starchy Veg.	1 C	4.0	20.0	36.0		56.00
1 Green Veg (10%)	1 C	4.0	20.0	20.0		56.00
1 Green Veg (5%)	1 C	4.0	20.0	12.0		56.00
Bread	1 slice	2.0	-	15.0		
Butter	1 pat	-	10.0	-		28.00
Coffee	2 C					
Sugar	2 tsp			12.0		
Milk	1/4 C	1.7	1.8	2.5		6.00
		88.6	223.1	347.0	4752.1	887.80

The Average Daily Consumption of Food Nutrients for Twenty-seven  
Male Subjects

Number	Protein grams	Fat grams	Carbohydrate grams	Calories Per Day	Cholesterol mg
28	49.9	111.6	154.3	1821	495.5
29	120.8	227.7	417.3	4202	623.2
30	132.0	183.8	481.8	4109	397.7
31	78.8	130.4	196.4	2274	389.9
32	146.0	325.2	301.8	4718	1149.2
33	108.9	213.3	295.3	3537	797.4
34	183.2	305.4	429.8	5201	1677.9
35	80.3	167.5	417.4	3498	563.6
36	125.1	197.2	486.9	4223	571.0
37	91.4	181.1	299.5	3194	488.0
38	53.0	118.0	414.0	2930	708.0
39	116.0	182.6	321.0	3391	576.8
40	95.9	144.7	193.6	2460	758.2
41	114.5	184.3	344.8	3496	691.2
42	163.3	323.6	484.5	5502	1033.2
43	144.5	280.0	317.0	4366	1053.4
44	123.1	196.6	419.5	3940	950.8
45	102.0	168.2	307.5	3152	666.9
46	50.5	125.1	318.0	2600	338.5
47	82.6	119.6	378.8	2922	441.0
48	98.0	160.2	250.5	2836	641.4
49	116.9	281.5	632.0	5529	936.5
50	89.7	169.5	224.5	2782	795.3
51	70.1	140.6	287.5	2696	699.1
52	162.4	254.9	479.8	4863	847.4
53	103.3	182.0	388.1	3604	760.2
54	88.6	223.3	347.0	3752	887.8
Average	166.9	196.2	355.1	3611	738.5
Average Females and Males	86.6	161.4	301.8	3007	592.4

The Average Daily Consumption of Food Nutrients for Twenty-seven  
Female Subjects

Number	Protein gm	Fat gm	Carbohydrate gm	Calories Per Day	Cholesterol mg
1	59.8	145.0	353.0	2956	717.4
2	72.3	143.3	291.2	2744	561.8
3	83.9	122.4	272.7	2528	530.6
4	98.3	253.2	313.0	3924	996.0
5	45.9	69.9	298.9	2008	301.6
6	31.6	54.8	147.4	1208	134.0
7	55.7	99.5	201.8	1926	215.6
8	62.7	112.8	207.2	2095	408.2
9	43.2	118.0	212.8	2086	361.8
10	59.0	206.0	374.0	3586	705.5
11	78.5	141.6	381.2	3113	307.1
12	64.9	52.4	298.6	1926	400.9
13	75.6	177.1	276.0	3000	805.9
14	67.0	118.7	211.0	2180	348.5
15	60.5	80.0	88.6	1316	391.0
16	63.0	80.0	162.0	1620	393.0
17	65.3	144.5	150.0	2162	312.1
18	104.1	185.5	380.6	3608	646.2
19	64.5	121.5	295.6	2534	215.6
20	46.5	65.7	116.0	1241	265.7
21	103.9	175.8	292.1	3166	583.0
22	61.0	116.4	263.3	2345	479.7
23	85.9	177.6	269.3	3019	551.0
24	81.0	182.4	329.1	3282	607.0
25	55.7	110.1	163.3	1867	371.8
26	50.9	82.8	171.0	1633	235.0
27	46.0	83.0	191.0	1695	202.4
Average	66.2	126.7	248.5	2399	446.2

THE DETERMINATION OF CHOLESTEROL IN WHOLE, PLASMA, OR  
SERUM

Procedure:

1. Place 2 milligrams doucil (app.) in a 10 cc glass stoppered cylinder. Volume of doucil should reach approximately 2.5 or 3 cc mark.
2. Add 10 cc chloroform. Shake. Add 0.5 serum--shake for 2 minutes.
3. Set the cylinder aside placing it on its side and leaving the doucil evenly distributed along the tube. Shake occasionally and after 1 hour filter through fat-free filter paper No-43. Transfer directly to another cylinder.
4. Transfer 5 cc of the filtrate to a 10 cc glass stoppered cylinder.
5. Place 5 cc of the dilute standard to another cylinder.
6. Add to each 2 cc acetic anhydride allowing the fluid to run gently down the side of the cylinder.
7. Add 0.1 cc of concentrated sulfuric acid -- mix well by inverting several times. Place in a dark place in a beaker of cold water for 15 minutes.
8. Read in colorimeter.

Cal. Set unknown at 20 - multiply reading by 10 -  
Results in mgs. x 100 cc.

If 10 multiply by 20.

$\frac{\text{Reading of standard} \times 200}{\text{Reading of unknown}} = \text{mgs. cholesterol/100 cc.}$

This test may be run on plasma but it is best to use serum as the anticoagulant may interfere with the test.

Reagents may be obtained from  
General Chemical Company, New York  
or Doucil - American Doucil Company,  
121 West 3rd Street, Philadelphia, Penna.

## REAGENTS:-

Acetic Anhydride - C.P.  
Concentrated Sulfuric Acid -C.P.  
Standard stock - 100 mgs - cholesterol  
100 cc chloroform - C.P.

Keep in a dark bottle.

Dilute Standard - 10 cc stock - 100 cc volumetric flask - Dilute to mark with chloroform.

2/ Forbes, J. C., "The Determination of Cholesterol," Journal of Laboratory and Clinical Medicine, " 61:520, 1931.

The Cholesterol Levels of the Blood for Twenty-nine Fasting Subjects

Subject Number	Females	Subject Number	Males
	Cholesterol Blood Level Mg %		Blood Level Mg %
1	200	28	230
		29	200
3	240	30	220
4	160	31	240
		32	210
6	200		
8	180	35	160
		36	230
11	215	38	130
12	170		
13	180		
		43	165
17	260		
18	300	45	170
19	170	46	230
		47	180
21	180		
23	200		
		51	290
25	160	52	230
		53	180
Average	201.1		203.7

## Standard Table of Heights and Weights

## MEN

Taken From the Metropolitan Life Insurance Company

Heights		Weights According to Age Period								
Ft.	In.	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59
4	11	89	94	98	100	102	104	106	106	107
		111	117	122	125	127	130	132	133	134
		133	140	146	150	152	156	158	160	161
5	0	90	95	99	102	103	106	107	108	109
		113	119	124	127	129	132	134	135	136
		136	143	149	152	155	158	161	162	163
	1	92	97	101	103	105	107	109	110	110
		115	121	126	129	131	134	136	137	138
		138	145	151	155	157	161	163	164	166
	2	94	99	102	105	106	109	110	111	112
		118	124	128	131	133	136	138	139	140
		142	149	154	157	160	163	166	167	168
	3	97	102	105	107	109	111	113	114	114
		121	127	131	134	136	139	141	142	143
		145	152	157	161	163	167	169	170	172
	4	99	105	107	110	112	114	115	116	117
		124	131	134	137	140	142	144	145	146
		149	157	161	164	168	170	173	174	175
	5	102	108	110	113	115	117	118	119	120
		128	135	138	141	144	146	148	149	150
		154	162	166	169	173	175	178	179	180
	6	106	111	114	116	118	120	122	122	123
		132	139	142	145	148	150	152	153	154
		158	167	170	174	178	180	182	184	185
	7	109	114	117	119	122	123	125	126	126
		136	142	146	149	152	154	156	157	158
		163	170	175	179	182	185	187	188	190
	8	112	117	120	123	126	127	129	130	130
		140	146	150	154	157	159	161	162	163
		168	175	180	185	188	191	193	194	196
	9	115	120	123	126	130	131	133	134	134
		144	150	154	158	162	164	166	167	168
		173	180	185	190	194	197	199	200	202

## Standard Table of Heights and Weights

WOMEN (Continued)

Taken from the Metropolitan Life Insurance Company

Heights		Weights According to Age Period								
Ft.	In.	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59
5	10	116	119	122	124	127	130	133	136	138
		145	149	152	155	159	162	166	170	173
		174	179	182	186	191	194	199	204	208
	11	120	122	124	126	130	133	136	139	142
		150	153	155	158	162	166	170	174	177
		180	184	186	190	194	199	204	209	212
0	0	124	126	127	130	132	135	138	142	146
		155	157	159	162	165	169	173	177	182
		186	188	191	194	198	203	208	212	218

## Standard Table of Heights and Weights

## WOMEN

Taken From the Metropolitan Life Insurance Company

Heights		Weights According to Age Period								
Ft.	In.	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59
4	11	88	90	93	95	98	101	103	105	106
		110	113	116	119	122	126	129	131	132
		132	136	139	143	146	151	155	157	158
5	0	90	92	94	97	99	102	105	106	107
		112	115	118	121	124	128	131	133	134
		134	138	142	145	149	154	157	160	161
	1	91	94	96	98	101	104	106	108	110
		114	117	120	123	126	130	133	135	137
		137	140	144	148	151	156	160	162	164
	2	94	96	98	100	103	106	109	110	112
		117	120	122	125	129	133	136	138	140
		140	144	146	150	155	160	163	166	168
	3	96	98	1 00	102	106	109	111	113	114
		120	123	125	128	132	136	139	141	143
		144	148	150	154	158	163	167	169	172
	4	98	101	103	106	109	111	114	115	117
		123	126	129	132	136	139	142	144	146
		148	151	155	158	163	167	170	173	175
	5	101	103	106	109	112	114	117	118	120
		126	129	132	136	140	143	146	148	150
		151	155	158	163	168	172	175	178	180
	6	104	106	109	112	115	118	121	122	122
		130	133	136	140	144	147	151	152	153
		156	160	163	168	173	176	181	182	184
	7	107	110	112	115	118	121	124	126	126
		134	137	140	144	148	151	155	157	158
		161	164	168	173	178	181	186	188	190
	8	110	113	115	118	122	124	127	130	130
		138	141	144	148	152	155	159	162	163
		166	169	173	178	182	186	191	194	196
	9	113	116	118	122	125	127	130	133	134
		141	145	148	152	156	159	163	166	167
		169	174	178	182	187	191	196	199	200

## Standard Table of Heights and Weights

## MEN (Continued)

Taken from the Metropolitan Life Insurance Company

Heights		Weights According to Age Period								
Pt.	In.	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59
5	10	118	123	126	130	134	135	137	138	138
		148	154	158	163	167	160	171	172	173
		178	185	190	196	200	203	205	206	208
	11	122	126	130	134	138	140	142	142	143
		153	158	163	168	172	175	177	178	179
		184	190	196	202	206	210	212	214	215
6	0	126	130	135	139	142	145	146	147	148
		158	163	169	174	178	181	183	184	185
		190	196	203	209	214	217	220	221	222
	1	130	134	140	144	147	150	152	153	154
		163	168	175	180	184	187	190	191	192
		196	202	210	216	221	224	228	229	230
	2	134	138	145	149	153	155	158	158	159
		168	173	181	186	191	194	197	198	199
		202	208	217	223	229	233	236	238	239
	3	138	142	150	154	158	161	163	164	165
		173	178	187	192	197	201	204	205	206
		208	214	224	230	236	241	245	246	247

Twenty-seven Female Subjects Observed for Cholesterol Content of the Diet and Fasting Cholesterol Level of the Blood

Number	Age in Years	Weight in Pounds	Height in Inches
1	45	135	65
2	48	132	64
3	48	175	65.5
4	53	225	65.5
5	41	135	65.5
6	49	130	65
7	50	121	63
8	40	126	65.5
9	52	145	61
10	40	130	65
11	57	150	69.5
12	40	94	67.5
13	52	120	63
14	50	145	64
15	57	208	68.5
16	57	112	67
17	53	160	66
18	47	135	67
19	45	160	62
20	49	150	69
21	51	165	68
22	44	125	63
23	53	150	67
24	45	125	64
25	50	128	65
26	53	130	63
27	43	137	66
Average	48.6	142.2	64.3

Twenty-seven Male Subjects Observed For Cholesterol Content of the  
Diet and Fasting Cholesterol Level of the Blood - Continued

Number	Age in Years	Weight in Pounds	Height in Inches
28	51	133	68
29	42	160	72
30	56	166	66
31	51	167	68
32	57	170	68.5
33	40	195	70
34	57	147	66
35	50	145	65.5
36	59	190	63
37	44	152	66
38	45	125	68
39	42	170	71.5
40	62	187	68
41	42	240	72
42	40	145	66
43	59	165	66
44	57	130	64.5
45	44	153	67
46	59	205	71
47	40	120	68
48	59	135	64
49	58	215	70.5
50	55	153	68
51	48	182	67.5
52	53	208	65
53	47	165	61
54	48	175	70
Average	50.6	163.0	67.4
Total Average for Females and Males	49.6	154.0	65.9

History of Heart Disease, Hereditary and Individual, for Twenty-seven Male Subjects

Subject Number	Hereditary History Indicating Heart Disease	History of Subject Indicating Heart Disease
28	Father died of heart disease	No leading symptoms
29	Father died of heart disease	No leading symptoms
30	Father died of heart disease	No leading symptoms
31	No known deaths from heart disease	Has had hypertension all of life
32	Mother and Father died from heart disease	Diagnosis unknown
33	Unknown	No leading symptoms
34	Unknown	No leading symptoms
35	No known deaths from heart disease	No leading symptoms
36	Brother dead from heart disease	Hypertension for some time
37	Grandfather died from heart disease	No leading symptoms
38	Grandmother died from heart disease	No leading symptoms
39	Mother died from heart disease Family with long history of hypertension	No leading symptoms
40	Sister and brother died from heart disease	Has had heart attack- Coronary vascular collapse
41	Mother died from heart disease	No leading symptoms
42	No known cases	No leading symptoms
43	Mother and Father died from heart disease	Enlarged heart
44	No known cases	No leading symptoms
45	Mother, Father, Grandmother, Grandfather	No leading symptoms
46	Unknown	Leakage of the heart-
47	History of hypertension Mother died from heart disease	No leading symptoms
48	No known cases	No leading symptoms
49	Mother, Father, Sister, Brother	Hypertension and Enlarged heart
50	Father, Brother, and Sister	No leading symptoms
51	Father, and Grandfather	No leading symptoms
52	Mother died from heart disease	Arteriosclerosis
53	Father died from heart disease	No leading symptoms
54	Grandmother and Father	No leading symptoms
Average	19 with known hereditary histories of heart disease	7 with leading symptoms of any heart disease

History of Heart Disease, Hereditary and Individual, For Twenty-seven Female Subjects

Subject Number	Hereditary History Indicating Heart Disease	History of Subject Indicating Heart Disease
1	Grandmother died of heart disease	Rheumatic fever when a child now hemoglobin
2	Father died of heart disease	Shortness of breath, tightness
3	Two grandparents and father died of heart disease	No leading symptoms
4	Father died of heart disease	No leading symptoms
5	Mother and brother died of heart disease	No leading symptoms
6	Father died of arteriosclerosis	No leading symptoms
7	Mother died of heart disease	No leading symptoms
8	Mother died of heart disease	No leading symptoms
9	Mother and Father died of heart disease	No leading symptoms
10	Unknown	No leading symptoms
11	Brother living with heart disease	No leading symptoms
12	Mother died with heart disease	No leading symptoms
13	Grandfather and Father died with heart disease	No leading symptoms
14	Unknown	No leading symptoms
15	Unknown	History of hypertension
16	Mother and Brother died of heart disease	No leading symptoms
17	Grandmother, Brother, died of heart disease	Myocarditis - swelling in legs
18	Father died of heart disease	Palpitation and Precardial pain
19	Mother and Father died of heart disease	No leading symptoms
20	Grandmother, Mother and Father died of heart disease	Presistent pain in chest
21	Unknown	No leading symptoms
22	Grandfather, and Mother died of heart disease	No leading symptoms
23	Two Grandparents, Father died of heart disease	No leading symptoms
24	Mother died of heart disease	No leading symptoms
25	Father died of heart disease	No leading symptoms
26	Mother and Father died of heart disease	No leading symptoms
27	Grandmother died of heart disease	No leading symptoms
Average	23 with known histories of heart disease	6 with leading symptoms of any heart disease

CHOLESTEROL CONTENT OF FOOD SAMPLES PURCHASED IN OPEN MARKET- (EDIBLE PORTION) TAKEN FROM OKEY, RUTH, JOURNAL OF AMERICAN DIETETIC ASSOCIATION 21:341, 1945

Food	Moisture %	Fatty Acid %	Total Cholesterol % Moist. Wt. .100 Ave.
<b>Meat</b>			
<b>Muscle meats.</b>			
Beef round (mod.fat)	72.1	4.6	.125
Beef round (lean)	71.7	2.1	.095
Veal shank	74.5	1.0	.14
Veal breast	70.6	7.2	.10
Pork spareribs	56.4	19.5	.105
<b>Bacon</b>			
.110			
<b>Variety meats</b>			
<b>Liver</b>			
Lamb (4 samples)	67.1	5.9	.61
Pork	69.6	3.7	.42
Beef	68.0	3.7	.32
Calf (4 samples)	74.7	3.0	.36
Tripe	82.7	4.1	.15
Sweetbread	79.1	1.0	.28
<b>Shellfish</b>			
Oysters, Eastern	84.1	1.7	.23
Oysters, Calif. I	87.6	2.9	.28
Oysters, Calif. II	85.4	5.2	.47
Crab	77.1	.85	.145
<b>Cheese</b>			
American	35.5	28.2	.16
American, processed	38.7	21.6	.155
Swiss, processed	38.7	21.0	.145
Monterery, Jack	28.2	29.9	.19
Velveeta	40.9	19.3	.16
Linburger, processed	51.3	20.0	.135
Pimento cream, processed	65.6	16.3	.14
Butter		68.0	.28
Egg Yolk, dried	3.7	63.8	3.9
Egg Yolk, fresh	49.5	33.1	2.0
Primex		99.0	.15
(Sterol (Food other than chol.)			
Brower's Yeast, dry			.68
(Food other than chol.)			
Casein, raw			.065

Dairy  
Milk and Cream  
Ice Cream  
Fats for cooking:  
Animal  
Vegetable  
Alcohol

## CHOLESTEROL CONTENT OF SUBSTANCES USED AS FOODS

Organs	Fat % Dry Wt.	Total Cholesterol % Dry Wt.	Moisture %	Fat % Moist.	Total Cholesterol % Moist. Wt.
Beef brain 1	49.4	10.67	77.9	10.9	2.36
11	53.8	9.61	77.9	11.8	2.11
1	17.4	.49	70.0	5.2	.15
Beef heart 11	15.5	.46	70.0	4.7	.14
1	16.6	1.60	74.9	4.2	.40
Beef kidney 11	17.9	1.67	74.9	4.5	.41
1	20.5	.86	69.7	6.2	.26
Beef liver 11	25.5	.63	69.7	7.7	.19
1	14.6	1.95	80.0	2.9	.39
Beef lung 11	15.0	1.75	80.0	3.0	.35
Beef thymus 1	10.5	.99	75.0	2.6	.25
(Sweatbread) 11	30.4	.89	75.0	7.6	.22
Heart muscle					
Rabbit		.57	64.0		.20
Av. mammal		.51	64.0		.18
Hen		.54	69.6		.16
Pigeon		.52	69.6		.16
Duck, wild		.52	69.6		.16
Turtle		.80	80.0		.16
Skeletal Muscle 1	14.2	.21	70.0	4.2	.06
Beef 11	9.8	.22	70.0	2.9	.06
Lamb	11.2	.24	71.0	3.2	.07
Pork	22.4	.175	64.0	8.0	.06
Rabbit (Laboratory)		.17	67.9		.05
" wild	.25	67.9			.08
Veal	11.8	.25	74.0	3.0	.065
Av. mammal		.27	67.9		.087
Chicken, light	12.7	.35	73.0	3.4	.09
Chicken, dark	7.0	.32	72.5	1.9	.06
Hen		.25	73.0		.07
Duck		.21	68.8		.07
Pigeon		.41	74.0		.11
Codfish	9.5	.29	82.6	1.6	.05
Frog	10.9	.23	82.0	2.0	.04
Salmon	18.3	.16	64.0	6.6	.06
Shrimp	8.1	.74	80.0	1.6	.15
Turtle 1	17.4	.32	80.0	3.5	.06
11					

## CHOLESTEROL CONTENT OF SUBSTANCES USED AS FOODS

	Fat % Dry Wt.	Total Cholesterol % Dry Wt.	Moisture %	Fat % Moist	Total Cholesterol Moist. Wt.
Eggs (hens)					
Frozen whole		2.11	73.4		.56
Frozen yolk		2.88	53.8		1.33
Liquid whole		1.97	73.7		.518
Dehydrated Whole					2.14
Dehydrated Yolk					2.81
Fresh whole	50.3	1.80	74.0	13.1	.468

Milk whole \_\_\_\_\_

## DEFINING PROBABILITY

When calculating the probability that the association between the qualities or the instances of the degrees of qualities of two or more factors may or may not be due to chance alone, the method of  $X^2$  or the sum of relative differences is used. In doing this it is necessary to compare the actual frequencies of the degrees of the factors with the distribution expected to be found if the factors were independent and unrelated.

After the observed values are inserted in a table, the first step is to find the independence value for each cell. In the example these values (N) represent the number of subjects in the study with different cholesterol intakes, which one should expect to find in the absence of any actual association between the daily fat consumption and cholesterol intake.

For example the actual number of subjects with a fat intake of zero to one-hundred in the zero to five hundred Mg % of cholesterol intake in the sample of twenty-seven females was nine. If there is no association between fat intake and cholesterol intake, one should expect to find  $\frac{17 \times 9}{27}$  or 5.7 subjects with an intake of fat no more than one hundred grams that did not increase the cholesterol intake above five hundred milligram percent. The "independence" values are found for each cell by multiplying together the totals of the row and column in which the cell lies and dividing

the product by the total number of instances.

When the "independence" values have been calculated for each cell the next step is to find the difference ( $d$  in Table) between the (obs) actual value and independence values ( $M$ ). Each particular difference ( $d$ ) is then squared ( $d^2$  in Table) and the square is divided by each particular independent value ( $d^2$  divided by  $M$ ). These quotients are called the relative difference. The sum of the relative differences is called  $X^2$ .

The probability that  $X^2$  in the sample table (9.80 for a 3 x 1 table) could be due to chance alone is less than .05. This means that there are five chances in one hundred that the association could be due to chance alone. For  $X^2$  to be significant the probability must be less than .05.

Females

Fat Intake Grams	Mg 0-500	Mg 500-1000	Mg 1000-1500	Mg 1500-2000	Total
0-100	obs 9 M $\frac{9 \times 17}{27} = 5.66$ D - 3.34 D <sup>2</sup> = 11.156 RD = 1.970	obs 0 M $\frac{9 \times 10}{27} = 3.33$ D - 3.33 D <sup>2</sup> = 11.089 RD = 3.327	obs 0 M 0 D D <sup>2</sup> RD 0	obs 0 M 0 D D <sup>2</sup> RD 0	9
100-200	obs 8 M $\frac{16 \times 17}{27} = 10.07$ D 2.07 D <sup>2</sup> 4.284 RD .4155	obs 8 M $\frac{16 \times 10}{27} = 5.92$ D 2.08 D <sup>2</sup> 4.326 RD .7307	obs 0 M 0 D D <sup>2</sup> RD 0	obs 0 M 0 D D <sup>2</sup> RD 0	16
200-300	obs 0 M $\frac{2 \times 17}{27} = 1.22$ D = 1.22 D <sup>2</sup> 1.488 RD 1.211	obs 2 M $\frac{2 \times 10}{27} = .740$ D - 1.26 D <sup>2</sup> 1.588 RD 2.145	obs 0 M 0 D D <sup>2</sup> RD 0	obs 0 M 0 D D <sup>2</sup> RD 0	2
300-400	obs 0 M D D <sup>2</sup> RD 0	obs 0 M D D <sup>2</sup> RD 0	obs 0 M 0 D D <sup>2</sup> RD 0	obs 0 M D D <sup>2</sup> RD 0	0
Total	17	10	0	0	27

$X^2 = 9.80$

$P = .05$

227