SERUM FATTY ACID PATTERNS OF CLINICALLY HEALTHY MEN LIVING IN SOUTHEASTERN ARIZONA

by

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ABSTRACT

Twelve men 26 to 56 years of age, residing in Tucson, Arizona served as subjects for the investigation. All subjects were evaluated to be in apparent clinical health according to standard clinical blood and urine analyses.

The self-selected diets of the subjects, with few exceptions, met the 1968 Recommended Dietary Allowances of the National Research Council. The caloric distribution of the diets averaged 16 per cent from protein, 44 per cent from carbohydrate and 40 per cent from fat. Daily linoleic acid intakes represented from 3/4 to 3 and 1/2 per cent of total calories. Significant correlations were observed between serum linoleic acid and the per cent of calories from dietary linoleate (0.80); serum linoleic plus arachidonic acid and the per cent of calories from dietary linoleate (0.77) and between serum P:S ratio and the per cent of calories from dietary linoleate (0.75).

Biochemical measurements for selected serum lipid fractions were determined on all subjects and compared with those of previous Arizona lipid studies. The eight detected fatty acids were characterized by a mean distribution of lauric (12:0), 0.43% ± 0.14; myristic (14:0), 1.97% ± 0.62; palmitic (16:0), 23.35% ± 2.48; palmitoleic (16:1), 4.09% ± 0.90; stearic (18:0), 4.14% ± 0.61; oleic (18:1), 29.79% ± 2.46; linoleic (18:2), 32.38% ± 5.62; and arachidonic (20:4), 3.73% ± 0.87. The oleic to linoleic acid (O:L) ratio was 0.92. The possibility was speculated that the sex hormones may exert some influence on the distribution of the serum fatty acids.

CHAPTER 1

INTRODUCTION

Since the turn of the century, the importance of fat in the human diet has been recognized as an essential contribution to good health. The role of fatty acids, and more specifically, the essential fatty acids, was speculated as early as 1954 when Hansen and Wiese concluded that man cannot synthesize essential fatty acids in adequate amounts for good health. At this time, this research team believed that two fatty acids, linoleic and arachidonic, were essential to health (1). Four years later, in 1958, the team of Adam, Hansen and Wiese determined that there was only one essential fatty acid, linoleic (2). They found a direct relationship between the amount of linoleate in the diet and the serum levels of di-, tri-, and tetraenoic acids. Concluding their investigation, they established a minimum daily requirement for linoleic acid to be approximately one per cent of total dietary calories for infants (3).

The Food and Nutrition Board (4) also established a minimal allowance for linoleic acid in 1958 which agreed with the allowance set by Adam, Hansen and Wiese. In 1964, the revised edition of the Recommended Dietary Allowances of the Food and Nutrition Board (5) stated that linoleic acid intake should be one to three per cent of total dietary calories to provide for the infant's requirement, and probably this would also be sufficient for adult needs which were believed to be less than the infant's.

The 1968 revision of the Recommended Dietary Allowances (6) stated that two per cent of total calories appeared to be the minimum human requirement for essential fatty acid in infancy, but recommended that a level of three per cent of total calories be provided as essential fatty acid to prevent a subclinical physiologic deficiency and to provide a reserve against stress.

M. A. Kight's fatty acid work, 1967 (7), established characteristic serum fatty acid patterns as a parameter for evaluating the nutritional status of women living in southeastern Arizona. Kight found levels for dietary linoleic acid intake to be one to six per cent of adequate total calories for clinically healthy females aged 28 to 47 years, living in southeastern Arizona. In the publication of that data in 1972, Kight and Sheehan (8) suggested that possibly a linoleic acid intake greater than one per cent of adequate total calories might be in excess of needs for the subjects studied.

E. Tu's work, 1969 (9), utilized serum fatty acid distributions as parameters in the assessment of the nutritional status of extended age groups in Arizona. Tu's subjects consisted of clinically healthy, free-living men and women between the ages of 55 and 79 years, residing in southeastern Arizona. Levels of dietary linoleate observed for the subjects ranged from 0.4 to 5.3 per cent of total calories.

Neither Kight (7) nor Tu (9) reported statistically significant correlations between dietary linoleate and serum linoleic acid, suggesting that all observed dietary levels of linoleic acid intake were sufficient to maintain serum linoleic acid at what appears to be desirable levels.

A great deal of research effort has been expended since the early 1900's searching to define the relationship between diet and the functioning of the cardiovascular system--especially that relationship existing between dietary lipids and heart disease. J. Mayer (10) recently quoted that nearly 50 per cent of American men between the ages of 40 and 60 years die of cardiovascular disease, many of them with coronary heart disease. He observed from this fact, ". . . that we have returned unwittingly to the days of the great pandemics . . . this time . . . one of a degenerative nature rather than of an epidemic disease" (p. 15).

In its summary of Panel Recommendations (11) the Conference Staff of the White House Conference on Food, Nutrition and Health devoted an entire section to deal with the nutritional needs of Adults in an Affluent Society. The Conference Staff urged high priority for "a National Diet-Heart Study to determine the effect of diet on atherosclerosis and its complications.

The Council on Foods and Nutrition of the American Medical Association in its recently published statement on the relationship of diet to coronary heart disease (12) states that even though it is not yet possible to quantitatively identify the benefits resulting from modifying various risk factors associated with coronary heart disease, the seriousness of the situation demands that all reasonable means be used to reduce conditions that contribute to risk of coronary heart disease. Abundant evidence exists, the statement continues, "that risk of developing coronary heart disease is positively correlated with the level of cholesterol in the plasma" (p. 1647).

So it is that the study of diet and dietary lipids and their relationship to serum lipids has been established as a high priority in human nutrition research throughout the United States. The Arizona lipid studies, Project NIIA (Nutritional Information and/or Influences in Arizona), developed and headed by M. A. Kight, has focused on establishing base line data for studying lipid status and characteristic fatty acid patterns in clinically healthy men and women living in southeastern Arizona (13). Kight's work (7) provided this base line data for clinically healthy, premenopausal women. Tu expanded this work to define parameters of normality for serum fatty acids for members of the extended age group of both sexes (9).

One of the most serious manifestations of abnormal lipid metabolism, atherosclerosis and resulting coronary heart disease, is reported to be more prevelant among men than women (14). Therefore, further investigation is indicated to establish base line data of lipid status in clinically healthy, adult men living in southeastern Arizona, with special attention to the serum fatty acid distribution as the parameter of lipid status. The subjects for the study reported herein perpetuate the previous Arizona studies in that they represent free-living adults in an affluent society. Particular attention is given to men ranging in age from 26 to 56 years. The parameters selected for observation in this study are closely parallel to certain of those investigated by Kight (7).

CHAPTER 2

PROCEDURE AND METHODS

The experimental design for this investigation is detailed in the paragraphs below.

Clinical Measurements

Subjects

Twelve men between the ages of 26 and 56 years and residing at Tucson, Arizona for at least 12 consecutive months prior to the study served as volunteer subjects. Eleven of the subjects were gainfully employed as professionals in the nutritional sciences; one of the subjects was gainfully employed by the Physical Plant at The University of Arizona. Routine clinical and selected biochemical measurements closely parallel to certain of those in Kight's work (7) were made on each of the 12 subjects.

Blood and Urine Sample Analyses

Blood samples were collected by venipuncture at Tucson Medical Laboratories following an overnight fast. At this same time, urine specimens were also collected. The Tucson Medical Laboratory staff analyzed each subject's serum for hemoglobin, hematocrit, differential white cell count, protein-bound iodine (PBI), thyro-binding index (TBI) and blood glucose. Urine analyses included sugar, albumin, pH reaction and bacteria.

Other Clinical Measurements

Heights were taken using the standard stadiometer. Each subject was measured without shoes, the measurement recorded to the nearest centimeter.

Each subject was weighed to the nearest kilogram without shoes, before breakfast. Per cent standard weight was determined for each subject by directly reading from the Manual for Nutrition Surveys, Table VII (15).

Blood pressure for each subject was measured and recorded as systolic/diastolic using the standard blood pressure Baumanometer.

Dietary Information

A 14-day history of self-selected diet was recorded by each subject. The diet records were evaluated for the following nutrients: calories, protein, fat, carbohydrate (total and fiber), ash, calcium, phosphorus, iron, sodium, potassium, vitamin A, thiamine, ribolfavin, niacin, ascorbic acid, total saturated fatty acid, oleic, linoleic, and total cholesterol. The CDC 6400 Computer and the 1963 revised edition of Handbook No. 8, U.S.D.A. (16)

facilitated the dietary evaluation. The program for evaluating dietary data using the IBM 7072 computer as reported by Kight (7) was converted for use on the CDC 6400 Computer. The program provides for analysis of a diet for 1 to 99 days and up to 100 subjects, tabulating total nutritive values and average daily nutrient intake for each subject, the Recommended Dietary Allowances for his respective age group (6), and the variation from the recommended amount.

Biochemical Lipid Determinations

Total Lipids

The method of Lis (17) as modified for quantitative determination of total serum lipids by Kight (7) was utilized in this study. Following extraction of the lipids from the serum, the solvent from a 2-ml aliquot of the extract was evaporated in a vacuum oven. The lipid residue was weighed to constant weight on a Mettler B-5 Analytical Balance. Total lipid concentrations were recorded in milligrams of lipid per 100 ml of serum.

Total Fatty Acids

Determination of total serum fatty acids was also accomplished gravimetrically following saponification of the 2-ml aliquot of total lipid extract and acid extraction and purification of the fatty acids as indicated in Kight's work (7) except that the samples were dried in a vacuum oven rather than under nitrogen. The dried samples were weighed using the Mettler B-5 Analytical Balance and recorded in milligrams per 100 ml of serum.

Total Lipid Fatty Acids

The serum lipids were extracted and the methyl esters of fatty acids prepared according to the established procedures adapted by Kight (7), except that the evaporation of the various phases during the procedures was accomplished in the vacuum oven. The analysis of the fatty acid methyl esters was accomplished with a Perkin-Elmer 880 Gas Chromatograph--column 1/8 inch in diameter, five feet in length, and containing 15 per cent diethylene glycol succinate (DEGS) on 60/80 chromosorb W, hexamethyldisilazane (HMDS) treated. Argon was used as the carrier gas. The inlet pressure was 25 pounds. The eight major detected fatty acids were recorded using the Speedomax H Leeds & Northrup recorder. The percentage concentration of each fraction was calculated by triangulation. Relative concentrations of each of eight measurable fatty acid fractions were evaluated as percentage of the total area obtained from the recorded tracings.

Data Editing and Statistical Treatment

The mean, standard deviation, standard error and coefficient of variation for physiological information were obtained by the programs written for CDC (Central Data Control) 6400 Computer. The correlations of clinical, dietary and physiological factors were evaluated by the multiple regression program used on this computer (18). The level of confidence was 0.01; correlations of greater than 0.70 were considered significant.

CHAPTER 3

RESULTS AND DISCUSSION

Clinical Measurements

Fasting blood and urine findings for each of the men subjects are shown in Tables A.1 and A.2 of Appendix A. The values used for comparison are based on data from the Department of Pathology, Mount Sinai Hospital, Chicago, Illinois (19). Some deviations from the usual blood findings were observed, but these variances were not considered suggestive of pathology which might be reflected in abnormal fatty acid patterns. Very likely, the observed deviations can be explained by differences in methods and techniques among laboratories.

Table A.3 of Appendix A summarizes additional clinical data for each subject. The age in years ranged from 26 to 56. Heights as recorded in centimeters ranged from 163 to 184; weights as recorded in kilograms ranged from 70 to 104. Expressing these measurements as per cent standard weights according to the Society of Actuaries Standard (15) discloses that 5 of the 12 subjects were of desirable weight for height. According to the definition of Proudfit and Robinson published in 1965 (20), two subjects were obese (per cent standard weight of 120 or greater) and five subjects were overweight)per cent standard weight of 110-120). More recently, obesity has been defined as an "excess relative body fat content," thus distinguishing overweight due to accumulated muscle mass from the overweight of obesity caused by excessive deposition of fatty tissue in the body (21). Considerable evidence has been purported in recent years to delineate a relationship between obesity and mortality of cardiovascular heart disease, but most of this evidence has not shown any consistent association between the risk factor of obesity and atherosclerotic lesions (22).

The blood pressures recorded for the subjects were compared with the standards established by the Lasser and Master blood pressure study (23). These authors suggested a gradual rise in systolic pressure and a smaller rise in diastolic pressure occurs with increasing age. This trend was not observed in the subjects of this study, although generally, blood pressures of the group did fall within the limits established by Lasser and Master. The slight deviations of subjects 2, 5 and 11 from these standards are not considered indicative of any gross abnormalities. Table 1 compares the mean blood pressure and standard deviations in apparently healthy men as reported by Lasser and Master to those recorded for the subjects in this study.

Table 1. Mean blood pressure measurements in apparently healthy men 26 to 56 years of age.

Subject Number	Age Group	Lasser Standard Males Systolic (mm)	Lasser Standard Males Diastolic (mm)	Subject Measurements Systolic (mm)	Subject Measurements Diastolic (mm)	Difference
1	25-29	125±12.6	78±9.0	118	72	46
2	30-34	126±13.6	79±9.7	108	78	30
3	30-34	126±13.6	79±9.7	122	84	38
4	30-34	126±13.6	79±9.7	120	84	36
5	30-34	126±13.6	79±9.7	146	88	58
6	30-34	126±13.6	79±9.7	122	70	52
7	30-34	126±13.6	79±9.7	118	78	30
8	35-39	127±14.2	80±10.4	120	82	38
9	35-39	127±14.2	80±10.4	124	88	36
10	40-44	129±15.1	81±9.5	126	90	36
11	40-44	129±15.1	81±9.5	140	94	46
12	55-59	138±18.8	84±11.4	128	86	42

The number of years continuously lived in Arizona prior to the study was recorded for each subject. The length of residence ranged from 1 to 19 years. Consistent with previous observations on Arizona subjects (7, 9), no significant correlations were found between years lived in Arizona and dietary or physiologic measurements.

Dietary Information

Table B.1 of Appendix B compares the mean values of the computer-evaluated 14-day dietary records for each subject with the appropriate Recommended Dietary Allowance (RDA) according to the 1968 revision (6).

No significant correlation was found between per cent of RDA calories consumed and per cent standard weight, concurring with other recent studies (9, 24). Subjects 1, 2, 4, 6 and 12 who were 10 to 20 per cent overweight consumed 90.67%, 95.96%, 102.48%, 114.94% and 82.08% respectively of RDA calories. Subjects 9 and 11 who were more than 20 per cent overweight consumed 105.84% and 91.90% respectively of RDA calories.

The 1968 revision of the RDA (6) adjusted the calorie allowances for the reference man downward to account for the decreasing activity pattern which developed in our society subsequent to the previous revision in 1963. The fact that more than half of the overweight subjects in this study were consuming less than 100 per cent of RDA calories suggests these recent revisions in recommended calorie allowances may still be too high. The Food and Nutrition Board also noted in their 1968 revision that a higher level of health could more likely be reached if the population were more physically active, citing recent studies supporting this hypothesis and indicating that perhaps greater emphasis should be placed on increasing physical activity and then adjusting caloric intake to achieve and maintain that weight which is consistent with good health.

Distribution of the calories consumed by the subjects of this study is presented in Table 2. The mean values for protein, carbohydrate and fat were 16.26%, 43.48% and 39.52% respectively. These findings concur with those of other recent investigations. In 1972, Bebb, Houser, Witschi, and Littell reported the nutrient intakes of two groups of 82 Ohio professional and executive men, ranging in age from 23 to 62 years (25). The nutrient intakes were recorded by the subjects at frequent intervals over a 12-month period. These investigators reported mean values for protein, carbohydrate and fat of 15.4%, 47.7% and 36.9% respectively for Group I and 17.7%, 43.1% and 29.2% respectively for Group II. In a study of the extended age group in Arizona, Tu observed caloric distribution among men subjects for protein, carbohydrate and fat to be 18,6%, 44.3% and 38.0% respectively (9). A tabular

Table 2. Caloric distribution of self-selected diets for southeastern Arizona men.

Subject Number	Mean Daily Calorie Intake	Calories Per Cent RDA	Per Cent From Protein	Per Cent From CHO	Per Cent From Fat	Per Cent From 18:2	P:S Ratio
1	2629.58	90.67	18.24	41.59	40.63	2.24	0.51
2	2782.88	95.96	19.98	42.63	37.65	2.45	0.53
3	2886.34	99.52	14.86	49.79	36.78	1.01	0.41
4	2972.10	102.48	12.08	48.16	37.28	1.02	0.16
5	2415.86	83.80	14.52	42.92	42.98	3.08	0.51
6	3333.33	114.94	15.42	44.41	41.27	3.13	0.46
7	2409.43	83.08	17.20	40.71	40.39	3.01	0.50
8	2115.90	72.96	15.20	39.48	45.88	3.56	0.39
9	2751.85	105.84	17.72	40.82	40.02	1.25	0.17
10	2027.29	77.97	15.95	47.80	36.74	0.75	0.24
11	2389.49	91.90	17.40	44.35	38.01	1.69	0.36
12	2134.09	82.08	16.61	39.12	36.67	1.85	0.24
Mean	2570.67	91.72	16.26	43.48	39.52	2.16	0.37

presentation comparing the mean caloric distributions for men in these recent Ohio and Arizona studies with the findings of this investigation is given in Table 3.

The per cent of calories obtained from linoleic acid for the subjects ranged from 0.75 to 3.56 with a group mean of 2.16. Tu reported a mean value for dietary linoleate of one per cent of total calories for Arizona men and women (9). Kight reported a mean value of three per cent of total calories for Arizona women (7). The Food and Nutrition Board (6) recognizes that two per cent of total calories as linoleate appears to be the minimum requirement for humans in infancy if the triene to tetraene ratio is used as an index of essential fatty acid (EFA)

Table 3. Mean caloric distribution of self-selected diets for men in Ohio and Arizona.

Source of Calories	Ohio Subjects*		Arizona Subjects	
	Group I	Group II	Tu (9)	Present Study
Fat %	36.9	39.2	35.5	39.5
Protein %	15.4	17.7	19.0	16.2
Carbohydrate %	47.7**	43.1**	46.2	43.4

*H. T. Bebb, et al. (25).

**Includes calories from alcohol.

deficiency. The Board recommends three per cent of total calories be provided as linoleic for infants to prevent a subclinical deficiency and provide a reserve against stress. Because spontaneous EFA deficiency has never been documented in adult human subjects, the Board has not yet established a recommended allowance for the adult.

Subject 10 of this study reported 0.75% of total calories as linoleic acid. The corresponding fraction of the subject's serum fatty acid pattern represents 23.43% of total lipid fatty acids and was considerably lower than linoleic serum levels observed for the other subjects studied. All subjects except Subject 10 reported at least one per cent of total calories as linoleic acid. These observations indicate that perhaps the one per cent level recently suggested as adequate for the needs of adult women (8) may be a very minimum level.

The self-selected intake of nutrients for each subject was interpreted as suggested by Kight (7). The per cent of RDA for each nutrient was determined to be high, acceptable or low according to the guide published by the Interdepartmental Committee on Nutrition for National Defense. This evaluation is found in Table 4. In general, the diets of most subjects were at acceptable to high levels for protein, calcium, phosphorus, iron, vitamin A, thiamine, riboflavin, niacin and ascorbic acid

Table 4. Suggested guide* to interpretation of nutrient intake data using per cent of RDA values**.

Subject Number	Nutrient Intake Expressed as Per Cent of RDA									
	Calories	Protein	Calcium	Phosphorus	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
1	93.91	184.53	186.04	243.40	156.90	111.84	126.42	165.29	98.61	112.86
2	99.38	213.93	149.32	250.82	215.80	293.95	130.71	185.29	147.66	206.75
3	103.08	165.01	143.52	208.83	156.40	189.19	152.14	195.29	145.27	361.06
4	106.14	138.18	128.26	193.15	126.50	116.41	77.85	127.64	93.05	90.25
5	86.28	134.92	116.09	184.52	143.20	192.79	102.85	118.82	100.16	257.05
6	119.04	197.69	168.76	249.00	188.10	146.97	95.71	158.23	107.22	127.86
7	83.08	159.46	123.80	211.29	152.90	95.15	82.85	115.29	137.61	96.00
8	75.56	123.70	102.83	152.72	114.80	90.33	72.85	97.64	84.94	67.30
9	105.84	187.55	129.75	237.17	188.80	104.50	103.07	131.17	128.70	120.36
10	77.97	124.41	105.54	162.40	103.00	71.51	90.00	102.94	86.64	208.25
11	91.90	91.90	163.14	211.44	129.10	136.77	96.92	137.64	89.70	79.75
12	88.92	136.38	76.89	159.01	149.50	118.66	102.50	92.94	147.35	105.68

*Guide: less than 90% of RDA — low
90 to 124% of RDA — acceptable
125% or more of RDA — high

**Per cent of RDA Values: $\frac{\text{Mean Daily Nutrient Intake (Table B.1, Appendix B)}}{\text{Recommended Daily Allowance (Table B.1, Appendix B)}}$

and at acceptable to low levels for calories, indicating the subjects selected foods wisely, using their daily calorie allowances for foods which would provide optimum nourishment.

Vitamin A, ascorbic acid, calcium and iron are nutrients which have been reported to be consumed in lower than recommended amounts in other dietary surveys. Likewise, thiamine and riboflavin are often reported to be low (26). Low levels of intake were observed for one or more subjects of this study for calcium, vitamin A, thiamine, niacin and ascorbic acid. Subjects 4 and 7 had low level intakes of thiamine, 77.85% and 82.85% respectively of the Recommended Dietary Allowances. Subject 7 was also low in total calories, 83.08% of RDA. Subject 8 was low in total calories, 75.56%; thiamine, 72.85%; niacin, 84.94%; and ascorbic acid, 67.30% of RDA. Subject 10 was low in total calories, 77.97%; vitamin A, 71.51% and niacin, 86.64% of RDA. Subject 11 had low level intake of two nutrients--niacin, 89.70% and ascorbic acid, 79.75% of RDA. Subject 12 was low in total calories, 88.92% and calcium, 76.89% of RDA. Subjects 1, 2, 3, 6 and 9 had acceptable to high intake levels for all nutrients evaluated. The diet of Subject 5 was low only in total calories, 86.28% of RDA.

The overall acceptable to high nutrient levels of the diets reported for the subjects of this study can most probably be attributed to the awareness this group has for the science of nutrition. This observation was anticipated at the outset of the investigation.

Biochemical Lipid Determinations

Total Lipids

Mean total lipid values for the subjects, expressed in mg/100 ml of serum are presented in Table C.1 of Appendix C. The values observed were considered to represent clinically normal serum total lipid values (19), ranging from 393.25 to 726.00 mg/100 ml. Total serum lipids reported for Arizona women ranged from 370 to 765 mg/100 ml with a group mean of 530 mg/100 ml (7). These values are in close agreement.

Total Fatty Acids

Lindgren, Tandy, Wells and Nichols (27) approximated that two-thirds by weight of the total lipids of the blood are actually fatty acids. Approximately one-third by weight of total lipids were reported to be fatty acids for the Arizona men and women in recent studies (7, 9). The values reported for the men subjects in this study are given in Table C.1 of Appendix C and show that fatty acids account for approximately one-half to two-thirds of the total lipid weight, more closely agreeing with the findings of Lindgren, et al. (27).

Correlation between total lipid values and the total fatty acids recovered from the total lipid extract was found to be 0.72.

Total Lipid Fatty Acids

Eight fatty acids were separated and detected by gas liquid chromatography. The eight acids were identified to be 12:0 (lauric), 14:0 (myristic), 16:0 (palmitic), 16:1 (palmitoleic), 18:0 (stearic), 18:1 (oleic), 18:2 (linoleic) and 20:4 (arachidonic). Table C.2 of Appendix C presents the mean fatty acid values for each of the subjects. Variability for the acids is summarized in Table 5.

Lauric and myristic, the smallest fractions, showed the greatest variability (31 per cent for each). The larger fractions, palmitic, stearic, oleic and linoleic were found to be less variable.

Kight reported mean values for per cent of total fatty acids observed in Arizona women to be: 12:0, 0.47%; 14:0, 1.21%; 16:0, 20.68%; 16:1, 3.92%; 18:0, 3.94%; 18:1, 26.37%; 18.2, 39.39% and 20:4, 4.22% (7).

Tu reported mean concentration of fatty acids for Arizona men and women subjects of the extended age group of; 12:0, 1.00%; 14;0, 1.75%; 16:0, 20.57%; 16:1, 5.25%; 18;0, 3,52%; 18:1, 31.07%; 18:2, 32.63% and 20:4, 4.22% (9).

Table 5. Variability in serum fatty acid components.

Acid	Mean (%)	S.D.	S.E.	C.V.
		Subjects		
12:0	0.43	0.14	0.04	31
14:0	1.97	0.62	0.17	31
16:0	23.35	2.48	0.71	10
16:1	4.09	0.90	0.26	21
18:0	4.14	0.61	0.17	14
18:1	29.79	2.46	0.71	8
18:2	32.38	5.62	1.62	17
20:4	3.73	0.87	0.25	23
		Pooled Control Serum		
12:0	0.29	0.14	0.06	47
14:0	0.93	0.37	0.16	39
16:0	23.26	2.40	1.07	10
16:1	3.59	0.86	0.38	23
18:0	6.23	4.41	1.97	70
18:1	26.62	2.71	1.21	10
18:2	35.77	3.77	1.69	10
20:4	3.27	1.24	0.55	37

The fatty acid distributions of the subjects of this study compared closely with those reported by Kight and Tu as shown in Table 6. Lauric and myristic are the two smallest fractions in all three studies. The three largest fractions of the serum were palmitic, oleic and linoleic in each of these studies, accounting for 86 per cent of the fatty acids in Kight's subjects (7), 84 per cent in Tu's (9) and 85 per cent in the subjects of this investigation. One difference of interest was observed in the relative distribution of oleic and linoleic. Kight reported the ratio of oleic to linoleic (O:L ratio) for the premenopausal Arizona women to be 0.66; Tu's observations for the extended age group men and women in Arizona showed an O:L ratio of 0.95; the present study of Arizona men yielded a value of 0.92 for the O:L ratio. In all three studies, linoleic was the major fatty acid component.

In a research publication reported in 1961, Lawrie, McAlpine and Rifkind (28) noted that Bottcher had determined that linoleic acid accounts for 37 per cent by weight of cholesterol esters found in human aortic atheroma. Lawrie's team found a mean value of 35 per cent for the linoleic fraction of human serum and reasoned that, in view of the findings of Bottcher, the cholesterol ester might simply be deposited in the vessel wall directly from the serum.

Table 6. Mean serum fatty acid distributions for subjects of recent Arizona studies.

Fatty Acid	Per Cent of Total Lipid Fatty Acids		
	Kight (7)	Tu (9)	Present Study
12:0	0.47	1.00	0.43
14:0	1.21	1.75	1.97
16:0	20.68	20.57	23.35
16:1	3.92	5.25	4.09
18:0	3.94	3.52	4.14
18:1	26.37	31.07	29.79
18:2	39.39	32.63	32.38
20:4	4.22	4.22	3.73

A recent medical text notes that premenopausal women are relatively immune to the complications of atherosclerosis and suggest that estrogens account for this difference (29). The differences cited in O:L ratios reported for Arizona subjects could possibly be due to the differences in hormonal balance. Although linoleic acid was the largest fraction of the serum reported in all Arizona studies, linoleate comprised a greater proportion of the serum fatty acids for the premenopausal subjects of Kight (7) than it did for the subjects observed by Tu (men and postmenopausal women) (9) and the men subjects of this study.

Lawrie, McAlpine and Rifkind noted a difference which they could not explain in the fatty acids of the triglyceride fraction of the serum between men and premenopausal women (28). Perhaps the female hormones could account for this observation also.

If indeed the cholesterol ester, which is relatively highly unsaturated, were simply deposited in the arterial wall directly from the serum as suggested by other authors (28), then the higher proportion of linoleic acid observed in the circulating serum of premenopausal women (7) could possibly reflect a slower rate of lipid deposition in the vessel wall.

Kight found no significant correlations between dietary linoleate and serum lipids (7). The present study did reveal significant correlations between serum linoleic acid and the per cent of calories from dietary linoleate (0.80). Adam, Hansen and Weise observed this same relationship in their early fatty acid work (2). Significant correlations were also observed for the men subjects of this study between serum linoleic plus arachidonic and the per cent of calories from dietary linoleic acid (0.77) and between serum P:S ratio and the per cent of calories from dietary linoleic acid (0.75), indicating that amounts of linoleic consumed in the diet are reflected in both the amount of linoleic acid present in the serum and the relative unsaturation of the blood lipids.

CHAPTER 4

SUMMARY AND IMPLICATIONS

Self-selected nutrient intakes and levels of selected serum lipid constituents were determined for 12 gainfully employed men, aged 26 to 56 years, living in southeastern Arizona.

Clinical, dietary and biochemical data: 1) indicated the subjects to be clinically healthy; 2) defined selected dietary nutrient intakes of men subjects living in Arizona; 3) compared patterns of serum total lipid fatty acid distribution with previous Arizona studies for further establishing base line clinical values; and 4) suggested sex hormones may influence the distribution of serum total lipid fatty acids which could provide significant information toward the elucidation of lipid metabolism.

The characteristic pattern of distribution for the detected fatty acids yielded mean values of lauric (12:0), 0.43% ± 0.14; myristic (14:0), 1.97% ± 0.62; pamitic (16:0), 23.35% ± 2.48; palmitoleic (16:1), 4.09% ± 0.90; stearic (18:0), 4.14% ± 0.61; oleic (18:1), 29.79% ± 2.46; linoleic (18:2), 32.38% ± 5.62 and arachidonic (20:4), 3.73% ± 0.87. The oleic to linoleic acid ratio was 0.92.

Many investigators in recent years have suggested possible relationships between fat consumed in the diet, blood lipids and atherosclerosis. The role of dietary fatty acids has been of particular interest in much of this research, creating a need for observations of fatty acid patterns of the blood lipids in human subjects in apparent health. Data from this investigation contribute in part to this need.

APPENDIX A

CLINICAL DATA

Table A.1. Fasting blood findings for southeastern Arizona men.

Item	Usual Findings	Age	Subject Number 1 (26)	2 (32)	3 (32)	4 (32)	5 (33)	6 (33)
Hemoglobin gm/100 ml	14-18		15.6	16.0	16.4	15.1	16.0	16.4
Micro. Hct. vols. %	37-47		47	49	49	44	48	47
W.B.C./cu mm	5,000-10,000		4,250	7,300	9,800	7,750	9,600	9,000
Segs. %	50-70		41	49	38	31	60	46
Stabs. %	0-5		1	0	1	1	1	1
Lyms. %	20-40		51	49	57	56	32	48
Eos. %	1-5		4	1	2	11	3	4
Baso. %	0-1		0	0	1	0	1	0
Monos. %	1-6		3	1	1	1	3	1
Glucose mg/100 ml	65-110		97	106	100	100	103	100
PBI mcg/100 ml	4.0-8.0		5.5	5.0	5.8	5.1	5.8	5.4
TBI	0.88-1.10		1.01	--	0.88	0.80	1.00	0.99

Table A.1. (Continued)

Item	Usual Findings	Subject Number Age 7 (33)	8 (35)	9 (37)	10 (43)	11 (43)	12 (56)
Hemoglobin gm/100 ml	14-18	15.6	16.0	15.1	15.6	15.6	16.0
Micro. Hct. vols. %	37-47	47	48	45	47	45	49
W.B.C./cu mm	5,000-10,000	7,200	7,500	7,700	8,650	9,700	5,800
Segs. %	50-70	48	42	55	56	50	41
Stabs. %	0-5	1	1	1	5	2	1
Lyms. %	20-40	49	50	42	36	43	52
Eos. %	1-5	0	5	1	2	5	4
Baso. %	0-1	0	0	0	0	0	0
Monos. %	1-6	2	2	1	1	0	2
Glucose mg/100 ml	65-110	97	97	103	100	109	106
PBI mcg/100 ml	4.0-8.0	4.1	5.5	6.3	5.2	4.1	6.5
TBI	0.88-1.10	0.98	0.97	1.01	0.90	0.95	0.99

Table A.2. Fasting urine findings for southeastern Arizona men.

Item	Usual Findings	Subject Number 1 Age (26)	2 (32)	3 (32)	4 (32)	5 (33)	6 (33)
Color	Yellow	Clear Yellow	Clear Yellow	Clear Yellow	Clear Yellow	Clear Yellow	Clear Yellow
Reaction (pH)	4.8-7.8	5.5	5.0	7.0	5.0	5.0	6.0
Sp. Gr.	1.002-1.030	1.012	1.018	1.024	1.008	QNS	1.020
Sugar	Negative	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Albumin	Negative	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
W.B.C.	Variable	1-2	Occ.	1-2	Occ.	50-60	Occ.
R.B.C.	Negative	Rare	None	None	None	1-2	Rare
Epith.	Variable	Occ.	Occ.	Occ.	Occ.	1-2	Occ.
Casts	Variable	None	None	None	Rare	Occ.	Occ.

Table A.2. (Continued)

Item	Usual Findings	Age	Subject Number 7 (33)	8 (35)	9 (37)	10 (43)	11 (43)	12 (56)
Color	Yellow		Clear Yellow	Clear Yellow	Clear Yellow	Clear Yellow	Clear Yellow	Clear Yellow
Reaction (pH)	4.8-7.8		5.5	6.5	6.5	5.5	5.0	5.5
Sp. Gr.	1.002-1.030		1.026	1.017	1.010	1.011	1.014	1.025
Sugar	Negative		Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Albumin	Negative		Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
W.B.C.	Variable		Occ.	10-12	6-7	Occ.	18-20	Occ.
R.B.C.	Negative		None	None	Occ.	Rare	Rare	None
Epith.	Variable		8-10	3-4	1-2	Occ.	Occ.	Occ.
Casts	Variable		None	Occ.	None	None	None	None

Table A.3. Additional clinical information about the subjects.

Subject Number	Age (yrs)	Height (cm)	Weight (kg)	Standard Weight Group (%)	Blood Pressure (s/d)	Lived in Arizona (yrs)
1	26	180	85	115-119	118/72	1
2	32	163	70	110-114	108/78	2
3	32	184	84	105-109	122/84	6
4	32	180	85	110-114	120/84	4
5	33	163	66	105-109	146/88	4
6	33	182	84	110-114	122/70	17
7	33	184	84	105-109	118/78	2
8	35	174	75	105-109	120/82	1
9	37	175	87	120-124	124/88	12
10	43	183	83	105-109	126/90	16
11	43	181	104	135-139	140/94	19
12	56	173	78	110-114	128/86	15

APPENDIX B

DIETARY DATA

Table B.1. Evaluation of self-selected dietary data.

Nutrient	Unit of Measurement	Recommended Daily Allowance	Mean Daily Nutrient Intake	Difference
		Subject Number 1		
Food Energy	Kcal	2800.00	2629.58	- 170.42
Protein	gm	65.00	119.15	+ 54.95
Fat	gm	--	118.74	--
CHO Total	gm	--	273.46	--
CHO Fiber	gm	--	4.37	--
Ash	gm	--	22.46	--
Calcium	mg	800.00	1448.39	+ 688.39
Phosphorus	mg	800.00	1947.25	+1147.25
Iron	mg	10.00	15.69	+ 5.69
Sodium	mg	--	3474.82	--
Potassium	mg	--	3562.19	--
Vitamin A	IU	5000.00	5592.42	+ 592.42
Thiamine	mg	1.40	1.77	+ 0.37
Riboflavin	mg	1.70	2.81	+ 1.11
Niacin	mg equiv	18.00	17.75	- 0.25
Ascorbic Acid	mg	60.00	67.72	+ 7.72
Total Saturated FA	gm	--	12.67	--
Oleic Acid	gm	--	16.03	--
Linoleic Acid	gm	--	6.56	--
Cholesterol	mg	--	559.42	--

Table B.1. (Continued) Evaluation of self-selected dietary data.

Nutrient	Unit of Measure-ment	Recommended Daily Allowance	Mean Daily Nutrient Intake	Difference
		Subject Number 2		
Food Energy	Kcal	2800.00	2782.88	- 17.12
Protein	gm	65.00	139.06	+ 74.06
Fat	gm	--	116.43	--
CHO Total	gm	--	296.61	--
CHO Fiber	gm	--	6.75	--
Ash	gm	--	22.32	--
Calcium	mg	800.00	1194.59	+ 394.59
Phosphorus	mg	800.00	2006.60	+1206.60
Iron	mg	10.00	21.58	+ 11.58
Sodium	mg	--	3067.38	--
Potassium	mg	--	4075.87	--
Vitamin A	IU	5000.00	14697.76	+9697.76
Thiamine	mg	1.40	1.83	+ 0.43
Riboflavin	mg	1.70	3.15	+ 1.45
Niacin	mg equiv	18.00	26.58	+ 8.58
Ascorbic Acid	mg	60.00	124.05	+ 64.05
Total Saturated FA	gm	--	14.25	--
Oleic Acid	gm	--	15.60	--
Linoleic Acid	gm	--	7.59	--
Cholesterol	mg	--	773.42	--

Table B.1. (Continued) Evaluation of self-selected dietary data.

Nutrient	Unit of Measure-ment	Recommended Daily Allowance	Mean Daily Nutrient Intake	Difference
		Subject Number 3		
Food Energy	Kcal	2800.00	2886.34	+ 86.34
Protein	gm	65.00	107.26	+ 42.26
Fat	gm	--	117.97	--
CHO Total	gm	--	359.34	--
CHO Fiber	gm	--	4.38	--
Ash	gm	--	18.17	--
Calcium	mg	800.00	1148.19	+ 348.19
Phosphorus	mg	800.00	1670.67	+ 870.67
Iron	mg	10.00	15.64	+ 5.64
Sodium	mg	--	2537.69	--
Potassium	mg	--	2904.02	--
Vitamin A	IU	5000.00	9459.52	+4459.52
Thiamine	mg	1.40	2.13	+ 0.73
Riboflavin	mg	1.70	3.32	+ 1.62
Niacin	mg equiv	18.00	26.15	+ 8.15
Ascorbic Acid	mg	60.00	216.64	+ 156.64
Total Saturated FA	gm	--	14.83	--
Oleic Acid	gm	--	21.37	--
Linoleic Acid	gm	--	6.15	--
Cholesterol	mg	--	464.07	--

Table B.1. (Continued) Evaluation of self-selected dietary data.

Nutrient	Unit of Measure-ment	Recommended Daily Allowance	Mean Daily Nutrient Intake	Difference
		Subject Number 4		
Food Energy	Kcal	2800.00	2972.10	+ 172.10
Protein	gm	65.00	89.82	+ 24.82
Fat	gm	--	123.13	--
CHO Total	gm	--	357.87	--
CHO Fiber	gm	--	2.63	--
Ash	gm	--	18.12	--
Calcium	mg	800.00	1026.12	+ 226.12
Phosphorus	mg	800.00	1545.22	+ 745.22
Iron	mg	10.00	12.65	+ 2.65
Sodium	mg	--	3175.84	--
Potassium	mg	--	2485.80	--
Vitamin A	IU	5000.00	5820.84	+ 820.84
Thiamine	mg	1.40	1.09	- 0.31
Riboflavin	mg	1.70	2.17	+ 0.47
Niacin	mg equiv	18.00	16.75	- 1.25
Ascorbic Acid	mg	60.00	54.15	- 5.85
Total Saturated FA	gm	--	20.01	--
Oleic Acid	gm	--	16.50	--
Linoleic Acid	gm	--	3.38	--
Cholesterol	mg	--	348.64	--

Table B.1. (Continued) Evaluation of self-selected dietary data.

Nutrient	Unit of Measure-ment	Recommended Daily Allowance	Mean Daily Nutrient Intake	Difference
		Subject Number 5		
Food Energy	Kcal	2800.00	2415.86	- 384.14
Protein	gm	65.00	87.70	+ 22.70
Fat	gm	--	115.38	--
CHO Total	gm	--	259.26	--
CHO Fiber	gm	--	4.06	--
Ash	gm	--	18.34	--
Calcium	mg	800.00	928.78	+ 128.78
Phosphorus	mg	800.00	1476.23	+ 676.23
Iron	mg	10.00	14.32	+ 4.32
Sodium	mg	--	2718.47	--
Potassium	mg	--	2745.96	--
Vitamin A	IU	5000.00	9639.56	+4639.56
Thiamine	mg	1.40	1.44	+ 0.04
Riboflavin	mg	1.70	2.02	+ 0.32
Niacin	mg equiv	18.00	18.03	+ 0.03
Ascorbic Acid	mg	60.00	154.23	+ 94.23
Total Saturated FA	gm	--	16.21	--
Oleic Acid	gm	--	25.65	--
Linoleic Acid	gm	--	8.29	--
Cholesterol	mg	--	500.14	--

Table B.1. (Continued) Evaluation of self-selected dietary data.

Nutrient	Unit of Measure-ment	Recommended Daily Allowance	Mean Daily Nutrient Intake	Difference
		Subject Number 6		
Food Energy	Kcal	2800.00	3333.33	+ 533.33
Protein	gm	65.00	128.50	+ 63.50
Fat	gm	--	152.87	--
CHO Total	gm	--	370.11	--
CHO Fiber	gm	--	4.83	--
Ash	gm	--	22.61	--
Calcium	mg	800.00	1350.09	+ 550.09
Phosphorus	mg	800.00	1992.05	+1192.05
Iron	mg	10.00	18.81	+ 8.81
Sodium	mg	--	3806.04	--
Potassium	mg	--	3052.13	--
Vitamin A	IU	5000.00	7348.99	+2348.99
Thiamine	mg	1.40	1.34	- 0.06
Riboflavin	mg	1.70	2.69	+ 0.99
Niacin	mg equiv	18.00	19.30	+ 1.30
Ascorbic Acid	mg	60.00	76.72	+ 16.72
Total Saturated FA	gm	--	25.20	--
Oleic Acid	gm	--	31.27	--
Linoleic Acid	gm	--	11.60	--
Cholesterol	mg	--	746.35	--

Table B.1. (Continued) Evaluation of self-selected dietary data.

Nutrient	Unit of Measure-ment	Recommended Daily Allowance	Mean Daily Nutrient Intake	Difference
		Subject Number 7		
Food Energy	Kcal	2800.00	2409.43	- 390.57
Protein	gm	65.00	103.65	+ 38.65
Fat	gm	--	108.15	--
CHO Total	gm	--	245.25	--
CHO Fiber	gm	--	5.67	--
Ash	gm	--	19.13	--
Calcium	mg	800.00	990.44	+ 199.44
Phosphorus	mg	800.00	1690.34	+ 890.34
Iron	mg	10.00	15.29	+ 5.29
Sodium	mg	--	2989.77	--
Potassium	mg	--	2344.79	--
Vitamin A	IU	5000.00	4757.74	- 242.74
Thiamine	mg	1.40	1.16	- 0.24
Riboflavin	mg	1.70	1.96	+ 0.26
Niacin	mg equiv	18.00	24.77	+ 6.77
Ascorbic Acid	mg	60.00	57.60	- 2.40
Total Saturated FA	gm	--	16.12	--
Oleic Acid	gm	--	18.48	--
Linoleic Acid	gm	--	8.07	--
Cholesterol	mg	--	319.85	--

Table B.1. (Continued) Evaluation of self-selected dietary data.

Nutrient	Unit of Measurement	Recommended Daily Allowance	Mean Daily Nutrient Intake	Difference
		Subject Number 8		
Food Energy	Kcal	2800.00	2115.90	- 684.10
Protein	gm	65.00	80.41	+ 15.41
Fat	gm	--	107.88	--
CHO Total	gm	--	208.89	--
CHO Fiber	gm	--	2.76	--
Ash	gm	--	15.97	--
Calcium	mg	800.00	822.66	+ 22.66
Phosphorus	mg	800.00	1221.83	+ 421.83
Iron	mg	10.00	11.48	+ 1.48
Sodium	mg	--	2762.82	--
Potassium	mg	--	1738.74	--
Vitamin A	IU	5000.00	4516.89	- 483.11
Thiamine	mg	1.40	1.02	- 0.38
Riboflavin	mg	1.70	1.66	- 0.04
Niacin	mg equiv	18.00	15.29	- 8.69
Ascorbic Acid	mg	60.00	40.38	- 19.62
Total Saturated FA	gm	--	20.99	--
Oleic Acid	gm	--	28.09	--
Linoleic Acid	gm	--	8.39	--
Cholesterol	mg	--	313.42	--

Table B.1. (Continued) Evaluation of self-selected dietary data.

Nutrient	Unit of Measure-ment	Recommended Daily Allowance	Mean Daily Nutrient Intake	Difference
		Subject Number 9		
Food Energy	Kcal	2600.00	2751.85	+ 151.85
Protein	gm	65.00	121.91	+ 56.91
Fat	gm	--	122.37	--
CHO Total	gm	--	280.85	--
CHO Fiber	gm	--	4.20	--
Ash	gm	--	22.54	--
Calcium	mg	800.00	1038.00	+ 238.00
Phosphorus	mg	800.00	1897.42	+1097.42
Iron	mg	10.00	18.88	+ 8.88
Sodium	mg	--	4050.28	--
Potassium	mg	--	2734.59	--
Vitamin A	IU	5000.00	5225.06	+ 225.06
Thiamine	mg	1.30	1.34	- 0.04
Riboflavin	mg	1.70	2.23	+ 0.53
Niacin	mg equiv	17.00	21.88	+ 6.59
Ascorbic Acid	mg	60.00	72.22	+ 12.22
Total Saturated FA	gm	--	21.34	--
Oleic Acid	gm	--	18.34	--
Linoleic Acid	gm	--	3.84	--
Cholesterol	mg	--	589.42	--

Table B.1. (Continued) Evaluation of self-selected dietary data.

Nutrient	Unit of Measure-ment	Recommended Daily Allowance	Mean Daily Nutrient Intake	Difference
		Subject Number 10		
Food Energy	Kcal	2600.00	2027.29	- 572.71
Protein	gm	65.00	80.87	+ 15.87
Fat	gm	--	82.76	--
CHO Total	gm	--	242.27	--
CHO Fiber	gm	--	3.62	--
Ash	gm	--	13.36	--
Calcium	mg	800.00	844.39	+ 44.39
Phosphorus	mg	800.00	1299.24	+ 499.24
Iron	mg	10.00	10.30	+ 0.30
Sodium	mg	--	1752.23	--
Potassium	mg	--	2002.80	--
Vitamin A	IU	5000.00	3575.79	-1424.21
Thiamine	mg	1.30	1.17	- 0.13
Riboflavin	mg	1.70	1.75	+ 0.05
Niacin	mg equiv	17.00	14.73	- 2.27
Ascorbic Acid	mg	60.00	124.95	+ 64.95
Total Saturated FA	gm	--	7.07	--
Oleic Acid	gm	--	6.45	--
Linoleic Acid	gm	--	1.70	--
Cholesterol	mg	--	285.50	--

Table B.1. (Continued) Evaluation of self-selected dietary data.

Nutrient	Unit of Measure-ment	Recommended Daily Allowance	Mean Daily Nutrient Intake	Difference
		Subject Number 11		
Food Energy	Kcal	2600.00	2389.49	- 210.51
Protein	gm	65.00	103.99	+ 38.99
Fat	gm	--	100.92	--
CHO Total	gm	--	264.98	--
CHO Fiber	gm	--	3.30	--
Ash	gm	--	17.56	--
Calcium	mg	800.00	1305.13	+ 505.13
Phosphorus	mg	800.00	1691.53	+ 891.53
Iron	mg	10.00	12.91	+ 2.91
Sodium	mg	--	2713.08	--
Potassium	mg	--	2218.25	--
Vitamin A	IU	5000.00	6838.96	+1838.96
Thiamine	mg	1.30	1.26	- 0.04
Riboflavin	mg	1.70	2.34	+ 0.64
Niacin	mg equiv	17.00	15.25	- 1.75
Ascorbic Acid	mg	60.00	47.85	- 12.15
Total Saturated FA	gm	--	12.44	--
Oleic Acid	gm	--	15.15	--
Linoleic Acid	gm	--	4.51	--
Cholesterol	mg	--	309.07	--

Table B.1. (Continued) Evaluation of self-selected dietary data.

Nutrient	Unit of Measure-ment	Recommended Daily Allowance	Mean Daily Nutrient Intake	Difference
		Subject Number 12		
Food Energy	Kcal	2400.00	2134.09	- 265.91
Protein	gm	65.00	88.65	+ 23.65
Fat	gm	--	86.97	--
CHO Total	gm	--	208.73	--
CHO Fiber	gm	--	4.23	--
Ash	gm	--	13.98	--
Calcium	mg	800.00	615.14	- 184.86
Phosphorus	mg	800.00	1272.10	+ 472.10
Iron	mg	10.00	14.95	+ 4.95
Sodium	mg	--	2543.93	--
Potassium	mg	--	2232.73	--
Vitamin A	IU	5000.00	5933.40	+ 933.40
Thiamine	mg	1.20	1.23	+ 0.03
Riboflavin	mg	1.70	1.58	- 0.12
Niacin	mg equiv	14.00	20.63	+ 6.63
Ascorbic Acid	mg	60.00	63.41	+ 3.41
Total Saturated FA	gm	--	17.82	--
Oleic Acid	gm	--	23.15	--
Linoleic Acid	gm	--	4.41	--
Cholesterol	mg	--	562.35	--

APPENDIX C

BIOCHEMICAL DATA

Table C.1. Mean serum lipid composition for southeastern Arizona men.

Subject Number	Total Lipid mg/100 ml	Total Fatty Acid mg/100 ml	Fatty Acid as Per Cent of Total Lipid
1	544.50	275.00	50
2	528.00	299.75	55
3	393.25	255.75	65
4	539.00	330.00	61
5	588.50	291.50	49
6	726.00	382.25	52
7	701.25	389.50	55
8	525.25	294.45	56
9	544.50	382.25	70
10	687.50	316.25	46
11	541.75	313.50	57
12	676.50	412.50	60
Mean	583.00	328.55	56

Table C.2. Mean serum fatty acid composition for southeastern Arizona men.

Subject Number	Fatty Acid Components as Per Cent of Serum Total Lipid Fatty Acid							
	12:0	14:0	16:0	16:1	18:0	18:1	18:2	20:4
1	0.47	1.44	22.73	3.23	4.26	28.90	35.30	3.63
2	0.72	2.99	21.96	5.48	4.01	29.17	31.14	4.49
3	0.45	2.00	25.42	5.66	4.20	31.07	28.05	3.10
4	0.37	1.76	23.08	4.03	4.95	29.71	31.40	4.66
5	0.22	1.03	21.39	2.67	4.53	28.36	38.29	3.48
6	0.29	1.86	23.00	3.36	3.91	27.88	36.41	3.24
7	0.26	3.09	23.51	4.88	4.11	30.07	31.72	2.33
8	0.43	1.34	17.90	3.38	3.89	24.36	44.78	3.87
9	0.48	1.90	25.14	4.25	3.62	30.85	30.78	2.94
10	0.47	2.06	27.87	4.13	4.30	34.36	23.43	3.34
11	0.64	2.46	25.17	3.71	4.56	30.31	27.56	5.55
12	0.41	1.79	23.07	4.35	4.08	32.39	29.68	4.17
Mean	0.43	1.97	23.35	4.09	4.14	29.79	32.38	3.73

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