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CHOLESTEROL, SATURATED FATTY ACID, POLYUNSATURATED FATTY ACID, COPPER, ZINC AND MAGNESIUM INTAKES OF THE U.S. POPULATION

By

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ABSTRACT

CHOLESTEROL, SATURATED FATTY ACID, POLYUNSATURATED FATTY ACID, COPPER, ZINC AND MAGNESIUM INTAKES OF THE U.S. POPULATION

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The potential impact of dietary cholesterol, polyunsaturated fatty acid, saturated fatty acid, linoleic acid, oleic acid, copper, zinc and magnesium on coronary heart disease is of interest. This study examined the intake of these dietary components for individuals in the 1977-78 Nationwide Food Consumption Survey. Analysis was accomplished by conversion of the United States Department of Agriculture Individual Dietary Intake Nutrient Data Bank to the Michigan State University Nutrient Data Bank. An examination of the completeness of nutrient composition data was completed.

This study indicated that cholesterol, saturated fatty acid and polyunsaturated fatty acid intake may be greater than recommended. Copper, zinc and magnesium intakes may be lower than recommended. The intake among seasons for these dietary components showed minimal variation. Individuals in the survey consumed enough foods with composition data available that intake information of these nutrients is meaningful.

To my parents, for their love and support

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INTRODUCTION

A knowledge of dietary practices of the United States population is important because food consumption practices and subsequent nutritional status have a profound influence on health. The current status of the United States diet and changes in diet over time have been examined as a means of relating food intake to health (Schwerin et al., 1981). The potential impact of intake of certain dietary components on heart disease mortality in the United States is of special interest since coronary heart disease (CHD) is the leading cause of death in the United States (U.S. DHEW, 1979b) and diet has been associated with coronary heart disease in humans (McGill, 1979).

The Ten-State Nutrition Survey (1968-70), the Health and Nutrition Examination Survey (HANES I, 1971-74; HANES II, 1976-80) and the Nationwide Food Consumption Survey (NFCS, 1965-66; NFCS 1977-78) have examined the nutrient intakes of individuals across large population areas. However, these investigations included only a limited number of nutrients. Nutrient intakes assessed in one or more of these studies included calories, protein, carbohydrate, fat, calcium, iron, magnesium, phosphorus, vitamin A, thiamin, riboflavin, niacin, vitamin B_6, vitamin B_{12} and ascorbic acid. Nutrients other than these have been implicated in the prevention or cause of coronary heart disease. Several studies on a smaller scale have examined the relationship of CHD to dietary cholesterol, saturated fatty acids, polyunsaturated fatty acids, copper, magnesium and zinc (Klevay, 1975, 1977; Abraham and Carroll, 1979; Punsar and Karvonen, 1979; Skekelle et al., 1981).

The risk of coronary heart disease has been inversely related to intake of polyunsaturated fatty acids and positively related to dietary cholesterol (Skekelle et al., 1981). Dietary saturated fatty acids have been shown to increase serum cholesterol (McGill and Mott, 1976) and are therefore believed to increase the risk of CHD (Kannel et al., 1971). Epidemiological studies support the hypothesis that these dietary components are related to the incidence of CHD (Fidanza, 1972). The American Heart Association (1978) and the Senate Select Committee on Nutrition and Human Needs (Abraham and Carroll, 1979) recommend a daily cholesterol consumption of less than 300 milligrams. They suggest the total calories from fat should be 30-40 percent of total energy intake and saturated fatty acids should account for only ten percent of total energy intake. Food consumption data from the national surveys and individual intake data from several small surveys indicate that the diet in the United States contains more saturated fatty acids and cholesterol than recommended by these two groups. A comprehensive study on individual intakes of saturated fatty acid, polyunsaturated fatty acids and cholesterol which used a large sample representing the United States would provide information on dietary intake of these nutrients.

Copper deficiency, especially in the presence of adequate zinc intake, has been shown to increase serum cholesterol levels in animals (Murthy and Petering, 1976; Klevay, 1979). Dietary copper and zinc have, therefore, been implicated in the development of coronary heart disease. Epidemiological studies have shown a positive correlation between the zinc to copper ratio in the diet and the incidence of CHD (Klevay, 1973). Reduced serum magnesium levels have been found in individuals with CHD (Abraham et al., 1977; Dyckner, 1980). Dietary magnesium deficiency has been suggested as a possible precursor to CHD. Several studies examining the copper, magnesium and zinc intake in small population groups indicate a marginal intake of these dietary components (Walker and Page, 1977; Klevay, 1979; NRC, 1980). The Nationwide Food Consumption Survey (1977-78) found mean magnesium intakes to be between 65 and 89 percent of the RDA for individuals nine years of age and older (USDA, 1980). The significance of this level of magnesium intake has not been established. A study examining the dietary intakes of copper and zinc on a national scale has never been done.

Conversion of the United States Department of Agriculture Individual Dietary Intake Nutrient Data Bank to a data base containing less frequently studied nutrients would enable study of saturated fatty acids, polyunsaturated fatty acids, cholesterol, copper and zinc intakes in a large population group. Information provided would be invaluable in assessing the intake of these nutrients in the United States population and in assessing needed changes in United States dietary patterns.

The major purpose of this investigation was to examine the dietary intake of individuals in the 1977-78 Nationwide Food Consumption Survey for cholesterol, saturated fatty acids, polyunsaturated fatty acids, copper, magnesium and zinc. The specific objectives were: (a) to convert the U.S.D.A. survey data to the M.S.U. Nutrient Data Bank; b) to evaluate the accuracy of the U.S.D.A.-M.S.U. Converted Data Bank; c) to analyze dietary intake data using the U.S.D.A.-M.S.U. Converted Data Bank; d) to determine differences in the intake of the above six dietary components among different age/sex partitions of the population. In addition, the number of food items with missing values for the six dietary components were examined.

REVIEW OF LITERATURE

The study of food consumption patterns has been an important part of revealing dietary component intakes of various population segments. Three studies on a national scale and numerous studies on a smaller scale have examined dietary intakes of the United States population. However, little research on individual intakes of saturated fatty acids, polyunsaturated fatty acids, cholesterol, copper, magnesium and zinc has been completed on a national scale. Much research has dealt with small population groups of various ages, or has concentrated on intake levels of other nutrients. In this literature review, the scope of the large surveys is reported as well as research in the area of dietary intake of saturated fatty acids, polyunsaturated fatty acids, cholesterol, copper, magnesium and zinc. Much attention has been focused on the effect of these six dietary components on coronary heart disease (CHD). Therefore, health concerns of CHD arising from a deficit or excess of these nutrients in the food supply are also reviewed. Of vital concern are the problems with surveys. Literature concerning the use and the problems of dietary surveys is examined.

National Food Consumption Surveys

Food consumption information has been collected by the U.S. Department of Agriculture approximately every ten years since 1936 using a national survey (Rizek, 1980; USDA, 1980; Pao and Mickle, 1981). These surveys have provided information on food used within households. Household food consumption surveys have provided data concerning quantities and costs of foods used by households in a week, i.e. foods brought into the kitchen from stores, gardens and other sources. Thus, these data include, for example, the bone, fat and gristle in meat as purchased. In addition to the household data, individual dietary intake at home and away from home was collected for the first time in the spring 1965-66 nationwide survey and again in all quarters of the 1977-78 Nationwide Food Consumption Survey (NFCS).

Approximately 15,000 households and about 34,000 individuals in these households participated in the 1977-78 NFCS (USDA, 1980). Trained interviewers collected most of the household data by personal interview with the household member most responsible for menu planning and food preparation. The respondent recalled the kind, form and quantity of food used in the household during the previous seven days. After household information was provided, the interviewer obtained from each eligible member present a recall of the previous day's dietary intake. Additionally, each respondent recorded intake the day of the interview and the following day. The one day diet recall plus two day diet record thus provided dietary intake information for three consecutive days (USDA, 1980). Information on dietary intake was collected for all individuals in the spring quarter segment of the survey; all individuals under nineteen years of age but only half of those nineteen years of age and older were asked to provide intake information in the remaining three seasons of the survey (USDA, 1980). The household respondant usually answered for children under twelve years of age and for others unable to answer for themselves. Forms were left to be completed by household members not present at the time of the interview, but expected to return within the next two days.

The dietary information obtained for each individual in the NFCS included: the kind and amount of food eaten, the time the food was eaten, the name of the eating occasion, with whom the food was eaten, where the food was eaten, if supplements were taken and if a special diet was followed (USDA, 1980). Nutritive values of food intakes of individuals were calculated from a nutrient data base constructed from composition values of foods from Agriculture Handbook No. 8 (Watt and Merrill, 1963). Nutrient values of foods not included in Agriculture Handbook No. 8 were obtained from manufacturers' data, were based on similar foods, were calculated from the ingredients, or were based on a composite of known values. Average nutrient intake was calculated for food energy, protein, fat, carbohydrate, calcium, iron, magnesium, phosphorus, vitamin A, thiamin, riboflavin, preformed niacin, vitamin B_6, vitamin B_{12} and ascorbic acid. The average intake of each nutrient was also expressed as a percentage of the 1980 National Research Council Recommended Dietary Allowances (RDA) (NRC, 1980) and per 1000 kilocalories (USDA, 1980).

Results of the survey of 9,620 individuals in the spring quarter 1977-78 NFCS were classified by 22 sex-age groups (USDA, 1980). A summary of the findings is presented in Table 1. Reported intake levels of iron, calcium, magnesium and vitamin B_6 did not meet the RDA for several sex-age groups. Individuals aged nine and over had magnesium intakes between 65 and 89 percent of the RDA. Magnesium intakes exceeded the RDA for children from infancy through two years of age; 3-8 year-olds

Table 1. Intakes of selected nutrients by individuals in the spring quarter 1977-78 NFCS.

Nutrient	Level of Intake
Energy	Averaged below the median 1980 RDA for all sex-age groups
Protein	Met the RDA for all sex-age groups; averaged 16.6 percent of total energy intake
Fat	Averaged 40.3 percent of total energy intake
Carbohydrate	Averaged 42.8 percent of total energy intake
Calcium	Children under 3 years of age and 6 to 8 years met the RDA. Males 19 to 34 years of age met the RDA. Females over 12 years of age met 58-64 percent of the RDA
Iron	Met the RDA for infants most school-age children and men; 1 to 5 year-olds met 53-79 percent of the RDA; females 12 to 50 years of age met 58-64 percent of the RDA
Magnesium	All sex-age groups over 2 years of age met less than 100 percent of the RDA
Phosphorus	Exceeded 90 percent of the RDA for all sex-age groups
Vitamin A	Exceeded 90 percent of the RDA for all sex-age groups
Thiamin	Exceeded 90 percent of the RDA for all sex-age groups
Riboflavin	Met the RDA for all sex-age groups
Niacin	Met the RDA for all sex-age groups
Vitamin B_6	All sex-age groups over 2 years of age met less than 100 percent of the RDA
Vitamin B_{12}	Exceeded 90 percent of the RDA for all sex-age groups
Ascorbic Acid	Met the RDA for all sex-age groups

had intakes slightly below the RDA. Magnesium intakes of women were lower than those of men. Comparisons of the findings with the 1965 NFCS showed energy intakes of all sex-age groups to be lower in the 1977-78 NFCS (USDA, 1980). Average intakes of fat were also less in 1977-78. Average iron intakes of infants and average ascorbic acid intakes were higher in 1977-78 than in 1965.

The Ten-State Nutrition Survey was conducted by the Department of Health, Education and Welfare to survey and identify the prevalence, magnitude and distribution of malnutrition and related health problems in the United States (U.S. DHEW, 1972; Schaefer, 1980; Schwerin et al., 1981). This was the first large survey designed to assess the nutritional status of the American People. The survey included a total of 86,352 persons in 23,864 households (U.S. DHEW, 1972). Texas, Louisiana, Kentucky, Michigan, New York, Massachusetts, Washington, California, West Virginia and South Carolina, plus New York City were selected to provide a population representative of target groups assumed to have a large number of poverty level families and a high prevalence of malnutrition and associated problems. Although the survey was heavily weighted toward people living in low income areas, data on middle and upper-income groups were also obtained (U.S. DHEW, 1972).

The Ten-State Nutrition Survey included collection of general demographic data plus medical, dental and nutritional evaluations (U.S. DHEW, 1972). These included biochemical tests of blood and urine samples, clinical assessments to detect physical signs and symptoms of deviation from a healthy state, x-ray assessments and anthropometric measurements to detect abnormal growth patterns and deviations from standard weight. The dietary component was designed to provide a description of food consumption for households and for selected subgroups of the population.

Respondants from half of the households provided a 24-hour recall of everything consumed by the household at home (U.S. DHEW, 1972). Usage of selected food groups and of some individual food items, food purchasing and food preparation data, and participation in feeding programs were also evaluated. A 24-hour recall of everything consumed the previous day was collected from all persons over 60 years of age in the other half of the households. A respondent from all households provided a 24-hour recall for all infants and children 0-36 months of age. Adolescents 10-16 years of age and pregnant and lactating women in all households also provided a 24-hour recall. Therefore, the Ten-State Nutrition Survey did not include individuals between the ages of 17-59 unless they were pregnant or lactating women. Dietary intake, however, was collected for over 11,000 individuals (U.S. DHEW, 1972).

Individual intake of kilocalories, protein, calcium, iron, vitamin A, ascorbic acid, thiamin, riboflavin and preformed niacin were determined (U.S. DHEW, 1972). The data base used to calculate nutrient values of food consumed was based on Agriculture Handbook No. 8 plus additional foods as needed to comply with those respondents reported they consumed. Mean nutrient intakes were evaluated in relation to dietary standards. The standards were developed by an ad hoc committee after review of the 1968 NRC-RDA and FAO/WHO standards. Calcium, vitamin A and ascorbic acid standards were nearer the FAO/WHO standards and were considerably lower than the RDA. The standards for the remaining nutrients were similar to the RDA (U.S. DHEW, 1972).

Iron intake of infants was below the standard (U.S. DHEW, 1972).

Many infants also had low intakes of kilocalories, vitamin A and ascorbic acid. A large percentage of adolescents had low calcium, iron and vitamin A intakes. Pregnant and lactating women consumed insufficient kilocalories, iron, calcium, protein and vitamin A. Kilocalorie intakes were below the standard in individuals over 60 years of age. Individuals over 60 years of age consumed marginal intakes of protein, iron and vitamin A (U.S. DHEW, 1972).

The results of the Ten-State Nutrition Survey indicated that a significant proportion of the population surveyed was malnourished or was at risk of developing nutritional problems (U.S. DHEW, 1972). The findings indicated that income was a major determinant of nutritional status as nutritional deficiencies were more prevalent in the low-income population areas than in high-income population areas. Other factors such as social, cultural and geographic differences also were related to the nutritional status of a population group (U.S. DHEW, 1972).

The Health and Nutrition Examination Survey (HANES) was established as a continuing national nutrition surveillance system. HANES I, conducted by the National Center for Health Statistics, was the first survey designed to assess nutritional status of a sample representative of the noninstitutionalized United States population over a broad range of ages (Youland and Engle, 1976; U.S. DHEW, 1979a; Murphy, 1980; Schwerin et al., 1981). HANES I, 1971-74, and HANES II, 1976-80, are part of a comprehensive program that not only assesses nutritional status, but monitors changes over time in status of the United States population. HANES includes a general medical examination for indications of nutritional deficiencies. Anthropometric measurements were taken; a medical history was administered and numerous laboratory tests were performed on whole blood, serum, plasma and urine (U.S. DHEW, 1979a). Nutritional status was therefore assessed by biochemical analysis of blood and urine, clinical examinations and anthropometric measurements as well as dietary intake information.

Dietary information was collected in an interview consisting of a food frequency questionnaire covering the preceding three months and a recall of food consumption over the 24-hour period prior to the interview (U.S. DHEW, 1979a). Nutrient composition of food recall data was calculated from a data base adapted from the one used in the Ten-State Nutrition Survey (Youland and Engle, 1976). Dietary standards used were developed with advice from an ad hoc advisory group. The group considered dietary standards from the World Health Organization, the Interdepartmental Committee on Nutrition for National Defense, the NRC-RDA and the standards used in the Ten-State Nutrition Survey (U.S. DHEW, 1979a). HANES provided information on intakes of kilocalories, protein, calcium, iron, vitamin A, ascorbic acid, thiamin, riboflavin and preformed niacin of the sample population (U.S. DHEW, 1979a).

HANES I contained a sample of 20,749 individuals 1-77 years of age in 65 locations between April, 1971 and June, 1974 (U.S. DHEW, 1979a). The sample focused special attention, i.e., over-sampling, on groups of people known to be at greater risk of malnutrition, Therefore, estimates of nutritional intake are able to be made for the total population along with a more detailed analysis of data for certain groups at high risk of malnutrition. Analysis of the data indicated mean dietary intakes of kilocalories and iron were below the standard for much of the population. Standards for thiamin and riboflavin were attained by all sex-age segments. Mean intakes of protein, calcium, vitamin A and ascorbic acid were below the standard in some sex-age segments of the population (U.S. DHEW, 1979a). Analysis of dietary intake as related to assessment of heart disease and cardiovascular risk factors is currently being conducted (Murphy, 1980).

National surveys of food consumption provide a reasonable reflection of what groups of people eat (Hegsted, 1980). These surveys have important uses in estimating nutritional adequacies of diets (Clark, 1974). Results of food consumption surveys can be used for the assessment of nutrition education and feeding programs, establishment of food regulatory policies and estimations of the effects of different levels of enrichment of food (Clark, 1974; Pao,1981; Schwerin et al., 1981).

A more comprehensive analysis of data in terms of who eats what and what is actually eaten will provide invaluable data in regards to certain disease states, such as dental caries, hypertension and coronary heart disease. Many nutrients have been implicated in the development of CHD including dietary cholesterol, saturated fatty acids, polyunsaturated fatty acids, copper, magnesium and zinc (Klevay, 1975; McGill and Mott, 1976; Punsar and Karvonen, 1979; Allen and Klevay, 1980).

Relationship of Saturated Fatty Acids, Polyunsaturated Fatty Acids and Cholesterol to Coronary Heart Disease

Coronary Heart Disease is the leading cause of death in the United States. Despite a decline since 1960, CHD still accounts for over one third of all deaths in the United States (U.S. DHEW, 1979b). As early as 1908, dietary cholesterol was examined as an etiological agent for atherosclerosis in experimental animals (McGill, 1979). The idea that diet was associated with atherosclerosis and consequently CHD in humans developed in succeeding years on the basis of epidemiological evidence, animal studies and clinical trials (McGill, 1979).

The Framingham Study was initiated in 1949. This study followed over 5,000 healthy individuals for more than twenty years to detect the occurrence of CHD. Several characteristics such as elevated blood pressure, obesity, cigarette smoking and diabetes mellitus were associated with future risk of developing CHD. The principal risk factor identified was elevated serum cholesterol concentration (Kannel et al., 1971). The Pooling Project Research Group (1978) combined Albany Civil Servant, Chicago Peoples Gas Company, Chicago Western Electric Company, Framingham and Tecumseh studies to provide data for 12,381 men in the United States over a period of ten years. Serum cholesterol, smoking and obesity were established as three major risk factors for the development of CHD. They also found the risk to be proportional to cholesterol level, meaning that the risk of CHD increased with increasing serum cholesterol. Dietary factors associated with serum cholesterol have been numerous. Saturated fatty acids, polyunsaturated fatty acids and cholesterol are three major dietary components that have been shown to affect serum cholesterol concentrations (McGill and Mott, 1976).

Skekelle et al. (1981) followed 1900 participants of the Western Electric Study to investigate the association of dietary saturated fatty acids, polyunsaturated fatty acids and cholesterol with serum cholesterol levels and with the risk of death from CHD. Dietary information had been obtained from males 40-55 years of age in 1957 and again in 1958 by two nutritionists using standardized interviews and questionnaires. Measurements of serum cholesterol and of body weight were also made. Vital status was determined for the participants at the twentieth anniversary of the initial examination. The cause of death for all decedents was determined from death certificates (Skekelle et al., 1981).

Dietary cholesterol and saturated fatty acid intakes were positively related to serum cholesterol; intake of polyunsaturated fatty acids was negatively correlated to serum cholesterol but the correlation was not statistically significant (Skekelle et al., 1981). The risk of CHD was inversely related to intake of polyunsaturated fatty acids and positively related to dietary cholesterol. The amount of saturated fatty acids in the diet was not significantly associated with the risk of death from CHD. Since correlation with dietary parameters and serum cholesterol were small, but risk of CHD was associated with dietary cholesterol, the idea that dietary cholesterol may be related to CHD by mechanisms other than increasing serum cholesterol was suggested. The authors concluded that lipid composition of the diet affects serum cholesterol concentration and the risk of coronary death in middle-aged American men.

Epidemiological studies have supported the hypothesis that differences in the incidence of CHD are related to differences in diet. Tillotson et al., (1973) examined Japanese men living in Japan, Hawaii and California. As the diet of these men changed from a low fat diet to a diet containing more animal protein, simple carbohydrate and saturated fat, the incidence of CHD increased. Kornitzer et al., (1979) found that people living in regions of Belgium where more saturated fats and cholesterol were consumed had higher serum cholesterol levels and a greater incidence of CHD. Fidanza (1972) reviewed epidemiological studies and concluded that dietary fats play a definite role in the etiology of CHD.

Surveys repeated on the same individual have shown that intra-individual variation in the intake of a nutrient is similar in magnitude to the variation among individuals (Fidanza, 1972; Liu et al., 1978). This means that within a fairly homogeneous population it is not possible to characterize with any certainty individuals with respect to diet. Liu et al., (1978) attributes low-order or zero correlations between dietary lipid intake of the individual and his serum cholesterol to insufficient number of measurements and the fact that serum cholesterol is influenced by many factors other than diet. According to Liu et al., (1978) it is difficult, if not impossible, to obtain dietary data on free-living people because of the difficulty of obtaining representative data and because being measured influences dietary behavior. Also, all dietary factors that influence serum cholesterol cannot be separated. Although a relationship between an individual's diet and serum cholesterol has not been shown, some population groups have shown significant correlation between diet and serum cholesterol (Liu et al., 1978).

Lewis (1980) cautioned that since the evidence that modest changes in fat and cholesterol intake reduce mortality from CHD is incomplete, the case must not be overstated. However, rigorous proof may never be attained as CHD is influenced by many factors. Therefore, combinations of risk factors are important when looking at preventative changes to obtain optimum health.

Complex etiology and intra-individual difference have been major reasons for several authors to question the link between dietary fat and cholesterol with CHD (Mann, 1977; Ahrens and Conner, 1979; Werko, 1979). Most (Glueck, 1979; Keys, 1980; Stamler, 1980; Walker, 1980) propound that the effect of dietary saturated fatty acids, polyunsaturated fatty acids and cholesterol on serum cholesterol levels in humans has been well established. Although many researchers have failed to find significant correlations in individual persons, decreasing the proportion of calories obtained from saturated fatty acids, increasing the proportion from polyunsaturated fatty acids and decreasing the amount of dietary cholesterol per 1000 kilocalories appears to lower by predictable amounts the average serum cholesterol in groups of individuals (Skekelle et al., 1981). Preliminary results of reducing dietary cholesterol and saturated fat in high risk men have been promising (Burr et al., 1979).

The American Heart Association (1978) has advocated a single set of dietary guidelines for all Americans. It recommends reducing the daily consumption of cholesterol to less than 300 milligrams and total calories from fat to under 30 percent. The American Medical Association (1972), the Committee on Dietary Allowances (NRC, 1980) and a task force of the American Society of Clinical Nutrition (Ahrens and Conner, 1979) do not believe it is desirable to make a blanket recommendation for dietary change for the entire population. They do agree that guidelines can be offered for individuals in the high risk category for CHD.

It is evident that diet is associated with CHD; however, the extent to which diet influences the development of coronary heart disease in man is questionable. It appears that any substantial reduction in serum cholesterol concentration must be accompanied by changes in a variety of dietary components. The feasibility and benefit of maintaining long term dietary changes have yet to be seen.

Saturated Fatty Acid, Polyunsaturated Fatty Acid and Cholesterol Content of Diets

National food consumption data and several intake surveys have provided information on fat and cholesterol content of the United States diet. The results as well as a description of the sample of some of these surveys are summarized in Table 2.

Page and Marston (1979) and Rizek (1981) reported that changes in food consumption since 1910 have affected fat, fatty acid and cholesterol content of the American diet. There has been a 25 percent increase in total fat consumed in the United States during this century (Page and Marston, 1979). This increase was attributable to increased use of vegetable fats such as salad and cooking oils. Animal fats, however, still contributed the major proportion of total fat.

Although the available food supply showed an increase in fat available, preliminary results from the 1977-78 NFCS indicate average fat intakes have decreased considerably between Spring 1965 and Spring 1977. The reason for this decrease is not known, but the data will be analyzed further (Pao, 1980; Rizek, 1981). Hegsted (1980) suggested that this may be related to trimming fat from meat at the table. Food consumption statistics of the United States Department of Agriculture indicate that total saturated fatty acid consumption had increased by about 12 percent since the early 1900's with no further increase since 1967 (Page and Marston, 1979). Cholesterol content of the average diet in the United States is currently the same as early in the century--at about 500 milligrams. During the late 1940's and the late 1950's, cholesterol intakes were higher than early in the century or in 1977 (Page and Marston, 1979; Rizek, 1981).

Table 2. Daily saturated fatty acids, polyunsaturated fatty acids and cholesterol intakes.

Population	Method	Sample	Intakes					Reference
			Saturated Fatty Acids		Polyunsaturated Fatty Acids		Cholesterol	
			g/day	% Kcal	g/day	% Kcal	mg/day	
The Nutrition Program for Older Americans	7-day food intake records	22 men 69 women					422 ± 21.3^b 261 ± 12.1^b	Clarke et al., 1981
Three semi-rural Northern California Communities	Diet history questionnaire	79 men & women	32.5^a		8.2^a		450.9^a	Fortmann et al., 1981
The United States	Food available for consumption in 1979			34			500^a	Rizek, 1981
Men of Japaness Descent living in Hawaii	24-hour recall & questionnaire	6774 men	59.8 ± 0.4^b				548.6 ± 3.8^b	Nomura et al., 1978
Residents of Fairfield County, Connecticutt	7-day diet history	7 men 14 women					386^a	Dorfman et al., 1976
Residents of Tecumseh, Michigan	24-hour recall	957 men 1082 women	53^a 33^c	16.5 16.1	26^a 17^a	8.2 8.6	551^a 327^a	Nichols et al., 1976
Residents of the Western Cape, Africa	7-day food intake records	44 men	41.1 ± 11.5^c	14.5	12.2 ± 5.9^c	4.3	565.8 ± 171.5^c	Rossouw et al., 1974
Pima Indians in Arizona	24-hour diet history	277 women	55.9 ± 1.1^b	15.9	19.7 ± 0.4^b	5.6	489.2 ± 11.6^b	Reid et al., 1971

[a] mean value

[b] mean value ± S.E.

c mean value + S.D.

Dietary data obtained from HANES I were used to examine the impact of diet on the decline in CHD (Abraham and Carroll, 1979). Data showed that males and females in every age group of the HANES I study obtained 36 percent or more of their total energy intake from fat. Saturated fatty acids accounted for 12-14 percent of total kilocalories. The majority of the males and more than one third of the females had dietary cholesterol intakes of 300 milligrams or more per day. Although limited data on the lipid composition of foods in HANES I were available, HANES I and USDA food consumption surveys indicated that diets in the United States contained a higher level of saturated fatty acids and cholesterol than recommended by the Senate Select Committee on Nutrition and Human Needs in the dietary goals (Abraham and Carroll, 1979).

Several investigators (Reid et al., 1971; Dorfman et al., 1976; Nomura et al., 1978) examined fatty acid and/or cholesterol content of the diet. Methods included questionnaires ascertaining frequency of food consumption and diet histories. Mean cholesterol intakes varied from 386 milligrams to 548 milligrams per day in adults. Reid et al., (1971) and Nomura et al., (1978) reported a saturated fatty acid intake of 55.9 milligrams per day and 59.8 milligrams per day, respectively. Rossouw et al., (1974) studied white males from the Western Cape of South Africa. A mean saturated fatty acid intake of 41.1 milligrams per day, polyunsaturated fatty acid intake of 12.2 milligrams per day and cholesterol intake of 566 milligrams per day were found using seven-day food records of 44 subjects. The subjects were middle aged and consumed a typical Western type diet. Fortmann et al., (1981) found a mean saturated fatty acid intake of 32.5 milligrams per day, mean polyunsaturated fatty acid intake of 8.2 milligrams per day and a mean cholesterol intake of 450.9 milligrams per day in male and female subjects from three rural California communities.

Sex differences in cholesterol intake have been reported. Clarke et al., (1981) studied nutrient intakes of participants of the Nutrition Program for Older Americans in Vermont. A seven-day food intake record for each participant showed an average daily intake of cholesterol of 261 milligrams for females and 422 milligrams for males. Nichols et al., (1976) used a 24-hour diet interview and reported daily cholesterol intakes of 551 milligrams for males and 327 milligrams for females. Saturated fatty acid and polyunsaturated fatty acid content of the diet was higher for men than for women, but the percent of kilocalories provided by each of these nutrients was similar in men and women.

Morrison et al. (1980) studied nutrient intakes in children 6-19 years of age. Saturated fatty acid and cholesterol intakes increased with age in males; the increase in intake with age of these two dietary components was not as significant in females. Laskarzewski et al., (1980) examined cholesterol, saturated fatty acid and polyunsaturated fatty acid intake of parents and children in 294 families from the Princeton school district. The intakes of saturated fatty acids and polyunsaturated fatty acids, but not cholesterol, of children were significantly and positively correlated with those of their parents. The authors suggested that close parent-child nutrient interrelationships may contribute to clustering of CHD in families.

It is evident upon examination of data concerning food consumption patterns that the amount and the kind of fat in the United States diet has changed during the past century. The effects of these changes on health and the benefits of altering our present eating patterns have yet to be shown. Many propose that a modification of eating habits is warranted (The American Heart Association, 1978; Ahrens and Conner, 1979). Whether modification should be encouraged for all the population and whether the severity of the modification should be similar for all is uncertain and depends largely on current eating habits. A study examining individual intakes of a large population would aid nutritionists in assessing current dietary status and therefore aid in making recommendations for dietary changes.

Relationship of Copper and Zinc to Coronary Heart Disease

The nutritional status and metabolism of copper and/or zinc have been implicated in coronary heart disease via alterations in serum cholesterol (Klevay, 1973; Klevay, 1975; Klevay et al., 1975; Murthy and Petering, 1976; Klevay, 1977; Petering et al., 1977; Klevay, 1979; Allen and Klevay, 1980). Rats receiving zinc to copper in a ratio of 40:1 had significantly higher plasma cholesterol levels than control rats receiving a 5:1 ratio (Klevay, 1973). The increased plasma cholesterol concentration could presumably result in increased risk of CHD.

Klevay et al. (1975) altered the dietary intake of copper of a 29 year old healthy male in a metabolic ward. The subject's plasma cholesterol increased linearly from 202 to 234 mg/dl during 105 days on a copper deficient diet. His plasma cholesterol decreased to 213 mg/dl after fourteen days on the same diet supplemented with 4 milligrams copper. Alterations in the electrocardiogram (ECG) late during the period of the copper deficient diet were not seen after the diet was supplemented with copper.

Allen and Klevay (1980) fed male rats a cholesterol-free, copper deficient diet or the diet plus 5.0 micrograms copper per gram of diet for 48 days. The copper deficient diet produced a 104 percent increase in plasma cholesterol concentration and a 252 percent increase in plasma triglyceride concentration. The distribution of cholesterol among the lipoproteins in plasma was altered by the copper deficient diet; copper deficiency produced a much greater increase in cholesterol associated with low density lipoproteins than with high density lipoproteins. Therefore, copper deficiency in rats may be associated with risk of CHD not only by increasing plasma cholesterol concentration (Klevay, 1973), but by increasing low density lipoprotein (LDL) bound cholesterol (Allen and Klevay, 1980). Increased risk of CHD is associated with elevations of LDL bound cholesterol and a reduced risk of CHD is associated with high density lipoprotein (HDL) bound cholesterol (Allen and Klevay, 1980). Hearts of the copper deficient rats were hypertrophied with large areas of hemorrhage, inflammation and focal necrosis suggesting that the copper deficiency was associated with the atherosclerotic process (Allen and Klevay, 1978).

Fischer et al. (1980) studied cholesterol metabolism in male rats using diets with a marginal or adequate copper level together with a marginal, adequate or high zinc level. The diets were designed so that the ranges of zinc and copper content would be comparable to those likely to occur in a normal North American mixed diet. No significant changes in serum cholesterol were observed in any treatment group. The authors concluded that copper and zinc at levels likely to occur in a normal mixed diet have no significant effect on cholesterol metabolism. Excessive intakes of zinc may aggravate marginal copper deficiency by competing with copper for absorption (Fischer et al., 1980; NRC, 1980).

Adequate levels of copper in the diet appeared to be sufficient to overcome any inhibitory effect of zinc on copper absorption (Fischer et al., 1980).

Caster and Doster (1979) fed male rats diets containing zinc to copper ratios in the range of 2 to 220. Their conclusions were similar to those of Fischer et al., (1980) and contrary to those of Klevay (1973). They found no correlation between zinc to copper ratio in the diet and plasma cholesterol concentration. Thus, the results of animal studies are inconclusive and not in agreement. This could be partially due to the fact that all basic diets were not the same.

Murthy and Petering (1976) found serum cholesterol to be inversely related to dietary copper in male rats. There was no significant relationship of dietary zinc to serum cholesterol. Since serum cholesterol was correlated with dietary copper but not with dietary zinc, the dietary zinc to dietary copper ratio showed a positive correlation with serum cholesterol. Petering et al., (1977) also found a highly significant inverse relationship between dietary copper and serum cholesterol in male rats. Dietary zinc modified the relationship, but was not determinative of serum cholesterol.

Klevay (1973, 1977) pointed out that other hypotheses of the development of CHD, such as increased sugar and fat intake, decreased fiber intake and decreased physical activity, may be related to copper and zinc metabolism. Increased consumption of sucrose, decreased consumption of vegetable fiber, consumption of soft water, lack of exercise and increased fat intakes can lead to an increased zinc to copper ratio in the body; all have been hypothesized to increase risk of CHD (Klevay, 1973, Klevay, 1977).

Copper deficiency, especially in the presence of adequate or high zinc levels, increases serum cholesterol. Whether the levels of zinc and copper intake in the American diet are significant in the etiology of CHD have yet to be determined.

Relationship of Magnesium to Coronary Heart Disease

Magnesium deficiency states have been associated with an increased tendency to cardiac arrhythmias in humans (Dyckner, 1980). Abraham et al., (1977) and Dyckner (1980) found that patients with acute myocardial infarction had reduced serum magnesium levels immediately following the infarction. Serum magnesium levels returned to normal values within twelve days (Abraham et al., 1977). The reason for the reduced level after myocardial infarction is unknown.

Dyckner (1980) states that glycosuria and thiazide diuretic therapy result in increased urinary magnesium losses and depressed serum magnesium levels. Dietary magnesium may therefore be of particular importance in diabetics or in hypertensive patients treated with thiazide diuretics.

Hardness of water consumed has been proposed as a factor associated with the development of cardiovascular disease. Punsar and Karvonen (1979) reported an association between coronary heart disease and magnesium content of drinking water. Comstock (1979) reviewed epidemiological evidence and stated that hard water may be associated with a decreased incidence of CHD, but its existence is far from certain. Sharrett (1981) reviewed previous research and could draw no conclusive evidence between water hardness and cardiovascular disease. It is possible that enough magnesium is present in some hard waters to prevent borderline magnesium deficiency in some persons (Comstock, 1979; Sharrett, 1981).

More research on different sources of human magnesium intake, on the human magnesium requirement, and on magnesium deficiency as a possible precursor to CHD was recommended before drawing conclusions regarding the relationship between magnesium deficiency and CHD (Sharrett, 1981).

Few animal studies have investigated the relationship of magnesium and CHD. Neal and Neal (1962) reported that rabbits on distilled water developed more atherosclerosis than those on hard water and that rabbits given magnesium sulfate developed no atherosclerosis at all. However, information on methods were not reported exactly and the results were only in general terms.

Copper, Zinc, and Magnesium Content of Diets

Several researchers have examined copper, magnesium and zinc content of foods and of diets. The results as well as a description of the sample of some of these surveys are summarized in Table 3.

Freeland et al. (1976) obtained a 24-hour dietary recall from presumeably affluent patients of a private dentist. Zinc and copper intakes were calculated and averaged 12 milligrams of zinc and 2 milligrams of copper per day. Guthrie and Robinson (1977) collected a duplicate of all meals consumed for periods of 3-21 days by 23 New Zealand women in a free living situation. Twelve of the subjects lived in a residential hall for students, while eleven lived in their own home or apartment. Analyzed average daily intake of zinc was 10 milligrams and of copper was 1.5 milligrams when the diet did not contain liver or

Table 3. Daily copper, zinc and magnesium intakes.

Population	Method	Sample	Intakes				Reference
			Copper mg/day	Zinc mg/day	Zinc to Copper Ratio	Magnesium mg/day	
Volunteer vegetarians from Austin, Texas	24-hour diet recall and food pattern questionnaire	57 lacto-ovo 8 vegans	3.9±4^{c} 3.7±3^{c}	11.2±7^{c} 7.9±8^{c}	2.9 2.1		Freeland-Graves et al., 1980
Teen-age males	Foods from USDA "Market basket"	Analyzed 2 week samples of foods		18.7^{a}			Harland et al., 1980
Hospital diets	Analyzed one day diets	5 diets	.76±0.11^{c}	9.4±1.4^{c}	12.4		Klevay et al., 1979
Low Income Pregnant Women of Mexican Descent from Los Angeles County	24-hour diet recall	344-1st & 2nd trimester 279-3rd trimester	9.4±3.8^{c} 10.0±4.3^{c}				Hunt et al., 1979
230 Military Personnel	Diet diaries for two weeks	Selected Individ.	1.7^{a}	20.3^{a}	11.9		Milne et al., 1978
New Zealand Women	Analyzed 179 duplicate diets	23 women aged 19-50 years	1.5±0.8^{c,d} 7.6±3.3^{c,e}	10.0±4.1^{a}	6.7^{d} 1.3^{e}		Guthrie and Robinson, 1977
University of Delaware Academic Community	24-hour diet recall	12 males volunteers 7 female volunteers		15.8±7.4^{c} 8.9±5.9^{c}			Haeflein and Rasmussen, 1977
50 colleges in 31 states	Analyzed duplicate diets	84 meals per college	3.37±1.68^{c}	11.03±2.28^{c}	3.3	251±30^{c}	Walker and Page, 1977
	Analyzed duplicate diets for 6 days	22 subjects age 14-64	1.01±0.087	8.63±0.52	8.5		Wolf et al., 1977
VA Hospital, Washington, DC	Analyzed hospital trays	7 days	0.90±.80	14.6±4.5^{c}	16.2		Brown et al., 1976 Brown et al., 1977
Patients of a private dentist	24-hour diet recall	80 volunteers	2.0^{a}	12.0^{a}	6.0		Freeland et al., 1976
Girls and women in Evanston, Illinois	Analyzed duplicate of one days diet	15 high school girls 33 college women	12.0±5.0^{c} 13.8±7.3^{c}				White, 1976

^{a} mean value ^{b} mean value ± S.E. ^{c} mean value ± S.D. ^{d} with liver ^{e} without liver

7.6 milligrams if the diet did contain liver. The recommended dietary allowance (RDA) for zinc is 15 milligrams in adults (NRC, 1980). Copper has no RDA, but 2.0-3.0 milligrams is an estimated safe and adequate daily dietary inake (NRC, 1980). Both Freeland et al., (1976) and Guthrie and Robinson (1977) found copper and zinc intakes to be marginal unless liver was consumed. However,the zinc to copper ratio was less than 7 as both zinc and copper intakes were low.

Freeland-Graves et al. (1980) calculated trace mineral content of diets consumed by vegetarians. Vegetarians, especially vegans, had low intakes of dietary zinc. Copper intake, however, exceeded the estimated safe and adequate daily dietary intake, resulting in low zinc to copper ratios.

Meals for a day of general, soft, low sodium, low calorie and pureed diets from one hospital were anlyzed for copper and zinc (Klevay et al., 1979). The total copper and zinc content of dietary composites for one day was less than the estimated safe and adequate amounts for copper and less than the NRC-RDA for zinc. The low amounts of copper and zinc could not be attributed to unusual food given on special diets as no special food items were used. The energy level of the diets was low, but the copper and zinc content was much lower than would have been anticipated relative to energy content. Therefore, not only were the mean copper and zinc content of the diets low, but the nutrient density of copper and zinc, or the copper and zinc per kilocalorie was low.

Copper content of diets has not been a concern based on the belief that most diets provided 2-5 milligrams per day (Klevay et al., 1980). Recent surveys of dietary intakes, however, have shown lower intakes of copper (Brown et al., 1977; Walker and Page, 1977; Wolf et al., 1977;

Milne et al., 1978). Klevay et al., (1980) calculated copper content of diets received by patients in a clinical research center using tables of food composition as well as analyzing the same diets by atomic absorption spectrometry. Mean copper content was calculated to be 3.6 milligrams and analyzed as 1.27 milligrams. Comparisons of the copper analysis of foods indicate that foods contain less copper now than they did in 1942 (Klevay, 1979). The difference between the older and the more recent data may represent a decrease in copper content of foods or differences in analytical methology. It is not known which is the case (NRC, 1980). More research on copper content of foods as well as copper requirements and factors affecting availability and loss is needed.

Sandstead (1973) expressed concern with the adequacy of zinc content in the American diet. Some women, teenagers, pregnant women and institutionalized individuals, in particular, have been identified as having marginal to deficient intakes of zinc (Sandstead, 1973). This may cause adverse effects, especially if these people experience additional stress that can occur with disease or trauma.

Milne et al. (1978) found calculated zinc intakes of military men to be adequate. The average intake was 20.3 milligrams per day. These subjects in general consumed more calories and more foods of animal origin than the individuals pinpointed by Sandstead to have marginal intake. Wolf et al., (1977) reported analyzed daily zinc intakes of only 8.63 milligrams in 22 subjects of mixed age and sex studied over a period of six days.

Hunt et al. (1979) calculated zinc intakes of low income pregnant women of Mexican descent from 24-hour dietary recalls. Mean daily intakes were estimated to be 9.4 milligrams during the first two trimesters and 10.0 milligrams during the third trimester. Protein and zinc contents of the diets were highly correlated. Diets that provided 90-100 grams of protein provided a mean of 13.6 milligrams of zinc, or about 67 percent of the NRC-RDA for pregnant women (Hunt et al., 1979).

Haeflein and Rasmussen (1977) calculated dietary zinc intakes from a 24-hour dietary recall for 12 male and seven female adult volunteers from the academic community at the University of Delaware. The mean dietary zinc intake was 13.3 milligrams and also showed a positive correlation to mean dietary energy and protein intakes.

White (1976) analyzed zinc content of duplicate diets consumed by high school girls and college women. The mean zinc intakes were 12.0 milligrams for high school girls and 13.8 milligrams for college women. Harland et al. (1980) analyzed market baskets consisting of approximately 117 food items from four geographic regions selected by teen-age males. The variety of foods in each market basket reflected a two week diet. The mineral analysis of the total 2-week market basket was divided to get a one day average diet. The average daily zinc intake was 13.3 milligrams when 2800 kilocalories were consumed, but only 4.7 milligrams when 1000 kilocalories were consumed. It was concluded that special attention must be given to select foods that are a good source of zinc when caloric intake is low.

Laboratory analysis of school lunches from 300 schools showed that lunches contained an average of 93 milligrams magnesium (Murphy et al., (1970). This failed to provide one third, or 100 milligrams, of the RDA. Walker and Page (1977) collected and analyzed breakfast, lunch and dinner meals served at 52 colleges. An average daily diet contained 251 milligrams of magnesium, falling short of the NRC-RDA of 350 milligrams for males and of 300 milligrams for females.

Ohlson and Harper (1976) examined the nutrient intake of 158 women over a 37 year period. Nutrient intake was calculated from a 24-hour dietary recall taken at four different times during the study. Only 28 percent of the women had daily intakes of magnesium as high as 200 milligrams, while only two subjects ingested as much as 300 milligrams of magnesium.

The Nationwide Food Consumption Survey (USDA, 1980) reported intakes of magnesium equaling between 65 and 89 percent of the NRC-RDA for adults. Intakes for women averaged slightly above 200 milligrams, whereas intakes of men were closer to 300 milligrams.

Copper, zinc, and magnesium intakes may be marginal in some people. More research is needed on the dietary intakes of these minerals, on content of these minerals in food and on bioavailability and the effects of marginal or deficient intakes on health.

Problems of Surveys

The quality of data regarding nutrient intakes can be no better than the quality of the methods used to obtain the data. Three major areas must be examined when discussing the limitations of dietary surveys. First, methods of collecting data cover only a sample of the diets for a relatively short time for the persons in a survey. Therefore, it is virtually impossible to ascertain whether the findings of a survey properly represent the dietary habits of the population surveyed (Keys, 1979). Secondly, dietary surveys measure only what people eat, but aim to provide data for estimations of nutritional deficiencies. Intraindividual variability in daily requirement, as well as the fact that recommended allowances are developed with a margin of safety, question the interpretation of dietary surveys in regards to nutritional adequacy of diet (Keys, 1979). Finally, tables of food composition used to calculate the nutrient content of foods consumed in surveys are at best, good estimates of averages (Keys, 1979).

Current knowledge of nutrient composition of food is not adequate (Stewart, 1981). There is substantial data on lipid composition of dairy products, eggs and egg products, fish, beef, nuts and seeds, and poultry. There is inadequate data available on lipid composition of baked products, fast foods, lamb, sausage, soups and snack foods. There exists substantial magnesium data for dairy products, fish, legumes, beef, poultry, soups and frozen and canned vegetables; data for baked products, eggs and egg products, fast foods, fats, fruits, frozen dinners, lamb, pork, nuts and seeds is inadequate. Copper and zinc data are considered substantial for dairy products, fish, beef, poultry and frozen and canned vegetables. Few other foods have been analyzed for content of copper and zinc (Stewart, 1981).

Gaps in our knowledge of nutrient composition may be attributed to the lack of accurate, precise and inexpensive methods for analysis of many nutrients. Trained analysts using precise analytical techniques can acquire reliable data of nutrient content in foods. Historically, nutrients identified with health problems have been given priority for being analyzed. Data for cholesterol, saturated fatty acids, polyunsaturated fatty acids and magnesium are therefore available for a considerable number of foods. Interest in copper and zinc has recently increased, but few foods have copper and zinc content data available (Stewart, 1981).

Food distribution systems have changed considerably in the past two decades. Marketing of precooked items has become common. There has been an increase in volume and type of convenience foods. Many new products are on the market. Cooking methods, such as microwave cookery, dehydration of foods and holding foods on steam tables, may alter nutrient composition of food. Knowledge of food composition of items always falls behind their use (Hertzler and Hoover, 1977; Hegsted, 1980; Stewart, 1981).

Calculating nutrient content of diets involves using tables of food composition, except in the less common cases where duplicates of the food in meals or diets are analyzed chemically. Although tables of food composition are extremely useful, they do have limitations. Diets assessed for zinc content via food composition tables compared favorably with assayed values of the same diets (Brown et al., 1976; White, 1976; Haeflein and Rasmussen, 1977). Assayed diets were within ten percent of the calculated diets, except when vegetarian diets were analyzed and the zinc content of calculated diets was over-estimated by 35 percent (Brown et al., 1976). Zinc content of vegetarian diets is low due to the lack of animal proteins which have a relatively high zinc concentration. Cereal grains contain phytate which chelates with zinc, thus decreasing intestinal absorption of zinc. Vegetarian diets may therefore be low in assayable zinc and even lower in biologically available zinc (Brown et al., 1976). The over estimation of zinc content of calculated diets was probably due to estimation of zinc in foods such as legumes, nuts and seeds that were not included in the tables.

Klevay et al. (1980) found calculated copper values to be greater than analyzed values of duplicate diets. They felt the difference was due to inclusion of older copper data and an apparent decrease in the copper content of human foods. White et al., (1981) found cholesterol content to be higher when calculated than when the diet was chemically analyzed.

The availability of minerals in various diets and interaction with other food components hinder the assessment of the dietary adequacy of trace elements (Sandstead, 1973). Substances including other nutrients within a food may complex with the nutrient studied, thus reducing the amount of nutrient available for absorption. The estimated amount of a nutrient present in a food may be erroneous if this were not considered in analysis. Nutrient intakes calculated from tables of food composition are derived by adding the content of individual foods and thus seldom consider the interactions of other nutrients which may enhance or inhibit absorption. Other limitations of food composition tables include variability of food composition (Keys, 1979). Nutrient composition of food varies with time of year, quality of food, plant variety, cooking and storage methods. Variations in the composition of food occur between geographical regions of the United States and between countries (Keys, 1979).

The adequacy of nutrient intake for the United States population is often evaluated using the NRC-RDA. The NRC-RDA were not set up for this purpose and it is questioned if these are the most appropriate standards for it (Harper, 1981). The National Research Council Recommended Daily Allowances (NRC, 1980) are set at levels to insure against any nutrient deficiency in most healthy persons. The intakes recommended are, in general, higher than the average requirements. Dietary excess has only recently received attention. Other methods used to evaluate nutritional adequacy of diets are also based on the NRC-RDA. Nutrient density, or the ratio of the percent of the RDA of a nutrient found in a food to the percent of kilocalorie standard provided by the food has been used to ascertain quality of the diet (Hansen et al., 1979). Although this method is extremely useful in determining food sources of nutrients and in educating individuals about good eating habits, its use in assessing diet quality is limited. There is no method that has been proven to be better than others and therefore, several methods are used (Johnson and Schwinn, 1978; Crocetti and Guthrie, 1981a; Fischer and Morgan, 1981).

Day to day variation in food intake can be considerable. Garn et al. (1976) stated that the larger the number of days included in an average, the closer the average approximated a longer term value. White et al., (1981) found that a minimum of nine daily records was required to estimate cholesterol intake within ten percent of a twenty day mean when the individuals keeping intake records followed a low cholesterol diet. Garn et al., (1976) and Hunt et al. (1979) have reported that the average of one-day intakes may not differ significantly from the average of seven-day intakes, given a sufficient sample size. Gersovitz et al., (1978) suggested that both the 24-hour dietary recall and the seven-day food record provide equally accurate estimates of mean intake in a group of 65 subjects. Beaton et al., (1979) reported that 24-hour dietary recalls provide estimates of group averages that are comparable to those obtained with more cumbersome techniques, even though the 24-hour dietary recall may be vulnerable to over-reported intakes below the mean and under-reported intakes above the mean. All proponents for the 24-hour dietary recall method recognize that the diet of a single day may not represent the average diet of an individual, but when the method is applied to many persons, the averages derived from 24-hour dietary recalls may properly depict the group (Keys, 1979). It has been suggested that one 24-hour dietary recall is suitable for obtaining the mean of groups of 50 persons or more if a 10 percent error is acceptable (Keys, 1979).

Quantitative measurements of food eaten are difficult to ascertain as most cooking and serving is done with little or no measurement. Use of scales, measuring cups and food models help, but surveys are still subject to considerable uncertainty (Keys, 1979). Keeping a food record may alter the subjects normal food patterns (Gersovitz et al., 1978; Liu et al., 1978; Dennis et al., 1980). Seasonal variation may also alter results. Crocetti and Guthrie (1981b) found that foods consumed during the year varied, but nutrient composition of the diet was similar throughout the year. Keys (1979) stated that seasonal variation in the diet deserves much more attention than it generally receives. Persons naturally have seasonal variation in physical activity with considerable variation in diet as well as changes in the foods available for consumption.

Sex of the respondant, the day of the week, and coding or clerical discrepancies of food intake records may contribute to variance (Beaton et al., 1979). These problems engendered in collecting accurate data in a cost-effective manner have long been recognized. The amount of nutrient per 1000 kilocalories, or nutrient concentration, is not affected by sex, so looking at nutrient concentration is a helpful tool when looking at population groups, if one is not able to examine males and females separately (Beaton et al., 1979). Reliability is improved if several days recall are taken for the same individual. This is more valuable than merely increasing sample size when attempting to account for intraindividual variability (Beaton et al., 1979). Reliability means essentially repeatability; but a high degree of reliability does not necessarily guarantee accuracy. Absolute validity of dietary survey data can rarely be attained, but need not seriously limit the practical value of dietary surveys (Beaton et al., 1979).

The examination of the relationship of diet to the incidence of a slowly developing pathological condition, such as CHD, would be much more useful if everyone adhered to a lifelong pattern of eating. However, very little is known about long term individual variability of diet. Often studies have examined eating pattern of a target group, such as middle-aged men, when examining relationships between dietary patterns and CHD. However, atherogenesis begins in youth and dietary patterns early in life may have most effect on development of CHD. Findings of a contemporary diet survey may therefore, be of most interest several decades in the future when compared to health status.

METHODS AND MATERIALS

Three day records for individuals of the U.S. population completed in the 1977-78 Nationwide Food Consumption Survey were the source of food intake information for this investigation. Calculations of nutrients were done using the Michigan State University Nutrient Data Bank. In the following pages, an explanation of the conversions of the USDA Nutrient Data Bank to the MSU Nutrient Data Bank, as well as the calculations utilized to complete the analyses of the data are presented.

Sample

The data used in this investigation were collected in the 1977-78 Nationwide Food Consumption Survey (NFCS). Approximately 34,000 individuals participated; the individuals surveyed were from a random sample of U.S. households. All individuals in households selected provided dietary intake information in the spring quarter segment of the survey; all household members under nineteen years of age but only half of those nineteen years of age and older were asked to provide intake information in the remaining three seasons of the survey (USDA, 1980). A comparison of the mean intakes for each season was done to establish any significance of the smaller sampling of individuals 19 years of age and over between spring quarter and the other three quarters. The variation in household members interviewed resulted in different proportions of children and adults in the spring quarter than in the other three quarters.

The USDA provided contractees with a set of weights recommended for assignment to various strata of individual respondants (Slonim, 1982). Weighting is a means of correcting non-representativeness in a sample population. The weighted values were used in this study, but the USDA provided no explanation or formula for the derivation of the weights recommended. Limited information was provided on the sampling process employed by the interviewers (Slonim, 1982).

An interviewer obtained a recall of the previous days dietary intake from each individual. In addition, each respondent recorded food intake the day of the interview and the following day thus providing dietary intake for three consecutive days (USDA, 1980). The respondent providing household information usually provided data for children under 12 years of age and for others in the household unable to answer for themselves. Forms were left to be completed by household members not present at the time of the interview, but expected to return within the next two days. The dietary information obtained for each individual in the NFCS included: the kind and the amount of food eaten, the time the food was eaten, the name of the eating occasion, with whom the food was eaten, where the food was eaten, if vitamin and mineral supplements were taken and if a special diet was followed.

There was lack of validation in the dietary intake methodology (Slonim, 1982). The 24-hour recall relied on the memory of the respondant and a trained interviewer to obtain the data. The two-day records required the respondant to record every item of food or beverage consumed on a special record sheet. These methods of recording intake could have resulted in under-reporting or over-reporting of intake items.

The completion rates also affected the representativeness of the sample. The non-compliance rate was not random. Crocetti and Guthrie (1980) found that young men and large households had disportionately high non-compliance rates. Crocetti and Guthrie (1980) found the weekends to be under-represented. All individuals not having 3-day records were screened in this study.

There were many sources of variance in dietary intake methodologies. Due to the sample design and the lack of validation of dietary intake methodology, the individuals surveyed did not represent a random sample of the U.S. population; further, the 24-hour recall and the two-day record may have introduced systematic bias. However, the large sample size and the averaging of data for the three days aided in the reliable interpretation of these data (Slonim, 1982).

Nutrient Data Bank Conversions

The NFCS food intake information had previously been analyzed for fifteen nutrients: food energy, protein, fat, carbohydrate, calcium, iron, magnesium, phosphorus, vitamin A, thiamin, riboflavin, preformed niacin, vitamin B_6, vitamin B_{12} and ascorbic acid (USDA, 1980). Nutritive values of food intakes of individuals were calculated from a nutrient data base constructed from partially updated composition values of foods from Agriculture Handbook No. 8 (USDA, 1980). Nutrient values of foods not included in Agriculture Handbook No. 8 were obtained from manufacturers' data, were based on similar foods, were calculated from the ingredients, or were based on a composite of known values.

Intake data for other nutrients of interest required use of a data bank containing a larger nutrient selection. Nutrients of interest in this study included cholesterol, polyunsaturated fatty acids, saturated fatty acids, linoleic acid, oleic acid, copper and zinc. Magnesium was also examined. Magnesium and the other nutrients of interest have been linked with coronary heart disease; magnesium allowed for an index of the accuracy of the conversions since it had been analyzed previously for NFCS data. The Michigan State University Nutrition Data Bank (Morgan and Zabik, 1979) has values for cholesterol, polyunsaturated fatty acids, saturated fatty acids, linoleic acid, oleic acid, copper, zinc and magnesium for most foods. Sources for these nutrients used by the M.S.U. Nutrient Data Bank include: Agriculture Handbooks No. 8 to No. 8.7, Agriculture Handbook No. 456, Church and Church, and articles from research journals. See Appendix I for a listing of sources for the nutrients examined in this study. Nutritive values were also obtained from manufacturers' data or were calculated from the basic ingredients listed in the data base using standardized recipes from widely sold cookbooks. The MSU Nutrient Data Bank contained over 3500 food items including fresh and processed foods, fast food restaurant items and home recipes.

Conversion of each USDA Nutrient Data Bank food item was made to a MSU Nutrient Data Bank food item or a recipe using proportions of MSU Nutrient Data Bank food items unless the food was consumed less than 25 times by participants in the entire study. Approximately 780 food items were omitted due to infrequent consumption. Examples of items infrequently consumed included groundhog, moose, pink squirrel cocktail, unenriched bread with garlic butter, gluten bread, dietetic fruit cookies, filled cow's milk, chocolate mousse, sorghum sirup, baked eggs, lemon-butter sauce, chocolate covered toffee, presweetened spiced tea, ham and cheese baby food, liver dumpling, beef sweetbreads, burbot fish, canary fish, beef and pork stroganoff with tomatoes, seafood salad and buttered spaghetti.

Direct conversions of items in the USDA Nutrient Data Bank to items in the MSU Nutrient Data Bank were made if specified nutrient composition of the items matched. Nutrient composition per 100 grams of foods with similar descriptions, such as low fat milk or broiled lean beef steak was compared. If the kilocalories per 100 grams were within 50 and the protein of a particular food item per 100 grams was within 6 grams, the items were considered a direct match.

A recipe, or a proportion of two or more MSU food items, was used if the nutrient comparisons were not within an acceptable range. For example, the USDA Nutrient Data Bank food item barbecued beef shortribs was equivalent to both the MSU Nutrient Data Bank food items beef shortribs and barbecue sauce in the proportions of 52 and 48 percent, respectively. Many recipes required only two items, such as tea with sugar or vegetables with butter. Several items, such as beef stew or tacoburger, required a recipe with proportions from three or more MSU food items. These more complex recipes were developed using the description of the USDA Nutrient Data Bank food item and popular cookbooks, such as the Joy of Cooking (Rombauer and Becker, 1975). For example, 100 grams of the USDA tacoburger was composed of the following MSU food items by weight: 30 percent ground beef, 10 percent cheddar cheese, 20 percent lettuce, 10 percent tomato, 10 percent taco sauce and 20 percent hamburger bun. Recipes were calculated so that nutrient comparisons per 100 grams of food product had a difference in protein value not greater than 3.5 grams, a difference in carbohydrate value no greater than 12.5 grams and a difference in fat value no greater than 3.5 grams. Recipes formulated for fried fish used butter. Other fried foods or foods with fat added were assumed to use corn oil or corn oil margarine unless specified otherwise.

USDA code numbers and the respective MSU code numbers or proportions of the MSU code number were sent to the University of Missouri-Columbia for data entry and analysis. The University of Missouri Computer Network operates on an Amdahl 470V/8 running OS/VS2 MVS/SP release 3 and JES2/NJE release 3.1 and an Amdahl 470V/7 VM/SP release 2 and RSCS networking release 3.

To varify the matches between the two data banks, initial food matches were compared by calculating ratios for each of fifteen dietary components; food energy, protein, fat, carbohydrate, calcium, iron, magnesium, phosphorus, vitamin A, thiamin, riboflavin, preformed niacin, vitamin B_6, vitamin B_{12}, and ascorbic acid for each food item matched. Examination of the ratios identified food items that did not match for one or more nutrients. Recipes or direct matches were altered for items which had poor ratios if the food was a significant source of the nutrient in question. For example, the carbohydrate content of baked and broiled fish had a low ratio, but carbohydrate content of fish is minimal and therefore, the match was not changed. However, if the fat or protein content for the fish item did not have a close ratio, the item or recipe was altered. For example, a fish with a different proportion of fat would be used or the proportion of butter or breading would be altered. As another example, the iron content of milk was not considered, but if the calcium content of milk did not have a close ratio, the match was altered. Altering a match was accomplished with the use of different MSU Nutrient Data Bank food items or different proportions of the MSU Nutrient Data Bank food items.

The ratios for protein, carbohydrate and fat were to be within 0.9 to 1.1 except in cases where a particular food did not contain a significant amount of one of the macronutrients. Food items that were rich sources of a micronutrient, i.e. calcium in milk, were also to have ratios between 0.9 and 1.1 for that nutrient. After all ratios were established to meet the above specifications, the validity of the conversion from the USDA to the MSU Nutrient Data Bank was further verified by calculating the nutrient intakes for the fifteen nutrients contained in both data bases for a random sampling of individuals from spring quarter and comparing these sets of nutrient intake values.

Means and standard deviations for a randomly selected subpopulation of NFCS consisting of 800 individuals were calculated using the USDA Nutrient Data Bank and the USDA-MSU Converted Nutrient Data Bank (Table 4). To ascertain whether any significant differences existed between the calculated values of each of the 15 dietary components, t-tests were utilized. No significant differences were noted ($p \leq 0.05$). This indicated that the conversions were valid; and therefore the USDA-MSU Converted Nutrient Data Bank could be validly used to assess cholesterol, saturated fatty acid, polyunsaturated fatty acid, oleic acid, linoleic acid, copper, zinc and magnesium intake levels of the sample population contained in the NFCS, 1977-78.

Table 4. Mean and standard deviation for 800 individuals from NFCS calculated using the USDA Nutrient Data Bank and the USDA-MSU Converted Nutrient Data Bank.[a]

Dietary Component	USDA Data Base		USDA-MSU Converted Data Base	
	Mean	S.D.	Mean	S.D.
Food Energy, kcal	1701	720	1702	721
Protein, g	69	30	68	30
Fat, g	77	37	79	38
Carbohydrate, g	181	82	179	81
Calcium, mg	714	431	689	420
Iron, mg	12	5	12	5
Magnesium, mg	226	103	187	90
Phosphorus, mg	1077	490	1031	471
Vitamin A, IU	4902	5171	2182	1175
Thiamin, mg	1.16	0.56	1.08	0.54
Riboflavin, mg	1.60	0.82	1.53	0.79
Preformed Niacin, mg	16.7	7.80	16.4	7.7
Vitamin B_6, mg	1.29	0.64	1.08	5.39
Vitamin B_{12}, mg	4.45	6.17	4.90	6.55
Vitamin C, mg	76	58	79	59

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[a] Based on 3-day averages.

Nutrient Intake Analyses

The University of Missouri-Columbia provided the computing facilities utilized in the analysis of the sample data. The USDA-MSU Converted Nutrient Data Bank was used to analyze NFCS data. Before the programs were processed, the sample population was partitioned into 12 groups based on age and sex. This allowed for the examination of the impact of age and sex on nutrient intake levels. The groupings were: children 0-5 years of age; children 6-11 years of age; females 12-18 years of age; females 19-34 years of age; females 35-50 years of age; females 51-64 years of age; females 65 years of age and older; males 12-18 years of age; males 19-34 years of age; males 35-50 years of age; males 51-64 years of age; and males 65 years of age and older.

The dietary intakes of cholesterol, total polyunsaturated fatty acids, total saturated fatty acids, linoleic acid, oleic acid, copper, zinc and magnesium of each age/sex classification in each of four seasons and for the total year were calculated. Means were useful for comparisons, but they did not provide a precise picture of the range of intake and the proportion of the sample falling within certain intervals within the range. Extremes in intake were examined by use of frequency distribution of average daily intake (3 day average) for each of the above listed nutrients for the specified age/sex categories. For these distributions, the intervals were designed to be of equal magnitude and so that no more than 20 percent of any age/sex grouping would fall within one interval. The span was large enough to distinguish extreme low and extreme high levels of intake. Cholesterol was examined at 50 milligram intervals from less than 51 milligrams to greater than 1000 milligrams. Total saturated fatty acids were assessed at 4 gram intervals from 6 to

100 grams; polyunsaturated fatty acids were examined at 2 gram intervals from 0 to 40 grams. The frequency distribution of linoleic acid and oleic acid was calculated at 2 gram intervals. The top of the range was 40 grams for linoleic acid and 60 grams for oleic acid. Copper was examined at 500 microgram intervals up to 3300 micrograms. The intervals for zinc were 2 milligrams ranging from 4 to 30 milligrams. Magnesium was divided into 20 milligram intervals up to 600 milligrams.

Recommendations for lipid intake from diet included the percentage of calories from each of the lipid components as well as the specific values (American Heart Association, 1978; NRC, 1980). Therefore, the cholesterol intake per 1000 kilocalories and the percentage of total fat obtained from saturated fatty acid, polyunsaturated fatty acid, oleic acid and unidentified fat were calculated. The percentage of kilocalories obtained from total fat and from each of the fat components was calculated. Zinc to copper ratios were calculated to ascertain any differences in these ratios from those reported in the literature. Amounts per 1000 kilocalories, percentages and ratios were all calculated using means for each age/sex group.

Although dietary components of interest in this study were believed to have fairly complete data, the completeness of nutritive composition values of foods was assessed. The MSU Nutrient Data Bank listed unknown if the value of a nutrient was not available for the food item. A listing of food items with unknown values for cholesterol, polyunsaturated fatty acids, saturated fatty acids, copper, zinc and magnesium was obtained. The consumption frequencies of all food items with missing data for any of the six nutrients in question were computed for each age/sex classification for each season of the survey. Each food or beverage item consumed was considered as a single observation. If milk was consumed at breakfast, lunch and dinner it would count as 3 observations regardless of portion size. Therefore, the portion size of the food consumed was not a factor in this assessment pertaining to completeness of nutrient composition. Approximately 960,000 different food items were consumed by the sample population. Any food item consumed over one percent of the time in any age/sex classification was examined to determine if unknown values would have an impact on the results of this study.

RESULTS AND DISCUSSION

The potential impact of dietary cholesterol, saturated fatty acids, polyunsaturated fatty acids, copper, zinc and magnesium on coronary heart disease is of interest. The purpose of this investigation was to examine the dietary intake of these dietary components by individuals who participated in the 1977-78 Nationwide Food Consumption Survey. This task was accomplished by conversion of the U.S.D.A. individual dietary intake nutrient data bank to the M.S.U. Nutrient Data Bank.

The dietary intakes of cholesterol, saturated fatty acids, polyunsaturated fatty acids, oleic acid, linoleic acid, copper, zinc and magnesium are reported in this section, as well as the frequency distribution of average intake levels for each of these nutrients within the different age/sex partitions of the population. Seasonal differences in intake levels of these dietary components are discussed. Finally, an examination of unknown values in the nutrient data for each of these dietary components is reported.

Sample Description

The NFCS used a random probability multistage, stratified sampling design intended to represent all private households in the 48 adjacent states. The design was based on the household as the sampling unit and does not yield a completely representative sample of individuals in the U.S. (Slonim, 1982). Approximately 34,000 individuals participated; after the application of weights the sample size was 37,919. Division by age/sex classification yielded a disproportionate distribution of the total sample (Table 5). The 0-5 year group contained 3288 subjects (8.7 percent of sample); 6-11 years had 3790 subjects (10.0 percent); females 12-18 years had 2621 subjects (6.9 percent); females 19-34 years had 5347 members (14.1 percent); females 35-50 years had 3850 members (10.2 percent); females 51-64 years had 3225 subjects (8.5 percent); females 65 years and older contained 2731 subjects (7.2 percent); males 12-18 years had 2545 subjects (6.7 percent); males 19-34 years contained 3929 members (10.4 percent); males 35-50 years contained 2670 subjects (7.0 percent); males 51-64 years had 2268 members (6.0 percent); and males 65 years and over contained 1655 members (4.4 percent). This distribution was in slight disagreement with the 1980 United States Census Data. The following distributions were found for the U.S. population: 0-5 years 7.2 percent; 6-11 years 10.6 percent; females 12-18 years 7.0 percent; females 19-34 years 13.0 percent; females 35-50 years 8.3 percent; females 51-64 years 7.8 percent; females 65 years and over 6.7 percent; males 12-18 years 7.2 percent; males 19-34 years 12.8 percent; males 35.50 years 7.9 percent; males 51-64 years 7.0 percent; and males 655 years and over 4.5 percent (U.S. Department of Commerce, 1983).

Cholesterol Intake

The potential impact of dietary intake of cholesterol on coronary heart disease has led to the development of recommendations for maximum intake levels. The American Heart Association (1978) recommended

Table 5. Number of subjects in the 1977-78 NFCS for each age/sex classification and the distribution percent of each age/sex classification for the 1977-78 NFCS and the 1980 U.S. population.*

Age/Sex Classification	1977-78 NFCS		1980 U.S. Population*
	Weighted n	Distribution %	Distribution %
0-5 Total	3288	8.7	7.2
6-11 Total	3790	10.0	10.6
Female:			
12-18	2621	6.9	7.0
19-34	5347	14.1	13.0
35-50	3850	10.2	8.3
51-64	3225	8.5	7.8
65 and Over	2731	7.2	6.7
Male:			
12-18	2545	6.7	7.2
19-34	3929	10.4	12.8
35-50	2670	7.0	7.9
51-64	2268	6.0	7.0
65 and Over	1655	4.4	4.5

* U.S. Department of Commerce, Bureau of the Census, 1983.

reducing the daily consumption of cholesterol to less than 300 milligrams. The mean cholesterol intake of females and children in this study was within the recommended level; however, the mean cholesterol intake for all males over 12 years of age in this sample exceeded the 300 milligram recommendation (Table 6). Sixty-one percent of males aged 12-18 years, 65 percent of males aged 19-34 years, 67 percent of males aged 35-50 years, 65 percent of males aged 51-64 years and 60 percent of males aged 65 years and over consumed on the average more than 300 milligrams cholesterol per average day (Table 7). Not as many women exceeded the recommended level; 35 percent of females aged 12-18 years, 38 percent of females aged 19-34 years, 39 percent of females 35-50 years, 38 percent of females aged 51-64 years and 34 percent of females aged 65 years and over consumed greater than 300 milligrams cholesterol per average day (Table 7).

The differences found here in cholesterol intake between males and females were in agreement with results reported by other researchers (Nichols et al., 1976; Clarke et al., 1981). Clarke et al., (1981) reported on cholesterol intakes in 90 volunteers 60-85 years of age. The mean cholesterol intake for males (422 milligrams) was higher than the mean of 388 milligrams reported in this study for men of similar age; however, the mean values for elderly females were similar in both studies (261 milligrams in Clarke et. al. and 265 milligrams in this study). The dietary intake methodology was similar; a possible explanation for the differences seen in elderly males was the small number of males included in Clarke's study. Males and females aged 16 to 69 years were interviewed in the study by Nichols et al., (1976). Nichols found higher cholesterol intakes for both sexes than found in the USDA survey using

Table 6. Mean[a] daily intake of eight dietary components for U.S. individuals[b] classified by age and sex.

	Age/Sex Classification											
	0-5 Male & Female		12-18 Male		19-34 Male		35-50 Male		51-64 Male		65 and over Male	
Nutrient	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Cholesterol, mg	208	134	396	214	434	316	432	299	429	313	388	277
Polyunsaturated Fatty Acids, g	6.8	4.3	13.6	7.1	15.0	10.2	14.9	10.6	14.0	9.4	11.4	8.0
Saturated Fatty Acids, g	20.4	8.8	38.7	16.0	38.1	22.4	36.5	21.1	34.5	20.1	29.3	17.2
Linoleic Acid, g	4.7	3.4	10.6	5.9	11.4	8.2	11.3	11.5	11.1	8.0	9.1	6.6
Oleic Acid, g	15.4	8.2	33.4	13.6	34.9	20.2	34.3	18.8	32.6	18.9	27.5	15.7
Magnesium, mg	155	123	288	346	270	303	263	263	275	335	259	316
Copper, µg	941	495	1591	817	1412	1086	1271	1122	1323	1178	1251	1093
Zinc, mg	6.3	3.7	12.1	4.9	12.1	6.8	11.8	7.3	11.5	7.9	10.3	8.2

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[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 6 Continued. Mean[a] daily intake of eight dietary components for U.S. individuals[b] classified by age and sex.

	Age/Sex Classification											
	6-11 Male & Female		12-18 Female		19-34 Female		35-50 Female		51-64 Female		65 and over Female	
Nutrient	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Cholesterol, mg	281	139	277	152	286	237	291	222	291	224	265	205
Polyunsaturated Fatty Acids, g	10.2	4.9	10.2	5.7	10.3	7.6	10.2	7.0	9.9	6.9	8.6	6.2
Saturated Fatty Acids, g	29.0	10.3	27.8	12.0	24.9	15.7	23.6	13.7	23.3	14.1	21.2	12.6
Linoleic Acid, g	7.8	4.0	8.0	4.7	8.1	6.4	8.0	6.0	8.0	5.9	7.1	5.3
Oleic Acid, g	24.3	8.6	23.9	10.0	22.5	14.0	22.1	12.7	22.0	13.0	19.5	11.3
Magnesium, mg	223	185	196	138	202	308	196	256	230	397	208	252
Copper, µg	1294	562	1131	584	987	801	944	910	969	780	989	892
Zinc, mg	8.9	3.2	8.6	3.8	8.1	5.3	8.0	5.5	8.0	5.4	7.5	5.1

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[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 7. Frequency distribution of average[a] daily intake of cholesterol for individuals[b] of specified age/sex groups of the U.S. Population.

Cholesterol Intake mg/day	Age/Sex Classification											
	0-5 Yrs Total		6-11 Yrs Total		12-18 Yrs Female		12-18 Yrs Male		19-34 Yrs Female		19-34 Yrs Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
Under 51	10.45	10.45	.18	.18	1.21	1.21	.23	.23	2.12	2.12	.58	.58
51-100	11.11	21.56	3.23	3.41	5.72	6.94	1.67	1.91	8.10	10.22	1.91	2.49
101-150	16.89	38.45	11.18	14.58	13.57	20.51	4.13	6.04	13.18	23.40	4.77	7.26
151-200	15.51	53.96	17.09	31.67	16.15	36.66	9.19	15.23	14.74	38.14	8.59	15.85
201-250	13.24	67.20	17.66	49.33	15.66	52.32	12.19	27.41	12.59	50.73	8.88	24.73
251-300	11.74	78.94	14.35	63.68	12.47	64.79	11.95	39.37	11.25	61.98	10.17	34.90
301-350	7.25	86.19	12.16	75.84	9.86	74.65	10.86	50.23	9.88	71.86	9.29	44.19
351-400	5.24	91.43	8.03	83.87	7.66	82.30	9.74	59.97	7.35	79.21	8.63	52.82
401-450	3.50	94.93	5.37	89.24	5.99	88.29	8.84	68.81	5.70	84.92	7.72	60.54
451-500	2.22	97.15	3.67	92.91	3.60	91.90	6.07	74.89	3.74	88.66	6.47	67.01
501-550	.75	97.90	2.45	95.36	2.58	94.47	5.61	80.50	3.02	91.68	5.81	72.82

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 7 Continued. Frequency distribution of average[a] daily intake of cholesterol for individuals[b] of specified age/sex groups of the U.S. Population.

Cholesterol Intake mg/day	Age/Sex Classification											
	0-5 Yrs Total		6-11 Yrs Total		12-18 Yrs Female		12-18 Yrs Male		19-34 Yrs Female		19-34 Yrs Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
551-600	.87	98.76	1.24	96.60	1.82	96.29	3.70	84.19	2.37	94.05	5.81	78.63
601-650	.63	99.39	.90	97.50	1.25	97.54	3.93	88.13	1.81	95.86	4.27	82.90
651-700	.24	99.63	.72	98.22	.68	98.23	2.92	91.05	1.28	97.13	3.69	86.59
701-750	.12	99.75	.75	98.97	.61	98.84	2.49	93.54	.75	97.88	2.86	89.45
751-800	.09	99.84	.31	99.28	.42	99.25	1.60	95.14	.59	98.47	1.91	91.36
801-850	.06	99.90	.31	99.59	.27	99.52	1.09	96.23	.56	99.03	1.87	93.23
851-900	.06	99.96	.21	99.80	.15	99.67	.86	97.08	.25	99.28	1.74	94.97
901-950		99.96	.05	99.85	.11	99.78	.70	97.79	.22	99.50	1.24	96.21
951-1000		99.96	.08	99.93	.15	99.93	.70	98.48	.28	99.78	.87	97.08
OVER 1001	.03	99.99	.08	100.01	.08	100.01	1.52	100.00	.22	100.00	2.90	99.98

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 7 Continued. Frequency distribution of average[a] daily intake of cholesterol for individuals[b] of specified age/sex groups of the U.S. Population.

Cholesterol Intake mg/day	Age/Sex Classification											
	35-50 Yrs Female		35-50 Yrs Male		51-64 Yrs Female		51-64 Yrs Male		65 & Over Female		65 & Over Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
Under 51	1.59	1.59	.24	.24	1.53	1.53	.43	.43	1.93	1.93	.49	.49
51-100	6.80	8.39	1.33	1.57	6.92	8.45	2.01	2.45	7.79	9.73	2.76	3.26
101-150	11.67	20.06	4.52	6.09	12.72	21.17	4.75	7.19	15.53	25.26	7.40	10.66
151-200	15.28	35.34	7.41	13.50	14.66	35.83	7.91	15.11	15.35	40.60	8.29	18.95
201-250	13.65	48.99	9.04	22.54	12.21	48.04	9.06	24.17	14.20	54.80	9.48	28.43
251-300	12.35	61.34	10.79	33.33	13.28	61.33	10.22	34.39	11.54	66.34	11.85	40.28
301-350	9.94	71.29	10.79	44.12	9.77	71.10	8.56	42.95	9.06	75.41	9.97	50.25
351-400	8.05	79.34	8.38	52.50	7.28	78.37	7.63	50.58	7.85	83.26	9.08	59.33
401-450	5.12	84.46	7.35	59.85	5.70	84.07	9.35	59.93	5.50	88.76	8.49	67.82
451-500	4.78	89.24	6.87	66.72	3.92	87.99	6.76	66.68	3.56	92.32	6.32	74.14
501-550	2.84	92.08	5.30	72.02	3.36	91.35	5.90	72.59	2.11	94.44	5.53	79.66

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 7 Continued. Frequency distribution of average[a] daily intake of cholesterol for individuals[b] of specified age/sex groups of the U.S. Population.

Cholesterol Intake mg/day	Age/Sex Classification											
	35-50 Yrs Female		35-50 Yrs Male		51-64 Yrs Female		51-64 Yrs Male		65 & Over Female		65 & Over Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
551-600	2.41	94.49	5.67	77.69	2.39	93.74	5.76	78.35	1.33	95.77	4.94	84.60
601-650	1.68	96.17	4.58	82.27	2.04	95.78	4.68	83.02	1.39	97.16	4.74	89.34
651-700	1.12	97.29	3.92	86.19	1.68	97.46	4.03	87.05	1.09	98.24	2.86	92.20
701-750	.99	98.28	3.32	89.51	.87	98.32	3.09	90.14	.48	98.73	1.78	93.98
751-800	.82	99.10	2.95	92.46	.61	98.93	2.73	92.88	.36	99.09	1.58	95.56
801-850	.39	99.48	2.35	94.81	.46	99.39	1.73	94.60	.42	99.51	1.28	96.84
851-900	.26	99.74	1.75	96.56	.20	99.59	1.51	96.12	.30	99.81	.79	97.63
901-950	.17	99.91	.90	97.46	.15	99.74	.79	96.91	.06	99.87	.99	98.62
951-1000	.04	99.95	.84	98.30		99.74	.72	97.63		99.87	.30	98.91
OVER 1001	.04	99.99	1.69	99.99	.25	99.99	2.37	100.00	.12	99.99	1.09	100.00

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

the converted data base. Other researchers have also shown cholesterol intakes to exceed the recommended 300 milligrams per average day (Reid et al., 1971; Rossouw et al., 1974; Dorfman et al., 1976; Nichols et al., 1976; Nomura et al., 1978; Fortmann et al., 1981). Rizek (1981) estimated the cholesterol content of the average diet in the United States to be about 500 milligrams. As indicated in Table 7, 88 to 92 percent of all adult females consumed less than 500 milligrams cholesterol and 67 percent of adult males aged 19-64 years consumed less than this amount.

Rossouw et al. (1974) reported a mean value for the daily intake of dietary cholesterol above 500 milligrams (566 mg/day). The subjects were males ages 40-59 years from the western cape of South Africa. Although the authors felt the diet closely resembled a typical American diet, it is possible that the subjects consumed a diet higher in animal fats than do middle aged males in the United States. A mean cholesterol intake of 549 milligrams per day for 6774 males was reported by Nomura et al. (1978). Nomura et al. (1978) used a 24-hour recall plus a questionnaire designed specifically to research dietary cholesterol intake. The emphasis on intake of high cholesterol foods in the questionnaire may have resulted in higher average cholesterol intake than with food records alone, as used in the NFCS.

Pima Indian women (Reid et al., 1971) had a much higher mean cholesterol intake (489 milligrams/day) than did women in this study. Organ and variety meats were popular among the Pima Indian population. These meats plus the use of lard could account for higher cholesterol intakes. Dorfman et al. (1976) reported a mean cholesterol intake similar to that found in this study, but Fortmann et al. (1981) reported a higher mean cholesterol intake. However, both of these studies examined a small sample.

The 12-18, 19-34, 35-50 and 51-64 year old males consumed the largest average quantity of cholesterol (396 mg/day, 434 mg/day, 432 mg/day and 429 mg/day, respectively). These age/sex categories also consumed the greatest average number of kilocalories per day. Children had the lowest average intake levels of cholesterol but twenty-one percent of children aged 0-5 years and 36 percent of children 6-11 years consumed over 300 milligrams cholesterol per day. As seen with differences among the sexes, the lower cholesterol intakes found for children could be attributed to the lower intake of kilocalories in these groups. Differences among the sexes were not as evident when examining the cholesterol per 1000 kilocalories (Table 8). The males in each age classification had a greater cholesterol intake per 1000 kilocalories than did females in the same age classification, but older females consumed diets with more cholesterol per 1000 kilocalories than did younger males. Males aged 65 years and over had the greatest intake of cholesterol per 1000 kilocalories. Examination of the mean cholesterol intake per 1000 kilocalories showed that after age 5, the cholesterol intake increased with age, except for females aged 65 years and over (Table 8). The percentage of individuals consuming over 300 milligrams of cholesterol per day also increased with age up to 50 years. Since average kilocalorie and fat intake decreased with age, it appeared that younger individuals may have been selecting foods lower in cholesterol. Since several of the studies prior to this one reported higher mean cholesterol intakes, it is possible that education regarding lowering cholesterol in the diet has played a role, and food habits are changing.

Table 8. Cholesterol intake[a] per 1000 kilocalories by individuals of various age/sex classifications of the U.S. population.

Age/Sex	Cholesterol per 1000 kilocalories
Children:	
0-5	165
6-11	151
Female:	
12-18	155
19-34	177
35-50	189
51-64	190
65 and over	186
Male:	
12-18	163
19-34	180
35-50	190
51-64	194
65 and over	205

[a] Calculated from each age/sex group mean.

Few extremes were noted in cholesterol intake levels. Approximately 80 percent of the adult females consumed between 100 and 500 milligrams cholesterol per average day (Table 7). The range of intakes for adult males was wider. As seen in Table 6, ten percent of males 12-18 years of age consumed, on the average, greater than 650 milligrams and ten percent of males aged 19 - 50 years of age consumed greater than 750 milligrams cholesterol per day.

Cholesterol intakes estimated in this study for male partitions were higher than recommended by the American Heart Association. The recommended dietary intake for cholesterol consumption of not more than 300 milligrams per day appeared to have been obtained by most of the females and children. However, males and females consumed similar amounts of cholesterol per 1000 kilocalories, so that lowered intakes by females and children are not due to greater selection of low cholesterol foods but to more modest food intakes. The American Medical Association (1972), the Committee on Dietary Allowances (NRC, 1980) and a task force of the American Society of Clinical Nutrition (Ahrens, 1979) do not agree with the American Heart Association (1978) guidelines. They do not believe it is desirable to make blanket recommendations for the entire population. The amount of cholesterol desirable in the diet and the relationship of cholesterol in diet to the development of coronary heart disease in man is controversial.

Fatty Acid Intake

The American Heart Association (1978) recommended that the total kilocalories from fat be 30 percent or lower. None of the age/sex groups examined in this study met this recommendation. As indicated in Table 9,

Table 9. Mean[a] daily intake of kilocalories, total fat, saturated fatty acid, polyunsaturated fatty acid, oleic acid, and unidentified fat by individuals[b] of various age/sex segments of the U.S. population.

Age/Sex	Kcal	Fat (g)	Saturated Fatty Acid (g)	Polyunsaturated Fatty Acids (g)	Oleic Acid (g)	Unidentified Fat (g)
Children:						
0-5	1262	54.2	20.4	6.8	15.4	11.6
6-11	1858	82.3	29.0	10.2	24.3	18.8
Female:						
12-18	1792	81.2	27.8	10.2	23.9	19.3
19-34	1617	75.1	24.9	10.3	22.5	17.4
35-50	1536	72.8	23.6	10.2	22.1	16.9
51-64	1534	71.9	23.3	9.9	22.0	16.7
65 and over	1427	63.6	21.2	8.6	19.5	14.3
Male:						
12-18	2431	111.2	38.7	13.6	33.4	25.5
19-34	2410	114.0	38.1	15.0	34.9	26.0
35-50	2274	110.6	36.5	14.9	34.3	24.9
51-64	2213	104.3	34.5	14.0	32.6	23.2
65 and over	1891	87.5	29.3	11.4	27.5	19.3

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[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

males aged 12-64 years consumed approximately 30-40 grams more fat than did their female counterparts; however, the percentage of kilocalories provided by fat was basically the same for males and females (Table 10). The percentage of kilocalories obtained from fat varied from 40-44 percent for males and females 12 years of age and over. The percentage of kilocalories from fat was similar among children's age groups: 39 percent of kilocalories from fat for 0-5 year olds and 40 percent for 6-11 year olds.

The average fat intake for adults decreased with age. Males 19-34 years of age consumed the greatest average amount of fat (114 grams/day) followed in descending order, by males 35-50 years of age (111 grams/day), males 51-64 years of age (104 grams/day) and males 65 years of age and over (88 grams/day). The female segment of the population having the greatest mean fat intake was those aged 12-18 years, but this group consumed less fat (81 grams/day) than males of any age group. The mean fat intake decreased as age increased (75 grams/day for females aged 19-34 years, 73 grams/day for females aged 35-50 years, 72 grams/day for feamles aged 51-64 years and 64 grams/day for females aged 65 years and over) (Table 9). The age/sex segments who consumed less fat also consumed fewer kilocalories per average day and therefore, the percentage of kilocalories obtained from total fat was similar among all age/sex categories. For this sample population, the percentage of total kilocalories obtained from fat (39 to 44 percent) was higher than that found in HANES I (Table 10). HANES I data showed that males and females in every age group obtained 36 percent or more of their total energy intake from fat (Abraham and Carroll, 1979). Page and Marston (1979) pointed out that there has been a decrease in fat consumed in the United

Table 10. Percentage[a] of total fat obtained from saturated fatty acid, polyunsaturated fatty acid, oleic acid and unidentified fat and percentage[a] of calories obtained from total fat and each of the fat components by individuals of various age/sex segments of the U.S. populations.

	% Fat				% Kilocalories				
Age/Sex	Saturated Fatty Acid	Polyunsaturated Fatty Acids	Oleic Acid	Unidentified Fat	Total Fat	Saturated Fatty Acids	Polyunsaturated Fatty Acids	Oleic Acid	Unidentified Fat
Children:									
0-5	38	13	28	21	39	15	5	11	8
6-11	35	12	30	23	40	14	5	12	9
Female:									
12-18	34	13	29	24	41	14	5	12	10
19-34	33	14	30	23	42	14	6	13	10
35-50	33	14	30	23	43	14	6	13	10
51-64	32	14	31	23	42	14	6	13	10
65 and over	33	14	31	22	40	13	5	12	9
Male:									
12-18	35	12	30	23	41	14	5	12	9
19-34	33	13	31	23	43	14	6	13	10
35-50	33	13	31	23	44	14	6	14	10
51-64	33	14	31	22	42	14	6	13	9
65 and over	34	13	31	22	42	14	5	13	9

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[a] Calculated from each age/sex group mean.

States during this century. It is apparent from these data that more changes in the fat content of the diet must occur if the recommendations of the American Heart Association are to be met.

Saturated fatty acids contributed approximately 14 percent of total kilocalories consumed by all age/sex groups (Table 10). Saturated fatty acids accounted for 12-14 percent of total kilocalories consumed by individuals in the HANES I study (Abraham and Carroll, 1979). Males aged 12-18 years consumed an average of 38.7 grams of saturated fatty acids per day while females in this age group had an average daily intake of 27.8 grams. Younger individuals consumed more saturated fatty acids than did older individuals. The average saturated fatty acid intake decreased from 38.7 grams/day to 38.1 grams/day, 36.5 grams/day, 34.5 grams/day and 29.3 grams/day for males aged 12-18 years, 19-34 years, 35-50 years, 51-64 years and 65 years and over, respectively and from 27.8 grams/day to 24.9 grams/day, 23.6 grams/day, 23.3 grams/day and 21.2 grams/day for females aged 12-28 years, 19-34 years, 35-50 years 51-64 years and 65 years and over, respectively (Table 6).

Fortmann et al. (1981) reported a mean saturated fatty acid intake of 32.5 grams/day for 80 males and females from semi-rural communities. This value was within the range of intake found in this study. Average intakes of saturated fatty acid for males was lower than those reported by other researchers (Rossouw et al., 1974; Nichols et al., 1976; Nomura et al., 1978). Reid et al. (1971) and Nichols et al. (1976) found mean saturated fatty acid intakes for women of 55.9 grams/day and 33 grams/day, respectively; both values were higher than those reported in the present study. Reid et al. (1971) reported a much higher intake because the population studied (Pima Indians) consumed many foods high in saturated fat, such as organ meats. The percentage of kilocalories provided by saturated fatty acids has been reported at 15.9, 14.5, and 16.1-16.5 (Reid et al., 1971; Rossouw et al., 1974; Nichols et al., 1976). These values are also slightly higher than those reported in this study. Different food consumption patterns of the sample, smaller sample size and samples from less varied populations could explain the higher values reported elsewhere. Nomura et al., (1978) studied males in Hawaii; Hawaii was not included in the USDA survey. Rossouw et al. (1974) and Reid et al. (1971) studied African males and Pima Indian women, respectively. The distribution of fatty acid intakes in this study was over a large range. Mean intakes were similar for all age/sex classifications. Frequency distributions shown in Table 11 indicate that ninety percent of all women had saturated fatty acid intakes less than 40 grams/day and ninety percent of all men had intakes less than 55 grams/day.

As shown in Table 9, average polyunsaturated fatty acid intake per day varied from 8.6 to 10.3 grams/day for females and 11.4 to 15.0 grams/day for males. Other researchers reported intakes of 8.2 to 26.0 grams/day (Reid et al., 1971; Rossouw et al., 1974; Nichols et al., 1976; Fortmann et al., 1981) with the values being lower for females than for males (Nichols et al., 1976). The range was not altered by inclusion of population groups outside the United States. Therefore, the results reported here were within the range reported elsewhere, but were at the lower end of the range. The percentage of kilocalories from polyunsaturated fatty acids was 5 to 6 percent. This finding is in agreement with other researchers (Reid et al., 1971; Rossouw et al., 1974; Nichols et al., 1976). Comparisons with other studies indicated

Table 11. Frequency distribution of average[a] daily intake of total saturated fatty acids for individuals[b] of specified age/sex groups of the U.S. Population.

Total Saturated Fatty Acid	Age/Sex Classification											
	0-5 Yrs Total		6-11 Yrs Total		12-18 Yrs Female		12-18 Yrs Male		19-34 Yrs Female		19-34 Yrs Male	
Intake g/day	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
Under 6	3.98	3.98	.10	.10	1.02	1.02	.16	.16	1.71	1.71	.37	.37
6-10	7.91	11.89	1.37	1.47	3.41	4.44	.74	.90	6.67	8.38	1.49	1.86
11-15	19.53	31.42	6.45	7.92	9.78	14.22	2.49	3.34	14.37	22.75	3.57	5.43
16-20	24.65	56.06	14.22	22.15	15.16	29.38	6.70	10.09	19.98	42.72	8.30	13.73
21-25	19.98	76.04	19.67	41.82	18.73	48.10	9.89	19.98	18.51	61.23	11.33	25.06
26-30	12.70	88.74	20.55	62.36	17.55	65.66	14.41	34.38	13.52	74.75	12.45	37.50
31-35	6.50	95.24	15.15	77.52	13.68	79.34	15.11	49.49	10.25	85.01	13.40	50.91
36-40	2.99	98.23	10.25	87.76	8.26	87.60	14.06	63.55	6.23	91.24	12.24	63.15
41-45	1.20	99.43	6.07	93.83	6.29	93.90	10.55	74.10	4.02	95.26	10.66	73.81
46-50	.18	99.61	3.25	97.08	2.54	96.44	7.71	81.81	1.75	97.01	7.47	81.28

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 11 Continued. Frequency distribution of average[a] daily intake of total saturated fatty acids for individuals[b] of specified age/sex groups of the U.S. Population.

Total Saturated Fatty Acid Intake g/day	Age/Sex Classification											
	0-5 Yrs Total		6-11 Yrs Total		12-18 Yrs Female		12-18 Yrs Male		19-34 Yrs Female		19-34 Yrs Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
1-55	.18	99.79	1.52	98.61	1.52	97.95	5.72	87.54	1.31	98.32	6.18	87.46
56-60	.09	99.88	.54	99.15	.99	98.94	3.70	91.24	.69	99.01	3.82	91.28
61-65	.06	99.94	.36	99.51	.38	99.32	2.30	93.54	.31	99.32	2.49	93.77
66-70	.03	99.97	.21	99.72	.30	99.62	2.34	95.87	.31	99.63	1.62	96.39
71-75		99.97	.15	99.87	.11	99.73	1.32	97.20	.12	99.76	1.16	96.55
76-80	.03	100.00	.08	99.95		99.73	1.01	98.21	.16	99.91	1.16	97.71
81-85		100.00	.05	100.00	.04	99.77	.66	98.87	.06	99.97	.58	98.29
86-90		100.00		100.00	.04	99.81	.27	99.14		99.97	.58	98.87
91-95		100.00		100.00	.11	99.92	.31	99.45		99.97	.21	99.08
96-100		100.00		100.00	.04	99.96	.16	99.61	.03	100.00	.37	99.45
OVER 100		100.00		100.00	.04	100.00	.39	100.00		100.00	.54	99.99

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[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 11 Continued. Frequency distribution of average[a] daily intake of total saturated fatty acids for individuals[b] of specified age/sex groups of the U.S. Population.

Total Saturated Fatty Acid Intake g/day	Age/Sex Classification											
	35-50 Yrs Female		35-50 Yrs Male		51-64 Yrs Female		51-64 Yrs Male		65 & Over Female		65 & Over Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
Under 6	1.68	1.68	.24	.24	1.73	1.73	.43	.43	1.87	1.87	.69	.69
6-10	6.93	8.61	1.51	1.75	6.92	8.65	1.87	2.30	9.12	10.99	3.06	3.75
11-15	15.63	24.24	4.22	5.97	17.30	25.95	5.90	8.20	19.88	30.87	8.29	12.04
16-20	20.45	44.69	7.53	13.50	21.32	47.28	9.57	17.77	23.56	54.43	15.20	27.24
21-25	20.75	65.44	13.14	26.64	18.68	65.95	13.31	31.08	20.97	75.40	18.95	46.19
26-30	15.28	80.72	15.07	41.71	14.40	80.36	14.68	45.76	10.76	86.16	17.57	63.76
31-35	8.44	89.16	13.14	54.85	8.35	88.70	13.17	58.92	6.71	92.87	11.55	75.31
36-40	5.55	94.71	12.54	67.39	5.34	94.05	12.73	71.65	3.87	96.74	9.58	84.89
41-45	2.63	97.34	10.01	77.40	2.54	96.59	9.21	80.86	1.51	98.25	5.63	90.52
46-50	.95	98.29	7.35	84.75	1.63	98.22	6.55	87.41	.85	99.10	4.34	94.86

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 11 Continued. Frequency distribution of average[a] daily intake of total saturated fatty acids for individuals[b] of specified age/sex groups of the U.S. Population.

Total Saturated Fatty Acid Intake g/day	Age/Sex Classification											
	35-50 Yrs Female		35-50 Yrs Male		51-64 Yrs Female		51-64 Yrs Male		65 & Over Female		65 & Over Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
51-55	.69	98.98	5.18	89.93	.76	98.98	4.75	92.16	.30	99.40	2.07	96.93
56-60	.52	99.50	3.38	93.31	.46	99.44	2.73	94.89	.30	99.70	.59	97.52
61-65	.22	99.72	2.35	95.66	.31	99.75	1.87	96.76	.24	99.94	.89	98.41
66-70	.12	99.84	1.51	97.17	.10	99.85	1.22	97.99	.06	100.00	.69	99.10
71-75	.12	99.96	.48	97.65	.10	99.95	.58	98.56		100.00	.20	99.30
76-80	-	99.96	.90	98.55	-	99.95	.58	99.14		100.00	.10	99.40
81-85	-	99.96	.48	99.04	-	99.95	.29	99.43		100.00	.20	99.60
86-90	.04	100.00	.24	99.28	.05	100.00	.14	99.57		100.00	.10	99.70
91-95	-	100.00	.36	99.64	-	100.00	.07	99.64		100.00	.10	99.80
96-100	-	100.00	.06	99.70	-	100.00	.14	99.78		100.00	.10	99.90
OVER 100	-	100.00	.30	100.00	-	100.00	.22	100.00		100.00	.10	100.00

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

that reported mean saturated fatty acid and polyunsaturated fatty acid intakes were lower in this study. However, studies that reported mean kilocalorie and total fat intake also showed a greater average kilocalorie and total fat intake than found here (Nichols et al., 1976; Nomura et al., 1978). Although the average amount of saturated and polyunsaturated fatty acids was generally lower in this study than reported elsewhere, the differences were not as great when the percentage of kilocalories from each lipid component was considered. Younger children consumed lower average intakes of cholesterol, saturated fatty acid and polyunsaturated fatty acid per day than did older children, resulting from the lower average kilocalorie intake of the younger children. This is in agreement with Morrison et al., 1980.

As displayed in Table 12, 57-60 percent of females aged 12-64 years and 73-75 percent of males in these age groups consumed between 8 and 26 grams polyunsaturated fatty acids per day. At least 90 percent of individuals in all age/sex classifications consumed less than 26 grams of polyunsaturated fatty acid per day. The average daily intake of polyunsaturated fatty acids accounted for 5-6 percent of the total kilocalories and for 12-14 percent of the total fat intake (Table 10). These calculated intakes of all age/sex groups were lower than the 25-33 percent of total fat that has been recommended desirable to be provided by polyunsaturated fatty acids (NRC, 1980). The Committee on Dietary Allowances has stated that an upper limit of 10 percent of dietary energy from polyunsaturated fatty acids was advisable due to the possible hazards of high intakes of polyunsaturated oils (McGill and Mott, 1976; NRC, 1980). The percentage of total kilocalories provided by polyunsaturated fatty acids found in this study was well within this

Table 12. Frequency distribution of average[a] daily intake of total polyunsaturated fatty acids for individuals[b] of specified age/sex groups of the U.S. Population.

Total Poly-Unsaturated Fatty Acid Intake g/day	Age/Sex Classification											
	0-5 Yrs Total		6-11 Yrs Total		12-18 Yrs Female		12-18 Yrs Male		19-34 Yrs Female		19-34 Yrs Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
Under 2	9.79	9.79	.52	.52	1.55	1.55	.58	.58	2.40	2.40	.21	.21
2-4	16.89	26.68	5.14	5.66	7.51	9.06	2.69	3.27	7.82	10.22	2.74	2.95
5-6	22.34	49.03	13.71	19.36	13.84	22.90	6.89	10.16	13.37	23.59	5.60	8.55
7-8	19.98	69.01	18.71	38.08	16.87	39.76	10.63	20.79	17.08	40.67	8.38	16.93
9-10	14.05	83.06	18.51	56.59	17.10	56.86	14.72	35.51	16.02	56.69	12.03	28.96
11-12	8.06	91.11	15.18	71.76	14.90	71.76	12.81	48.33	13.03	69.71	11.29	40.25
13-14	3.74	94.86	10.25	82.01	9.40	81.16	12.77	61.10	10.19	79.90	11.70	51.95
15-16	2.61	97.46	7.31	89.32	6.22	87.38	9.31	70.40	6.82	86.73	10.46	62.41
17-18	.87	98.33	3.67	92.98	4.70	92.08	8.22	78.62	4.21	90.93	8.63	71.04
19-20	.57	98.90	2.56	95.54	2.62	94.69	6.62	85.24	3.40	94.33	7.18	78.22
21-22	.54	99.44	1.78	97.32	2.01	96.70	4.32	89.56	1.84	96.17	5.68	83.90

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[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 12 Continued. Frequency distribution of average[a] daily intake of total polyunsaturated fatty acids for individuals[b] of specified age/sex groups of the U.S. Population.

Total Poly-Unsaturated Fatty Acid Intake g/day	Age/Sex Classification											
	0-5 Yrs Total		6-11 Yrs Total		12-18 Yrs Female		12-18 Yrs Male		19-34 Yrs Female		19-34 Yrs Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
23-24	.15	99.59	1.06	98.38	1.10	97.80	2.96	92.52	1.28	97.45	4.36	88.26
25-26	.15	99.74	.62	99.00	.83	98.63	1.52	94.04	.90	98.35	3.11	91.37
27-28	.03	99.77	.41	99.41	.57	99.20	1.52	95.56	.59	98.94	2.41	93.78
29-30	.06	99.83	.23	99.64	.23	99.43	1.29	96.85	.25	99.19	1.83	95.61
31-32		99.83	.13	99.77	.19	99.62	.58	97.43	.28	99.47	1.16	96.77
33-34	.03	99.86	.08	99.85	.11	99.73	.70	98.13	.12	99.60	.71	97.48
35-36		99.86		99.85	.08	99.81	.51	98.64	.06	99.66	.62	98.10
37-38	.06	99.92	.08	99.93	.08	99.89	.31	98.95	.03	99.69	.66	98.76
39-40		99.92		99.93	.08	99.97	.27	99.22	.12	99.81	.12	98.88
OVER 40	.09	100.01	.08	100.01	.04	100.01	.78	100.00	.19	100.00	1.12	100.00

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 12 Continued. Frequency distribution of average[a] daily intake of total polyunsaturated fatty acids for individuals[b] of specified age/sex groups of the U.S. Population.

Total Poly-Unsaturated Fatty Acid Intake	Age/Sex Classification											
	35-50 Yrs Female		35-50 Yrs Male		51-64 Yrs Female		51-64 Yrs Male		65 & Over Female		65 & Over Male	
g/day	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
Under 2	2.02	2.02	.42	.42	1.58	1.58	.36	.36	1.99	1.99	.99	.99
2-4	7.32	9.34	1.99	2.41	8.04	9.62	2.88	3.24	13.23	15.23	5.53	6.52
5-6	13.90	23.25	5.06	7.47	14.35	23.97	6.91	10.14	17.95	33.17	10.37	16.88
7-8	17.09	40.34	9.76	17.24	17.86	41.83	8.99	19.13	20.48	53.66	16.78	33.66
9-10	16.01	56.35	11.21	28.45	16.95	58.78	13.38	32.51	16.25	69.91	16.49	50.15
11-12	13.69	70.04	12.18	40.63	14.25	73.03	13.53	46.04	10.21	80.12	13.13	63.28
13-14	10.16	80.20	11.27	51.90	9.11	82.14	11.37	57.40	7.92	88.04	11.35	74.63
15-16	6.89	87.09	11.33	63.23	6.77	88.91	9.42	66.83	4.95	92.99	6.71	81.34
17-18	5.04	92.12	9.70	72.94	4.12	93.03	8.49	75.32	2.90	95.83	6.42	87.76
19-20	3.36	95.48	6.69	79.63	2.70	95.73	6.62	81.94	2.05	97.95	3.16	90.92
21-22	1.72	97.20	4.40	84.03	1.42	97.15	5.04	86.97	.79	98.73	3.75	94.67

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[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 12 Continued. Frequency distribution of average[a] daily intake of total polyunsaturated fatty acids for individuals[b] of specified age/sex groups of the U.S. Population.

Total Poly-Unsaturated Fatty Acid Intake g/day	Age/Sex Classification											
	35-50 Yrs Female		35-50 Yrs Male		51-64 Yrs Female		51-64 Yrs Male		65 & Over Female		65 & Over Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
23-24	1.16	98.36	4.82	88.85	1.22	98.37	4.68	91.65	.36	99.09	2.37	97.04
25-26	.56	98.92	2.77	91.62	.46	98.83	2.30	93.95	.30	99.40	.99	98.03
27-28	.34	99.27	2.53	94.15	.41	99.24	1.51	95.46	.30	99.70	.39	98.42
29-30	.09	99.35	1.69	95.84	.20	99.44	1.65	97.12	.06	99.76	.49	98.92
31-32	.26	99.61	1.21	97.05	.05	99.49	1.15	98.27		99.76	.39	99.31
33-34	.13	99.74	1.02	98.07	.20	99.69	.36	98.63	.06	99.82	.20	99.51
35-36	.09	99.83	.66	98.73		99.69	.36	98.99		99.82		99.51
37-38	.09	99.92	.48	99.22	.05	99.74	.29	99.27	.06	99.88	.10	99.61
39-40	.04	99.96	.18	99.40	.10	99.84	.14	99.42	.12	100.00	.20	99.81
OVER 40	.04	100.00	.60	100.00	.15	99.99	.58	100.00		100.00	.20	100.01

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

limit.

The polyunsaturated fatty acid of primary interest was the essential fatty acid, linoleic acid. The amount of dietary linoleic acid found to prevent evidence of fatty acid deficiency in man is one to two percent of total dietary kilocalories (NRC, 1980). Three percent of energy as linoleic acid should be a satisfactory minimum recommended intake for groups with relatively low fat intakes (NRC, 1980). In this study, linoleic acid intakes were adequate in this sample population and ranged from 3.4 to 4.6 percent of total kilocalories. However, for those consuming diets higher in fat, there is evidence that greater than 3 percent of kilocalories from linoleic acid may have beneficial health effects (NRC, 1980). The U.S. Department of Agriculture estimated that about 23 grams of linoleic acid was available per person per day in the United States food supply (Rizek et al., 1974). Available linoleic acid was considered to be the amount an individual would consume from the total available food, not actual consumption. The actual amount consumed would be lower due to trimming of fat from meats and food wastage. In other words, individuals did not consume all the food available to them. Less than 7 percent of adult males and less than 2 percent of adult females consumed 23 grams of linoleic acid per day (Table 13).

Males aged 12-64 years had a greater average linoleic acid intake level (10.6-11.4 grams/day) than did their female counterparts (8.0-8.6 grams/day). Males aged 65 years and over averaged intakes of 9.1 grams linoleic acid per day while females of this age group averaged intakes of 7.1 grams/day. Thus, the older age classifications had lower intakes than did younger individuals of the same sex, but males had larger average linoleic acid intakes than did females in all age

Table 13. Frequency distribution of average[a] daily intake of linoleic acid for individuals[b] of specified age/sex groups of the U.S. Population.

Linoleic Acid Intake g/day	Age/Sex Classification											
	0-5 Yrs Total		6-11 Yrs Total		12-18 Yrs Female		12-18 Yrs Male		19-34 Yrs Female		19-34 Yrs Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
Under 2	20.19	20.19	1.47	1.47	2.81	2.81	.86	.86	3.68	3.68	.91	.91
2.0-4.0	28.00	48.19	13.40	14.87	14.44	17.25	6.74	7.60	15.27	18.95	5.98	6.89
4.1-6.0	25.46	73.64	24.60	39.47	22.29	39.54	13.40	21.00	20.57	39.52	11.33	18.22
6.1-8.0	14.35	87.99	22.20	61.67	19.98	59.52	17.45	38.45	19.23	58.75	15.19	33.41
8.1-10.0	6.17	94.16	16.18	77.85	15.62	75.14	17.60	56.05	14.58	73.33	15.56	48.97
10.1-12.0	3.02	97.18	9.29	87.14	10.58	85.72	13.28	69.33	9.94	83.27	13.90	62.87
12.1-14.0	1.29	98.47	5.37	92.51	5.69	91.41	9.70	79.03	6.89	90.16	9.38	72.25
14.1-16.0	.57	99.04	3.33	95.84	3.60	95.01	6.19	85.22	4.33	94.49	8.88	81.13
16.1-18.0	.42	99.46	1.76	97.60	1.78	96.79	5.14	90.34	1.93	96.42	5.39	86.52
18-1-20.0	.21	99.67	1.08	98.68	1.18	97.97	2.88	93.22	1.37	97.79	4.40	90.92

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 13 Continued. Frequency distribution of average[a] daily intake of linoleic acid for individuals[b] of specified age/sex groups of the U.S. Population.

Linoleic Acid Intake g/day	Age/Sex Classification											
	0-5 Yrs Total		6-11 Yrs Total		12-18 Yrs Female		12-18 Yrs Male		19-34 Yrs Female		19-34 Yrs Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
20.1-22.0	.09	99.76	.65	99.33	.64	98.61	1.79	95.01	.75	98.54	2.90	93.82
22.1-24.0		99.76	.23	99.56	.45	99.06	1.40	96.41	.34	98.88	2.16	95.98
24.1-26.0	.09	99.85	.21	99.77	.42	99.48	1.13	97.54	.37	99.25	1.20	97.18
26.1-28.0		99.85	.03	99.80	.19	99.67	.74	98.28	.16	99.41	.66	97.84
28.1-30.0	.03	99.88	.10	99.90	.19	99.86	.47	98.75	.22	99.63	.41	98.25
30.1-32.0		99.88	.05	99.95	.07	99.97	.16	98.91	.06	99.69	.50	98.75
32.1-34.0		99.88		99.95		99.97	.43	99.34	.09	99.78	.33	99.08
34.1-36.0	.03	99.91		99.95		99.97	.31	98.66	.03	99.81	.29	99.37
36.1-38.0		99.91	.03	99.98		99.97	.19	99.85	.09	99.90	.29	99.66
38.1-40.0	.09	100.00	.03	100.01		99.97		99.85	.03	99.93	.12	99.79
OVER 40.0		100.00		100.01	.07	100.00	.16	100.01	.06	99.99	.21	100.00

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 13 Continued. Frequency distribution of average[a] daily intake of linoleic acid for individuals[b] of specified age/sex groups of the U.S. Population.

Linoleic Acid Intake g/day	Age/Sex Classification											
	35-50 Yrs Female		35-50 Yrs Male		51-64 Yrs Female		51-64 Yrs Male		65 & Over Female		65 & Over Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
Under 2	2.84	2.84	.66	.66	2.75	2.75	.79	.79	4.11	4.11	1.97	1.97
2.0-4.0	15.37	18.21	4.52	5.18	14.35	17.10	6.26	7.05	18.37	22.48	8.79	10.76
4.1-6.0	21.61	39.82	12.72	17.90	20.61	37.71	11.08	18.13	25.02	47.50	19.84	30.60
6.1-8.0	19.76	59.58	15.31	33.21	21.12	58.83	17.48	35.61	20.18	65.68	20.73	51.33
8.1-10.0	15.02	74.60	15.97	49.18	16.90	75.73	16.47	52.08	13.05	80.72	14.41	65.74
10.1-12.0	9.81	84.41	13.74	62.92	9.67	85.40	13.96	66.04	8.28	89.00	12.44	78.18
12.1-14.0	6.37	90.78	10.85	73.77	6.31	91.71	9.50	75.54	4.47	93.47	7.80	85.98
14.1-16.0	4.05	94.83	8.74	82.51	3.92	95.63	7.91	83.45	3.26	96.73	5.43	91.41
16.1-18.0	2.32	97.15	5.73	88.24	1.22	96.85	4.96	88.41	1.63	98.36	2.37	93.78
18-1-20.0	1.03	98.18	3.32	91.56	1.22	98.07	3.81	92.22	.60	98.96	2.57	96.35

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 13 Continued. Frequency distribution of average[a] daily intake of linoleic acid for individuals[b] of specified age/sex groups of the U.S. Population.

Linoleic Acid Intake g/day	Age/Sex Classification											
	35-50 Yrs Female		35-50 Yrs Male		51-64 Yrs Female		51-64 Yrs Male		65 & Over Female		65 & Over Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
20.1-22.0	.60	98.78	3.56	95.12	.56	98.63	2.37	94.59	.36	99.32	1.28	97.63
22.1-24.0	.39	99.17	1.57	96.69	.46	99.09	1.80	96.39	.36	99.70	.79	98.42
24.1-26.0	.34	99.51	1.51	98.20	.36	99.45	1.37	97.76	.06	99.76	.49	98.91
26.1-28.0	.09	99.60	.48	98.68	.10	99.55	.65	98.41	.12	99.88	.39	99.30
28.1-30.0	.13	99.73	.72	99.40	.10	99.65	.43	99.84		99.88	.10	99.40
30.1-32.0	.09	99.82	.06	99.46		99.65	.22	99.06		99.88	.20	99.60
32.1-34.0	.13	99.95		99.46	.20	99.85	.29	99.35	.06	99.94	.10	99.70
34.1-36.0	.04	99.99	.12	99.58		99.85	.14	99.59	.06	100.00		99.70
36.1-38.0		99.99	.06	99.64	.05	99.90	.22	99.72		100.00	.10	99.80
38.1-40.0		99.99	.12	99.76	.05	99.95	.14	99.86		100.00	.20	100.00
OVER 40.0		99.99	.24	100.00	.05	100.00	.14	100.00		100.00		100.00

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[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

classifications. Frequency distribution of linoleic acid shown in Table 13 indicates that less than one percent of males aged 12-64 years and that less than four percent of females in the same age category consumed less than 2 grams of linoleic acid per day. A larger percentage of males and females (2 percent and 4 percent, respectively) 65 years of age and over had intakes of linoleic acid less than 2 grams per day. Approximately twenty percent of children aged 0-5 years consumed less than 2 grams linoleic acid per day. Less than 10 percent of adult females consumed greater than 12 grams of linoleic acid per day and less than 10 percent of adult males had intake levels greater than 18 grams per day. It is apparent from this study that linoleic acid content of diets was not excessive and that few individuals were consuming amounts less than considered adequate.

As shown in Table 10, oleic acid contributed between one-fourth and one-third of total fat intake. Few studies have examined oleic acid content of the diet. No recommendation of a desirable amount of the monounsaturated fatty acid, oleic acid, in the diet has been made at this time. Ten percent of all adult males consumed over 50 grams of oleic acid and ten percent of all females consumed over 32 grams of oleic acid (Table 14).

Polyunsaturated fatty acids, saturated fatty acids and oleic acid calculated values did not sum to a quantity equal the total fat intake. Therefore, a category of unidentified fat was examined in this study. Unidentified fat accounted for 21-24 percent of the total fat intake and for 8-10 percent of the total kilocalorie intake (Table 10). Unidentified fat would consist of triglycerides and phospholipids as well as unknown fatty acids. The fatty acid breakdown of some processed and

Table 14. Frequency distribution of average[a] daily intake of oleic acid for individuals[b] of specified age/sex groups of the U.S. Population.

Oleic Acid Intake g/day	Age/Sex Classification											
	0-5 Yrs Total		6-11 Yrs Total		12-18 Yrs Female		12-18 Yrs Male		19-34 Yrs Female		19-34 Yrs Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
Under 2	7.79	7.79			.08	.08	.08	.08	.25	.25	.04	.04
2.0-4.0	2.10	9.89	.03	.03	.34	.42	.04	.12	.62	.87	.04	.08
4.1-6.0	2.79	12.68	.23	.26	.68	1.10	.04	.16	1.50	2.37	.04	.12
6.1-8.0	4.31	16.99	.46	.72	1.78	2.88	.35	.51	2.18	4.55	.66	.78
8.1-10.0	7.01	24.00	1.14	1.86	2.20	5.08	.35	.86	3.61	8.16	.79	1.57
10.1-12.0	8.86	32.86	2.66	4.52	3.53	8.61	1.05	1.91	4.92	13.08	.79	2.36
12.1-14.0	10.72	43.58	4.18	8.70	5.80	14.41	2.02	3.93	6.98	20.06	2.03	4.39
14.1-16.0	10.63	54.21	6.84	15.54	6.56	20.97	2.18	6.11	9.07	29.13	2.66	7.05
16.1-18.0	10.33	64.54	8.39	23.93	7.96	28.93	3.12	9.23	8.79	37.92	3.44	10.49
18-1-20.0	10.60	75.14	10.20	34.13	8.95	37.88	4.32	13.55	9.29	47.21	4.36	14.85

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 14 Continued. Frequency distribution of average[a] daily intake of oleic acid for individuals[b] of specified age/sex groups of the U.S. Population.

Oleic Acid Intake g/day	Age/Sex Classification											
	0-5 Yrs Total		6-11 Yrs Total		12-18 Yrs Female		12-18 Yrs Male		19-34 Yrs Female		19-34 Yrs Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
20.1-22.0	7.10	82.24	9.91	44.04	9.29	47.17	5.18	18.73	7.85	55.06	4.56	19.41
22.1-24.0	5.87	88.11	10.71	54.75	8.68	55.85	6.31	25.04	8.13	63.19	5.31	24.72
24.1-26.0	3.80	91.91	8.31	63.06	7.62	63.47	6.74	31.78	6.86	70.05	6.06	30.78
26.1-28.0	2.61	94.52	7.98	71.04	7.13	70.60	7.28	39.06	6.01	96.06	6.85	37.63
28.1-30.0	1.71	96.23	6.69	77.73	6.56	77.16	6.62	45.68	4.27	80.33	5.15	42.78
30.1-32.0	.87	97.10	5.83	83.56	5.38	82.54	6.93	52.61	4.52	84.85	6.02	48.80
32.1-34.0	.78	97.88	4.10	87.66	4.81	87.35	7.05	59.66	3.27	88.12	5.02	53.82
34.1-36.0	.57	98.45	3.07	90.73	2.65	90.00	5.57	65.23	2.52	90.64	5.77	59.59
36.1-38.0	.36	98.81	2.07	92.80	2.20	92.20	5.02	70.25	2.31	92.95	4.56	64.15
38.1-40.0	.42	99.23	1.94	94.74	2.05	94.25	4.67	74.92	1.50	94.45	4.56	68.71

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 14 Continued. Frequency distribution of average[a] daily intake of oleic acid for individuals[b] of specified age/sex groups of the U.S. Population.

Oleic Acid Intake g/day	Age/Sex Classification											
	0-5 Yrs Total		6-11 Yrs Total		12-18 Yrs Female		12-18 Yrs Male		19-34 Yrs Female		19-34 Yrs Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
40.1-42.0	.27	99.50	1.65	96.39	1.59	95.84	3.97	78.89	1.53	95.98	4.27	72.98
42.1-44.0	.14	9.64	1.11	97.50	.87	96.71	3.66	82.55	.75	96.73	4.02	77.00
44.1-46.0	.06	99.70	.70	98.20	.68	97.39	2.38	84.93	.47	97.20	3.07	80.07
46.1-48.0	.06	99.76	.49	98.69	.45	97.84	2.22	87.15	.59	97.79	3.11	83.18
48.1-50.0	.06	99.82	.41	99.10	.57	98.41	2.18	89.33	.56	98.35	2.32	85.50
50.1-52.0	.06	99.88	.15	99.25	.38	98.79	1.48	90.81	.34	98.69	2.04	87.54
52.1-54.0	.03	99.91	.15	99.40	.27	99.06	1.60	92.41	.25	98.94	1.99	89.53
54.1-56.0		99.91	.10	99.50	.19	99.25	.93	93.34	.22	99.16	1.62	91.15
56.1-58.0	.03	99.94	.09	99.59	.23	99.48	1.36	94.71	.22	99.38	1.41	92.56
58.1-60.0	.03	99.97	.15	99.74	.11	99.59	.74	95.45	.19	99.57	1.29	93.85
OVER 60	.03	100.00	.26	100.00	.42	100.01	4.56	100.01	.43	100.00	6.14	99.99

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 14 Continued. Frequency distribution of average[a] daily intake of oleic acid for individuals[b] of specified age/sex groups of the U.S. Population.

	Age/Sex Classification											
Oleic Acid	35-50 Yrs Female		35-50 Yrs Male		51-64 Yrs Female		51-64 Yrs Male		65 & Over Female		65 & Over Male	
Intake g/day	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
Under 2	.22	.22			.10	.10	.07	.07	.12	.12	.10	.10
2.0-4.0	.39	.61	.06	.06	.41	.51		.07	.36	.48	.20	.30
4.1-6.0	1.12	1.73	.18	.24	1.48	1.99	.14	.21	1.45	1.93		.30
6.1-8.0	1.76	3.49	.36	.60	2.39	4.38	.86	1.07	3.32	5.25	.88	1.18
8.1-10.0	4.13	7.62	.66	1.26	3.92	8.30	.79	1.86	4.59	9.84	1.68	2.86
10.1-12.0	5.77	13.39	.66	1.92	4.83	13.13	2.23	4.09	7.13	16.97	2.37	5.23
12.1-14.0	6.16	19.55	1.81	3.73	6.97	20.10	2.45	6.54	10.27	27.24	4.94	10.17
14.1-16.0	8.74	28.29	2.77	6.50	7.89	27.99	3.67	10.21	11.18	38.42	5.53	15.70
16.1-18.0	9.13	37.42	3.38	9.88	10.59	38.58	3.31	13.52	10.63	49.05	6.02	21.72
18-1-20.0	9.47	46.89	3.98	13.86	8.09	46.67	4.68	18.20	9.85	58.90	7.31	29.03

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 14 Continued. Frequency distribution of average[a] daily intake of oleic acid for individuals[b] of specified age/sex groups of the U.S. Population.

Oleic Acid Intake g/day	Age/Sex Classification											
	35-50 Yrs Female		35-50 Yrs Male		51-64 Yrs Female		51-64 Yrs Male		65 & Over Female		65 & Over Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
20.1-22.0	9.69	56.58	5.00	18.86	10.13	56.80	4.75	22.95	9.25	68.15	8.09	37.12
22.1-24.0	8.09	64.67	5.73	24.59	8.35	65.15	6.19	29.14	7.19	75.34	6.22	43.34
24.1-26.0	6.59	71.26	6.03	30.62	7.48	72.63	5.32	34.46	5.32	80.66	6.91	50.25
26.1-28.0	6.71	77.97	6.81	37.43	4.94	77.57	7.27	41.73	4.95	85.61	7.90	58.15
28.1-30.0	5.04	83.01	6.03	43.46	4.73	82.30	6.40	48.13	3.50	89.11	6.81	64.96
30.1-32.0	3.96	86.97	5.85	49.31	4.73	87.03	5.61	53.74	2.48	91.59	6.12	71.08
32.1-34.0	3.06	90.03	5.67	54.98	3.26	90.29	5.76	59.50	2.36	93.95	4.94	76.02
34.1-36.0	2.28	92.31	4.94	59.92	2.24	95.53	6.12	65.62	1.75	95.70	5.22	81.24
36.1-38.0	1.89	94.20	6.45	56.37	1.62	94.15	5.11	70.73	1.15	96.85	3.95	85.19
38.1-40.0	1.64	95.84	3.80	70.17	1.17	95.32	4.46	75.19	.54	97.39	2.86	88.05

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 14 Continued. Frequency distribution of average[a] daily intake of oleic acid for individuals[b] of specified age/sex groups of the U.S. Population.

Oleic Acid Intake g/day	Age/Sex Classification											
	35-50 Yrs Female		35-50 Yrs Male		51-64 Yrs Female		51-64 Yrs Male		65 & Over Female		65 & Over Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
40.1-42.0	.65	96.49	3.74	73.91	1.27	96.59	3.17	78.36	.86	98.25	2.17	90.22
42.1-44.0	.82	97.31	3.61	77.52	.81	97.40	3.53	81.89	.36	98.61	1.28	91.50
44.1-46.0	.69	98.00	4.04	81.56	.46	97.86	2.65	84.54	.06	98.67	1.88	93.38
46.1-48.0	.39	98.39	3.44	85.00	.25	98.11	2.59	87.13	.36	99.03	1.18	94.56
48.1-50.0	.17	98.56	2.77	87.77	.41	98.52	2.01	89.14	.36	99.39	.89	95.45
50.1-52.0	.43	98.99	1.87	89.64	.36	98.88	1.94	91.08	.36	99.75	.69	96.14
52.1-54.0	.30	99.29	1.33	90.97	.30	98.18	1.29	92.37	.12	99.87	.59	96.73
54.1-56.0	.26	99.55	1.56	92.53	.30	99.48	1.29	93.66		99.87	.79	97.52
56.1-58.0	.08	99.63	1.75	94.28	.05	99.53	1.37	95.03	.06	99.93	.79	98.31
58.1-60.0	.08	99.71	1.21	95.49	.10	99.63	.72	95.75		99.93	.40	98.71
OVER 60	.30	100.01	4.52	100.01	.36	99.99	4.25	100.00	.06	99.99	1.28	99.99

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[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

fast foods are not available.

Copper and Zinc Intake

The intakes of copper and zinc are shown in Table 6. The average figures for copper intake were lower than mean intakes reported by other researchers (White, 1976; Freeland et al., 1976; Walker and Page, 1977; Guthrie and Robinson, 1977; Milne et al., 1978; Hunt et al., 1979; Freeland-Grave et al., 1980) and slightly higher than those reported for analyzed hospital diets (Freeland et al., 1976; Klevay et al., 1979). However, these other studies included smaller samples of more limited populations.

The Food and Nutrition Board (NRC, 1980) set the Estimated Safe and Adequate Daily Dietary Intake for copper at 2.0-3.0 milligrams per day. Frequency distributions displayed in Table 15 indicated that 94 percent of females aged 12-18 years, 95 percent of females aged 19-34 years, 96 percent of females 35-50 years and 95 percent of females aged 51 years and over consumed less than 2.0 milligrams of copper per day. A very small proportion of adult females (less than 2 percent) exceeded the estimated safe and adequate amount. Less than 4 percent of adult males exceeded average intakes of 3.0 milligrams copper per day. Eighty percent of males aged 12-18 years, 86 percent of males 19-34 years, 90 percent of males aged 35-50 years, 88 percent of males aged 51-64 years and 90 percent of males 65 years and over consumed less than 2.0 milligrams per day. Our study also showed that 98 percent of children aged 0-5 years and 92 percent of children aged 6-11 years consumed less than 2.0 milligrams copper per day. The results indicate that a large percentage of the U.S. population consumed less copper than is considered

Table 15. Frequency distribution of average[a] daily intake of copper for individuals[b] of specified age/sex groups of the U.S. Population.

Copper Intake µg/day	Age/Sex Classification											
	0-5 Yrs Total		6-11 Yrs Total		12-18 Yrs Female		12-18 Yrs Male		19-34 Yrs Female		19-34 Yrs Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
Under 501	18.72	18.72	3.38	3.38	8.83	8.83	2.49	2.49	16.36	16.36	4.27	4.27
501-700	16.44	35.16	8.23	11.61	13.99	22.82	5.41	7.90	18.64	35.00	9.63	13.90
701-900	17.01	52.17	13.04	24.65	16.22	39.04	8.84	16.74	18.51	53.51	13.82	27.72
901-1100	13.81	65.98	15.59	40.24	15.62	54.66	10.36	27.10	16.17	69.68	14.61	42.32
1101-1300	12.10	78.08	15.85	56.09	13.12	67.78	13.67	40.77	9.63	79.31	13.94	56.26
1301-1500	8.92	87.00	13.55	69.64	10.61	78.39	12.85	53.62	6.76	86.07	10.08	66.34
1501-1700	5.48	92.48	10.74	80.38	7.54	85.93	10.40	64.02	4.67	90.74	9.25	75.59
1701-1900	3.35	95.83	7.07	87.45	4.81	90.74	8.72	72.74	2.65	93.39	5.64	81.23

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[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 15 Continued. Frequency distribution of average[a] daily intake of copper for individuals[b] of specified age/sex groups of the U.S. Population.

Copper Intake µg/day	Age/Sex Classification											
	0-5 Yrs Total		6-11 Yrs Total		12-18 Yrs Female		12-18 Yrs Male		19-34 Yrs Female		19-34 Yrs Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
1901-2100	2.07	97.90	4.36	91.81	3.26	94.00	6.70	79.44	2.03	95.42	4.94	86.17
2101-2300	.81	98.71	3.02	94.83	2.32	96.32	5.18	84.62	1.43	96.85	3.11	89.28
2301-2500	.33	99.04	1.65	96.48	1.48	97.80	4.17	88.79	.81	97.66	2.45	91.73
2501-2700	.36	99.40	1.21	97.69	.72	98.52	2.92	91.71	.56	98.22	1.63	93.36
2701-2900	.24	99.64	.59	98.28	.34	98.86	1.95	93.66	.31	98.54	1.58	94.94
2901-3100	.18	99.82	.70	98.98	.38	99.24	1.60	95.26	.37	98.91	1.08	96.02
3101-3300	.06	99.88	.42	99.40	.23	99.47	.86	96.12	.40	99.31	.83	96.85
OVER 3300	.12	100.00	.59	99.99	.53	100.00	3.89	100.01	.69	100.00	3.15	100.00

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[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 15 Continued. Frequency distribution of average[a] daily intake of copper for individuals[b] of specified age/sex groups of the U.S. Population.

Copper Intake µg/day	Age/Sex Classification											
	35-50 Yrs Female		35-50 Yrs Male		51-64 Yrs Female		51-64 Yrs Male		65 & Over Female		65 & Over Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
Under 501	19.20	19.20	5.24	5.24	16.28	16.28	5.54	5.54	14.44	14.44	6.91	6.91
501-700	22.51	41.71	12.48	17.72	18.63	34.91	12.01	17.55	20.12	34.56	11.55	18.46
701-900	19.50	61.21	15.37	33.09	20.66	55.57	15.04	32.59	21.33	55.89	17.97	36.43
901-1100	12.61	73.82	18.69	51.78	15.52	71.09	16.47	49.06	15.71	71.60	17.28	53.71
1101-1300	8.95	82.77	11.33	63.11	10.59	81.68	12.66	61.72	9.49	81.09	13.52	67.23
1301-1500	5.33	88.11	9.89	73.00	6.72	88.40	11.29	73.01	6.89	87.98	8.29	75.52
1501-1700	3.75	91.86	8.20	81.20	3.46	91.86	6.12	79.13	3.50	91.48	7.50	83.02
1701-1900	2.29	94.15	5.36	86.56	2.29	94.15	4.68	83.81	2.05	93.53	4.54	87.56

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 15 Continued. Frequency distribution of average[a] daily intake of copper for individuals[b] of specified age/sex groups of the U.S. Population.

Copper Intake µg/day	Age/Sex Classification											
	35-50 Yrs Female		35-50 Yrs Male		51-64 Yrs Female		51-64 Yrs Male		65 & Over Female		65 & Over Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
1901-2100	1.68	95.83	3.68	90.24	1.07	95.22	3.81	87.62	1.33	94.86	2.86	90.42
2101-2300	.82	96.65	3.38	93.62	1.17	96.39	2.73	90.35	1.51	96.37	2.17	92.59
2301-2500	.73	97.38	1.51	95.13	1.12	97.51	3.09	93.44	.60	96.97	1.58	94.17
2501-2700	.43	97.81	.96	96.09	.41	97.92	1.15	94.59	.24	97.21	1.38	95.55
2701-2900	.30	98.11	1.08	97.17	.41	98.32	1.01	95.60	.54	97.75	.89	96.44
2901-3100	.39	98.50	.48	97.65	.36	98.68	.87	96.47	.31	98.06	.80	97.24
3101-3300	.22	98.72	.42	98.07	.36	99.04	.79	97.26	.31	98.37	.59	97.83
OVER 3300	1.28	100.00	1.93	100.00	.96	100.00	2.73	99.99	1.63	100.00	2.17	100.00

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

adequate. Copper intakes may have actually been higher, with the lower reported values resulting from the unavailable composition values.

More males consumed the estimated safe and adequate amount of copper than did females or children. This was most likely due to the fact that males also consumed more kilocalories than did females and children. The age category consuming the most kilocalories per day for males and for females (ages 12-18 years) was also the age category that the largest proportion of individuals consumed between 2.0 and 3.0 milligrams copper per day. Five percent of females aged 12-18 years and 16 percent of males in this age group consumed between 2.0 and 3.0 milligrams copper per day. The proportion of the sample population consuming the estimated safe and adequate amount of copper per day was less in other age classifications (3 percent for females aged 19 years and over, 9 percent for males aged 19-34 years and 51-64 years, and 7 percent for males aged 35-50 years and 65 years and over).

The National Research Council Recommended Dietary Allowance (NRC-RDA) for zinc is 15 milligrams for males and females over 11 years of age and 10 milligrams for children aged 1-10 years (NRC, 1980). The mean values of zinc intake for all age/sex classifications were less than 100 percent of this recommendation. As displayed in Table 16, seven percent of children 0-5 years of age and 40 percent of children 6-11 years of age met the NRC-RDA for zinc. The percentage of females that met the RDA for zinc was lower than males of all ages. Approximately three percent of females aged 12-64 years, 2 percent of females aged 65 years and over, 16 percent of males aged 12-18 years, 19 percent of males aged 19-34 years, 14 percent of males aged 35-50 years, 13 percent of males aged 51-64 years and 8 percent of males aged 65 years and over met

Table 16. Frequency distribution of average[a] daily intake of zinc for individuals[b] of specified age/sex groups of the U.S. Population.

Zinc Intake mg/day	Age/Sex Classification 0-5 Yrs Total %	Cum %	6-11 Yrs Total %	Cum %	12-18 Yrs Female %	Cum %	12-18 Yrs Male %	Cum %	19-34 Yrs Female %	Cum %	19-34 Yrs Male %	Cum %
Under 4	18.66	18.66	2.43	2.43	6.18	6.18	1.36	1.36	10.00	10.00	1.62	1.62
4.0-6.0	33.48	52.14	13.47	15.90	17.17	23.35	5.41	6.77	21.50	31.50	6.64	8.26
6.1-8.0	28.45	80.59	27.39	43.29	26.54	49.89	13.12	19.89	25.80	57.30	12.66	20.91
8.1-10.0	12.43	93.02	26.43	69.72	22.74	72.63	17.52	37.41	19.94	77.24	17.80	38.71
10.1-12.0	4.16	97.18	16.57	86.29	13.99	86.62	19.00	56.41	12.00	89.24	17.26	55.98
12.1-14.0	1.56	98.74	7.92	94.22	6.90	93.52	16.24	72.65	5.24	94.48	15.56	71.54
14.1-16.0	.39	99.13	3.18	97.40	3.15	96.67	10.90	83.55	2.65	97.13	9.88	81.41
16.1-18.0	.15	99.28	1.32	98.72	1.48	98.15	6.62	90.17	1.40	98.53	6.89	88.30

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 16 Continued. Frequency distribution of average[a] daily intake of zinc for individuals[b] of specified age/sex groups of the U.S. Population.

Zinc	Age/Sex Classification											
	0-5 Yrs Total		6-11 Yrs Total		12-18 Yrs Female		12-18 Yrs Male		19-34 Yrs Female		19-34 Yrs Male	
Intake mg/day	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
18.1-20.0		99.28	.62	99.34	.76	98.91	3.93	94.10	.47	99.00	4.65	92.95
20-1-22.0	.09	99.37	.23	99.57	.38	99.29	2.45	96.55	.34	99.34	2.32	95.27
22.1-24.0	.09	99.46	.10	99.67	.23	99.52	1.36	97.91	.12	99.46	2.03	97.30
24.1-26.0	.06	99.52	.13	99.80	.19	99.70	.62	98.53	.06	99.52	1.04	98.34
26.1-28.0	.06	99.58	.08	99.88	.08	99.78	.55	99.08	.06	99.58	.58	98.92
28.1-30.0	.09	99.67	.03	99.91		99.78	.16	99.24	.06	99.64	.33	99.25
OVER 30.0	.33	100.00	.10	100.01	.23	100.01	.75	99.99	.34	99.98	.75	100.00

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 16 Continued. Frequency distribution of average[a] daily intake of zinc for individuals[b] of specified age/sex groups of the U.S. Population.

	Age/Sex Classification											
	35-50 Yrs Females		35-50 Yrs Male		51-64 Yrs Female		51-64 Yrs Male		65 & Over Female		65 & Over Male	
Zinc Intake mg/day	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
Under 4	8.90	89.00	1.69	1.69	8.91	8.91	2.73	2.73	11.36	11.36	3.06	3.06
4.0-6.0	23.00	31.90	5.91	7.60	24.12	33.03	7.91	10.64	26.34	37.70	14.81	17.87
6.1-8.0	26.70	58.60	13.86	21.46	26.56	59.59	13.88	24.52	27.61	65.31	19.64	37.51
8.1-10.0	20.10	78.70	18.93	40.39	19.29	78.88	18.49	43.01	18.49	83.80	22.11	59.62
10.1-12.0	11.40	90.10	19.23	59.62	10.43	89.31	19.57	62.58	8.64	92.44	17.18	76.80
12.1-14.0	5.00	95.10	15.67	75.29	3.45	94.76	14.53	77.11	3.63	96.07	10.46	87.27
14.1-16.0	2.20	97.40	10.55	85.84	2.29	97.05	9.50	86.61	1.75	97.82	5.23	92.50
16.1-18.0	1.20	98.60	5.79	91.63	1.27	98.32	5.76	92.37	.61	98.43	2.37	94.87

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[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 16 Continued. Frequency distribution of average[a] daily intake of zinc for individuals[b] of specified age/sex groups of the U.S. Population.

Zinc Intake mg/day	Age/Sex Classification											
	35-50 Yrs Females		35-50 Yrs Male		51-64 Yrs Female		51-64 Yrs Male		65 & Over Female		65 & Over Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
18.1-20.0	.30	98.90	3.50	95.13	.66	98.98	2.59	94.96	.31	98.74	1.09	95.96
20-1-22.0	.20	99.00	1.75	96.88	.20	99.19	2.30	97.26	.42	99.16	.79	96.75
22.1-24.0	.30	99.30	1.27	98.15	.15	99.34	.86	98.12	.24	99.40	.69	97.44
24.1-26.0	.10	99.40	.60	98.75	.10	99.44	.43	98.55	.06	99.46	.59	98.03
26.1-28.0		99.40	.24	98.99	.05	99.50	.29	98.84	.18	99.64	.10	98.13
28.1-30.0	.20	99.60	.36	99.35	.10	99.60	.14	98.98	--	99.64	.10	98.23
OVER 30.0	.40	100.00	.66	100.01	.40	100.00	1.01	99.99	.36	100.00	1.77	100.00

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

the NRC-RDA for zinc. The results of this study indicate that a large proportion of the U.S. population failed to consume zinc at such levels to meet the NRC-RDA. Females consumed less zinc than did males. This may be attributable to the lower average kilocalorie intakes of women.

Average intakes of zinc found in this study were, in general, lower than those reported elsewhere. Milne et al. (1978) found zinc and copper intakes of 20.3 milligrams per day and 1700 micrograms per day respectively for male military personnel. Average zinc intakes for male and female volunteers in the University of Delaware Academic Community (Haeflein and Rasmussen, 1977) were higher than those reported in this study. Walker and Page (1977) reported mean copper and zinc intakes of college meals (3370 micrograms/day and 22.03 milligrams/day, respectively) that were higher than averages found for copper and similar for averages of zinc intakes of males in this study. Wolf et al. (1977) reported mean values (1010 micrograms copper/day and 8.63 milligrams zinc/day) similar to those found here. Mean copper intakes for females reported by White (1976) were considerably higher (12,000 micrograms/day for high school girls and 13,800 micrograms/day for college women) than those reported by others. All the above studies had derived the mean intakes from analyzed aliquots of actual food eaten. Although copper and zinc composition data are considered substantial for dairy products, fish, beef, poultry and frozen and canned vegetables, the data available on copper and zinc content of foods are limited (Stewart, 1981). It is plausible that the intake data obtained from actual analysis of the diet as consumed, may be greater than intake data derived from diet records and composition tables. White (1976), however, found mean analyzed values and calculated values for food items in 5 basic menus to compare favorably. Freeland et al. (1976) calculated intakes and reported mean copper and zinc intakes for dental patients (2000 micrograms/day and 12 milligrams/day, respectively) that also were similar to studies using analyzed data. Vegetarians were found to have average zinc intakes which were similar and average copper intakes which were much higher than those reported in this study (Freeland-Graves et al., 1980). The higher amounts of copper by vegetarians appear reasonable since dried legumes and nuts are rich sources of copper. One would expect lower zinc intakes in vegetarians since animal foods are much better sources of zinc than vegetable products.

It is not the actual copper or zinc intake, but the ratio of the two that has been linked to CHD. Table 17 shows the zinc to copper ratios of the different age/sex classifications. Using the NRC-RDA for zinc and the estimated safe and adequate value for copper, a ratio of zinc to copper of 5-7.5 might be suggested. The research with animals indicated that a higher ratio would be more apt to be linked to CHD than a lower ratio (Klevay, 1973; Murthy and Petering, 1976). Children in the current study had average zinc to copper ratios of 6.7 and 6.9 for ages 0-5 years and 6-11 years, respectively; the ratio in all adult age/sex groups exceeded 7.6, with males ages 35-50 years having the highest ratio (9.3). Ratios reported by other researchers ranged from 2.1 for vegetarians to 16.2 for hospital diets (Brown et al., 1976; Freeland-Graves et al., 1980). The median ratios reported were 6.0 for dental patients (Freeland et al., 1976) and 6.7 for New Zealand women (Guthrie and Robinson, 1977). Whether the zinc to copper ratio affects CHD in humans remains questionable. The ratios found in this study indicate that an increase in copper content of the U.S. diet may be

Table 17. Zinc to copper ratio[a] of dietary intake by individuals of various age/sex classifications of the U.S. population.

Age/Sex	Zinc:Copper
Children:	
0-5	6.7
6-11	6.9
Female:	
12-18	7.6
19-34	8.2
35-50	8.5
51-64	8.3
65 and over	7.6
Male:	
12-18	7.6
19-34	8.6
35-50	9.3
51-64	8.7
65 and over	8.2

[a] Calculated from each age/sex group mean for zinc/each age/sex group mean for copper.

desirable in the prevention of heart disease. However, more research needs to be done before such a recommendation can be made.

Magnesium Intake

The NRC-RDA for magnesium is 300 milligrams for all females, 350 milligrams for males aged 11-14 years and 19 years and over in age, and 400 milligrams for males aged 15-18 years (NRC, 1980). The NRC-RDA for magnesium is 150 milligrams for children aged 1-3 years, 200 milligrams for children aged 4-6 years and 250 milligrams for children aged 7-10 years (NRC, 1980). Magnesium intakes estimated in this study for the U.S. population were lower than the NRC-RDA. These estimated average magnesium intakes were in agreement with other reported intake levels (Walker and Page, 1977; USDA, 1980).

Approximately 37 percent of children 0-5 years of age consumed 160 milligrams magnesium per day; 17 percent of this age/sex classification consumed at least 200 milligrams magnesium per day (Table 18). A major proportion of children aged 6-11 years had intakes less than the NRC-RDA; twenty percent of this age group consumed over 260 milligrams magnesium per day. Frequency distributions shown in Table 18 indicate that 8 percent of females 12-18 years of age, 9 percent of females 19-34 years of age, 7 percent of females 35-50 years of age, 11 percent of females 51-64 years of age and 8 percent of females 65 years of age and over met the NRC-RDA. Although the NRC-RDA for magnesium is higher for males than for females, more males consumed the recommended amount per day than did females. Seventeen percent of males aged 12-18 years, 15 percent of males aged 19-34 years, 12 percent of males aged 35-50 years, 13 percent of males aged 51-64 years and 8 percent of males aged 65 years and over

Table 18. Frequency distribution of average[a] daily intake of magnesium for individuals[b] of specified age/sex groups of the U.S. Population.

Magnesium Intake mg/day	Age/Sex Classification											
	0-5 Yrs Total		6-11 Yrs Total		12-18 Yrs Female		12-18 Yrs Male		19-34 Yrs Female		19-34 Yrs Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
Under 20	1.50	1.50		0.00	.15	.15	.12	.12	.06	.06		
21-40	1.86	3.36	.10	.10	.68	.83	.04	.16	.75	.81	.08	.08
41-60	4.25	7.61	.44	.54	1.59	2.42	.23	.39	2.24	3.05	.62	.70
61-80	7.31	14.92	1.01	1.55	3.15	5.57	.55	.94	4.49	7.54	1.04	1.74
81-100	9.16	24.08	2.58	4.13	5.46	11.03	1.56	2.50	8.16	15.70	2.28	4.02
101-120	12.37	36.45	4.83	8.96	8.76	19.79	3.27	5.77	9.29	24.99	3.94	7.96
121-140	13.06	49.51	8.31	17.27	9.82	29.61	4.48	10.25	11.22	36.21	6.35	14.31
141-160	13.48	62.99	10.51	27.78	10.69	40.30	6.19	16.44	11.97	48.18	8.05	22.36
161-180	11.08	74.07	11.51	39.29	11.56	51.86	7.24	23.68	10.31	58.49	7.72	30.08
181-200	9.01	83.08	12.03	51.32	10.20	62.06	9.35	33.03	9.22	67.71	8.51	38.59

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 18 Continued. Frequency distribution of average[a] daily intake of magnesium for individuals[b] of specified age/sex groups of the U.S. Population.

	Age/Sex Classification											
	0-5 Yrs Total		6-11 Yrs Total		12-18 Yrs Female		12-18 Yrs Male		19-34 Yrs Female		19-34 Yrs Male	
Magnesium Intake mg/day	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
201-220	5.27	88.35	12.00	63.32	8.76	70.82	8.64	41.67	8.16	75.87	9.05	47.64
221-240	3.89	92.24	9.16	72.48	6.71	77.53	8.45	50.12	5.52	81.39	7.26	54.90
241-260	2.01	94.25	7.82	80.30	6.75	84.28	8.53	58.64	4.36	85.75	7.76	62.66
261-280	1.50	95.75	5.11	85.41	4.17	88.45	7.09	65.73	3.15	89.90	5.73	68.39
281-300	1.20	96.95	4.00	89.41	3.07	91.52	4.87	70.60	2.43	91.33	5.39	73.78
301-320	.69	97.64	2.89	92.30	2.05	93.57	4.83	75.43	1.65	92.98	4.94	78.72
321-340	.45	98.09	1.81	94.11	1.25	94.82	4.48	79.91	1.50	94.48	3.44	82.16
341-360	.33	98.42	1.26	95.37	1.10	95.92	3.12	83.03	.65	95.13	3.11	85.27
361-380	.21	98.63	1.06	96.43	.83	96.75	3.31	86.34	.65	95.78	2.82	88.09
381-400	.21	98.84	.62	97.05	.45	97.20	2.53	88.87	.50	96.28	1.66	89.75

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 18 Continued. Frequency distribution of average[a] daily intake of magnesium for individuals[b] of specified age/sex groups of the U.S. Population.

Magnesium Intake mg/day	Age/Sex Classification											
	0-5 Yrs Total		6-11 Yrs Total		12-18 Yrs Female		12-18 Yrs Male		19-34 Yrs Female		19-34 Yrs Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
401-420	.06	98.90	.34	97.39	.49	97.69	2.02	90.89	.34	96.62	1.99	91.74
421-440	.06	98.96	.31	97.70	.27	97.96	1.48	92.37	.37	96.99	1.29	93.03
441-460		98.96	.10	97.80	.27	98.23	1.21	93.58	.16	97.15	.87	93.90
461-480	.09	99.05	.10	97.90	.19	98.42	.70	94.28	.22	97.37	.87	94.77
481-500		99.05	.13	98.03	.14	98.56	.66	94.94	.25	97.62	.41	95.18
501-520	.03	99.08	.10	98.13	.14	98.70	.66	95.60	.03	97.65	.66	95.84
521-540	.06	99.14	.15	98.28	.08	98.78	.47	96.07	.03	97.68	.29	96.13
541-560	.03	99.17	.08	98.36	.08	98.86	.51	96.58	.09	97.77	.46	96.59
561-580	.03	99.20	.03	98.39	.08	98.94	.55	97.13	.09	97.86	.29	96.88
581-600		99.20	.03	98.42	.08	99.02	.43	97.56	.06	97.92	.33	97.21
OVER 601	.80	100.00	1.58	100.00	.99	100.01	2.44	100.00	2.07	99.99	2.78	99.99

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 18 Continued. Frequency distribution of average[a] daily intake of magnesium for individuals[b] of specified age/sex groups of the U.S. Population.

Magnesium Intake mg/day	Age/Sex Classification											
	35-50 Yrs Female		35-50 Yrs Male		51-64 Yrs Female		51-64 Yrs Male		65 & Over Female		65 & Over Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
Under 20	.04	.04			.05	.05			.06	.06		
21-40	.34	.38	.12	.12	.20	.25	.07	.07	.06	.12		
41-60	1.25	.163	.24	.36	.56	.81	.43	.50	1.33	1.45	.59	.59
61-80	3.44	5.07	.60	.96	2.14	2.95	.65	1.15	2.36	3.81	.99	1.58
81-100	5.47	10.54	2.11	3.07	4.58	7.53	1.22	2.37	4.47	8.28	2.17	3.75
101-120	10.12	20.66	2.47	5.54	7.23	14.76	3.67	6.04	8.46	16.74	4.64	8.39
121-140	11.75	32.41	4.70	10.24	10.59	25.34	4.32	10.36	9.49	26.23	5.43	13.82
141-160	13.39	45.80	7.35	17.59	12.37	37.71	5.90	16.26	13.72	39.95	7.80	21.62
161-180	12.61	58.41	7.90	25.49	12.11	49.82	7.91	24.17	12.75	52.70	10.66	32.28
181-200	9.94	68.35	11.27	36.76	10.03	59.85	10.43	34.60	11.12	63.82	9.08	41.36

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 18 Continued. Frequency distribution of average[a] daily intake of magnesium for individuals[b] of specified age/sex groups of the U.S. Population.

Magnesium Intake mg/day	Age/Sex Classification											
	35-50 Yrs Female		35-50 Yrs Male		51-64 Yrs Female		51-64 Yrs Male		65 & Over Female		65 & Over Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
201-220	7.53	75.88	9.16	45.92	10.23	70.08	9.42	44.02	9.24	73.06	10.07	51.43
221-240	7.11	82.99	9.28	55.20	6.51	76.59	9.28	55.30	7.19	80.25	8.00	59.43
241-260	4.65	87.64	8.74	63.94	5.65	82.24	9.14	62.44	5.26	85.51	8.09	67.52
261-280	3.44	91.08	6.57	70.51	4.27	86.51	7.27	69.71	3.99	89.50	7.80	75.32
281-300	1.98	93.06	6.09	76.60	2.90	89.41	5.25	74.96	2.53	92.03	5.43	80.75
301-320	1.68	94.74	4.40	81.00	2.34	91.75	5.18	80.14	1.45	93.48	3.46	84.21
321-340	.82	95.56	3.68	84.68	1.88	93.63	3.45	83.59	1.09	94.57	3.95	88.16
341-360	.73	96.29	3.25	87.93	1.02	94.65	3.45	87.04	1.15	95.72	2.86	91.02
361-380	.47	96.76	3.08	91.01	.92	95.57	2.45	89.49	.48	96.20	1.58	92.60
381-400	.47	97.23	2.29	93.30	.66	96.23	2.09	91.58	.54	96.74	.99	93.59

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 18 Continued. Frequency distribution of average[a] daily intake of magnesium for individuals[b] of specified age/sex groups of the U.S. Population.

Magnesium Intake mg/day	Age/Sex Classification											
	35-50 Yrs Female		35-50 Yrs Male		51-64 Yrs Female		51-64 Yrs Male		65 & Over Female		65 & Over Male	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
401-420	.13	97.36	1.27	94.57	.51	96.74	1.58	93.16	.36	97.10	.99	94.58
421-440	.26	97.62	.66	95.23	.05	96.79	1.37	94.53	.36	97.46	.59	95.17
441-460	.22	97.84	.78	96.01	.25	97.04	.50	95.03	.18	97.64	.79	95.96
461-480	.17	98.01	.60	96.61	.15	97.19	.43	95.46	.18	97.82	.59	96.55
481-500		98.01	.19	96.80	.15	97.34	.79	96.25	.06	97.88	.59	97.14
501-520	.13	98.14	.60	97.40	.15	97.49	.29	96.54	.18	98.06		97.14
521-540	.04	98.18	.25	97.65	.10	97.59	.15	96.69	.06	98.12	.30	97.44
541-560		98.18	.06	97.71	.10	97.69	.22	96.91	.06	98.18	.20	97.64
561-580		98.18	.06	97.77	.10	97.79	.22	97.13	.06	98.24		97.64
581-600	.09	98.27	.06	97.83	.10	97.89	.65	97.78	.24	98.48	.49	98.13
OVER 600	1.72	99.99	2.17	100.00	2.10	99.99	2.22	100.00	1.51	99.99	1.88	100.01

[a] Based on a 24-hour recall plus two subsequent day diet records.

[b] 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

had average daily intake levels over 350 milligrams magnesium per day. It is apparent that magnesium intake levels of the U.S. population fall short of the recommended amount. The significance of magnesium intakes less than 100 percent of the NRC-RDA has not been established.

The hardness of water may be associated with magnesium intake. Magnesium content of water is not considered in the data base. Magnesium content of drinking water, coffee, tea, and carbonated beverages may add significant magnesium to the diet--dependent upon the source of the water. Higher magnesium intakes may have been seen if the contribution from water had been included in the calculations.

Seasonal Variation

Seasonal variation of food consumption has been suggested to alter the nutrient composition of diets. Keys (1979) stated that seasonal variation in the diet, due to different foods available, different eating habits and different physical activity levels, deserves much more attention than it generally receives. Although foods eaten throughout the year vary, Crocetti and Guthrie (1981b) found nutrient compositon of the diet to be similar thorughout the entire year.

Examination of dietary intake levels of cholesterol, polyunsaturated fatty acids, saturated fatty acids, linoleic acid and oleic acid for each of the four seasons in all age/sex categories showed minimal seasonal variation (Tables 19-30). Cholesterol intake varied slightly from season to season, but individual intake levels were not consistently higher in one season than in any other. The season with individuals consuming the highest mean cholesterol intake was not necessarily the season individuals consumed the highest saturated fatty

Table 19. Comparison of average daily intake[a] of eight dietary components consumed by children ages 0-5 years during four seasons of the year.

Dietary Component	Seasons								All Seasons	
	Spring (N = 761)		Summer (N = 822)		Fall (N = 869)		Winter (N = 835)		(N = 3288)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Cholesterol, mg	208	137	208	142	214	128	201	128	208	134
Polyunsaturated Fatty Acids, g	6.7	4.5	7.1	4.5	6.9	4.5	6.5	3.7	6.8	4.3
Saturated Fatty Acids, g	19.6	9.3	20.6	9.0	21.2	8.7	20.1	8.5	20.4	8.8
Magnesium, mg	146	88	157	154	153	87	162	163	154	123
Copper, µg	884	489	917	486	997	501	957	503	941	495
Zinc, mg	6.3	4.7	6.3	3.3	6.4	3.0	6.2	3.9	6.3	3.7
Linoleic Acid, g	4.8	3.8	4.5	3.3	4.9	3.6	4.5	3.0	4.7	3.4
Oleic Acid, g	15.2	8.6	15.3	8.5	16.1	8.2	14.8	7.7	15.4	8.2

[a] Based on a 24-hour recall plus two subsequent day diet records from the 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 20. Comparison of average[a] daily intake of eight dietary components consumed by children ages 6-11 years during four seasons of the year.

Dietary Component	Seasons								All Seasons	
	Spring (N = 846)		Summer (N = 953)		Fall (N = 1010)		Winter (N = 981)		(N = 3790)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Cholesterol, mg	276	148	280	144	291	131	275	134	281	139
Polyunsaturated Fatty Acids, g	9.9	5.0	10.3	5.6	10.4	4.7	9.9	4.3	10.2	4.9
Saturated Fatty Acids, g	27.3	10.8	28.4	11.3	30.7	9.6	29.3	9.5	29.0	10.3
Magnesium, mg	211	156	223	195	231	217	225	168	223	185
Copper, µg	1198	562	1243	601	1380	546	1337	540	1294	562
Zinc, mg	8.7	3.4	8.9	3.4	9.3	2.9	8.9	3.0	8.9	3.2
Linoleic Acid, g	7.7	4.2	7.6	4.4	8.1	3.9	7.7	3.6	7.8	4.0
Oleic Acid, g	23.3	8.8	24.1	9.5	25.4	8.2	24.2	7.9	24.3	8.6

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[a] Based on a 24-hour recall plus two subsequent day diet records from the 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 21. Comparison of average[a] daily intake of eight dietary components consumed by females ages 12-18 years during four seasons of the year.

	Seasons								All Seasons	
	Spring (N = 668)		Summer (N = 671)		Fall (N = 660)		Winter (N = 622)		(N = 2621)	
Dietary Component	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Cholesterol, mg	280	163	273	156	282	145	272	145	277	152
Polyunsaturated Fatty Acids, g	10.5	6.3	10.3	5.7	10.0	5.0	9.9	5.7	10.2	5.7
Saturated Fatty Acids, g	27.7	13.8	27.2	12.7	28.7	10.7	27.7	10.7	27.8	12.0
Magnesium, mg	205	175	183	97	193	104	205	180	196	138
Copper, µg	1094	622	1093	641	1192	550	1148	517	1131	584
Zinc, mg	8.7	4.8	8.4	3.8	8.9	3.5	8.4	3.0	8.6	3.8
Linoleic Acid, g	8.3	5.1	7.7	4.7	7.8	4.2	8.1	4.9	8.0	4.7
Oleic Acid, g	23.8	11.3	23.5	10.5	24.6	9.3	23.7	9.0	23.9	10.0

[a] Based on a 24-hour recall plus two subsequent day diet records from the 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 22. Comparison of average[a] daily intake of eight dietary components consumed by females ages 19-34 years during four seasons of the year.

Dietary Component	Seasons								All Seasons (N = 5347)	
	Spring (N = 1166)		Summer (N = 1395)		Fall (N = 1421)		Winter (N = 1365)			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Cholesterol, mg	285	184	291	285	284	232	285	240	286	237
Polyunsaturated Fatty Acids, g	10.2	6.5	10.6	8.7	10.1	7.5	10.3	7.7	10.3	7.6
Saturated Fatty Acids, g	24.6	12.6	24.9	17.6	25.5	16.2	24.6	16.0	24.9	15.7
Magnesium, mg	200	224	204	316	203	400	202	278	202	308
Copper, µg	959	655	955	892	1034	891	996	736	987	801
Zinc, mg	8.1	4.1	8.2	5.6	8.1	5.5	8.0	5.9	8.1	5.3
Linoleic Acid, g	8.0	5.3	8.4	7.3	8.0	6.5	8.2	6.4	8.1	6.4
Oleic Acid, g	22.0	10.9	22.7	15.3	23.1	14.5	22.1	14.7	22.5	14.0

[a] Based on a 24-hour recall plus two subsequent day diet records from the 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 23. Comparison of average[a] daily intake of eight dietary components consumed by females ages 35-50 years during four seasons of the year.

Dietary Component	Seasons								All Seasons (N = 3850)	
	Spring (N = 838)		Summer (N = 975)		Fall (N = 1056)		Winter (N = 980)			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Cholesterol, mg	280	164	285	250	308	233	288	231	291	222
Polyunsaturated Fatty Acids, g	10.2	5.7	10.6	8.1	10.1	7.3	9.9	6.9	10.2	7.0
Saturated Fatty Acids, g	22.9	10.8	23.3	15.0	24.2	14.7	23.7	13.8	23.6	13.7
Magnesium, mg	194	224	200	264	191	210	199	325	196	256
Copper, µg	866	579	917	871	960	940	1020	1199	944	910
Zinc, mg	7.8	3.7	7.9	5.3	8.2	5.9	8.0	6.7	8.0	5.5
Linoleic Acid, g	8.0	4.7	8.1	6.7	7.9	6.3	8.0	6.1	8.0	6.0
Oleic Acid, g	21.4	9.9	22.1	14.3	22.8	13.8	21.9	12.5	22.1	12.7

[a] Based on a 24-hour recall plus two subsequent day diet records from the 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 24. Comparison of average[a] daily intake of eight dietary components consumed by females ages 51-64 years during four seasons of the year.

Dietary Component	Seasons								All Seasons (N = 3225)	
	Spring (N = 717)		Summer (N = 847)		Fall (N = 879)		Winter (N = 782)			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Cholesterol, mg	300	181	289	247	293	241	281	220	291	224
Polyunsaturated Fatty Acids, g	10.2	5.8	10.0	8.0	9.7	7.2	9.7	6.6	9.9	6.9
Saturated Fatty Acids, g	23.1	10.5	23.8	17.1	23.5	14.8	22.9	13.4	23.3	14.1
Magnesium, mg	215	280	265	677	230	374	206	225	230	397
Copper, µg	941	591	934	801	1008	844	988	860	969	780
Zinc, mg	8.0	3.7	8.2	6.4	7.9	5.9	7.9	5.3	8.0	5.4
Linoleic Acid, g	8.2	5.0	8.0	6.7	8.0	6.0	7.8	5.6	8.0	5.9
Oleic Acid, g	21.9	10.0	22.1	15.2	22.1	13.9	21.7	12.2	22.0	13.0

[a] Based on a 24-hour recall plus two subsequent day diet records from the 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 25. Comparison of average[a] daily intake of eight dietary components consumed by females ages 65 years and over during four seasons of the year.

	Seasons								All	
	Spring (N = 519)		Summer (N = 738)		Fall (N = 750)		Winter (N = 724)		Seasons (N = 2731)	
Dietary Component	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Cholesterol, mg	266	165	259	226	267	214	268	204	265	205
Polyunsaturated Fatty Acids, g	9.0	5.2	8.6	7.0	8.6	6.0	8.2	6.3	8.6	6.2
Saturated Fatty Acids, g	21.6	9.8	21.3	14.9	21.5	12.2	20.5	12.5	21.2	12.6
Magnesium, mg	210	216	219	282	203	221	201	280	208	252
Copper, μg	1003	752	962	914	1007	936	990	923	989	892
Zinc, mg	7.6	3.6	7.4	5.0	7.6	5.8	7.3	5.4	7.5	5.1
Linoleic Acid, g	7.5	4.6	7.0	5.9	7.0	5.1	7.0	5.3	7.1	5.3
Oleic Acid, g	19.9	9.1	19.6	13.3	19.8	11.1	19.0	11.1	19.5	11.3

[a] Based on a 24-hour recall plus two subsequent day diet records from the 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 26. Comparison of average[a] daily intake of eight dietary components consumed by males ages 12-18 years during four seasons of the year.

Dietary Component	Seasons								All Seasons	
	Spring (N = 661)		Summer (N = 594)		Fall (N = 636)		Winter (N = 654)		(N = 2545)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Cholesterol, mg	401	239	386	217	410	206	386	192	396	214
Polyunsaturated Fatty Acids, g	14.0	7.5	13.5	7.9	13.8	6.8	13.2	6.4	13.6	7.1
Saturated Fatty Acids, g	38.9	17.7	37.7	16.8	39.3	14.0	38.8	15.4	38.7	16.0
Magnesium, mg	297	428	293	462	281	235	280	266	288	346
Copper, µg	1552	937	1545	847	1641	750	1625	735	1591	817
Zinc, mg	12.2	5.8	11.9	5.1	12.3	4.5	11.8	4.3	12.1	4.9
Linoleic Acid, g	10.7	6.2	10.3	6.4	11.0	5.9	10.5	5.2	10.6	5.9
Oleic Acid, g	33.6	14.7	33.1	14.8	33.8	12.0	33.2	12.9	33.4	13.6

[a] Based on a 24-hour recall plus two subsequent day diet records from the 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 27. Comparison of average[a] daily intake of eight dietary components consumed by males ages 19-34 years during four seasons of the year.

Dietary Component	Seasons								All Seasons (N = 3929)	
	Spring (N = 965)		Summer (N = 985)		Fall (N = 927)		Winter (N = 1052)			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Cholesterol, mg	432	259	415	331	459	358	432	316	434	316
Polyunsaturated Fatty Acids, g	15.3	8.3	14.3	11.0	15.4	10.9	15.0	10.4	15.0	10.2
Saturated Fatty Acids, g	38.1	18.5	36.1	24.2	40.2	24.2	38.0	22.6	38.1	22.4
Magnesium, mg	264	224	275	478	274	251	267	258	270	303
Copper, µg	1312	771	1347	1144	1521	1267	1470	1159	1412	1086
Zinc, mg	12.3	5.9	11.7	7.3	12.5	7.1	12.1	6.7	12.1	6.8
Linoleic Acid, g	11.5	6.7	10.7	8.8	11.9	9.4	11.6	8.0	11.4	8.2
Oleic Acid, g	35.0	16.7	32.8	21.6	36.9	22.0	35.1	20.6	34.9	20.2

[a] Based on a 24-hour recall plus two subsequent day diet records from the 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 28. Comparison of average[a] daily intake of eight dietary components consumed by males ages 35-50 years during four seasons of the year.

Dietary Component	Seasons								All Seasons	
	Spring (N = 716)		Summer (N = 695)		Fall (N = 590)		Winter (N = 669)		(N = 2670)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Cholesterol, mg	437	239	431	348	430	305	430	308	432	299
Polyunsaturated Fatty Acids, g	14.5	7.5	16.1	14.5	14.5	9.9	14.5	10.2	14.9	10.6
Saturated Fatty Acids, g	35.7	15.5	37.1	25.5	36.7	22.3	36.4	21.5	36.5	21.1
Magnesium, mg	242	109	277	333	270	321	265	304	263	263
Copper, μg	1255	912	1220	1003	1336	1772	1283	895	1271	1122
Zinc, mg	11.6	5.3	12.0	7.3	12.2	11.4	11.4	5.7	11.8	7.3
Linoleic Acid, g	11.2	6.2	11.9	11.9	10.9	7.5	11.1	8.3	11.3	8.5
Oleic Acid, g	33.3	14.1	35.4	22.5	34.2	19.5	34.5	19.5	34.3	18.8

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[a] Based on a 24-hour recall plus two subsequent day diet records from the 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 29. Comparison of average[a] daily intake of eight dietary components consumed by males ages 51-64 years during four seasons of the year.

Dietary Component	Seasons								All Seasons	
	Spring (N = 580)		Summer (N = 550)		Fall (N = 538)		Winter (N = 601)		(N = 2268)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Cholesterol, mg	434	249	428	354	427	323	429	327	429	313
Polyunsaturated Fatty Acids, g	14.0	7.7	14.4	10.5	14.1	9.6	13.7	9.8	14.0	9.4
Saturated Fatty Acids, g	33.4	14.9	35.5	23.2	35.0	20.4	34.0	22.0	34.5	20.1
Magnesium, mg	252	154	278	286	284	460	285	444	275	335
Copper, µg	1235	751	1251	1060	1403	1157	1402	1716	1323	1178
Zinc, mg	11.4	5.5	11.2	6.2	11.6	7.0	12.0	12.6	11.5	7.9
Linoleic Acid, g	10.9	6.5	11.4	9.4	11.2	8.1	10.8	7.9	11.1	8.0
Oleic Acid, g	32.0	14.9	32.8	20.8	33.4	19.6	32.3	20.4	32.6	18.9

[a] Based on a 24-hour recall plus two subsequent day diet records from the 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

Table 30. Comparison of average[a] daily intake of eight dietary components consumed by males ages 65 years and over during four seasons of the year.

	Seasons								All	
	Spring (N = 386)		Summer (N = 406)		Fall (N = 414)		Winter (N = 449)		Seasons (N = 1655)	
Dietary Component	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Cholesterol, mg	390	219	383	302	398	287	382	295	388	277
Polyunsaturated Fatty Acids, g	11.8	6.5	11.6	9.1	11.4	8.8	10.8	7.4	11.4	8.0
Saturated Fatty Acids, g	29.2	13.8	29.6	18.5	30.0	19.4	28.5	17.0	29.3	17.2
Magnesium, mg	260	349	290	508	264	296	225	134	259	316
Copper, µg	1190	844	1185	957	1291	950	1326	1562	1251	1093
Zinc, mg	10.2	6.2	10.3	7.6	9.9	7.1	10.6	11.4	10.3	8.2
Linoleic Acid, g	9.7	5.8	8.8	6.7	9.2	7.8	8.8	6.2	9.1	6.6
Oleic Acid, g	27.9	12.7	27.6	17.2	27.9	17.8	26.6	15.0	27.5	15.7

[a] Based on a 24-hour recall plus two subsequent day diet records from the 1977-78 Nationwide Food Consumption Survey, Individual Dietary Intake, Basic Survey, USDA Human Nutrition Information Service, Consumer Nutrition Center, Hyattsville, MD.

acid intake. Cholesterol and saturated fatty acid therefore, were not consumed in equal proportions. In most cases, the season that individuals in each age/sex classification consumed the highest levels of polyunsaturated fatty acid, was also the season they showed the highest linoleic acid intake. This was as anticipated because one would expect linoleic acid to contribute the major proportion of polyunsaturated fatty acids.

The season that individuals consumed the lowest mean oleic acid intake was also the season that individuals consumed the lowest saturated fatty acid intake except for children aged 0-5 years and females aged 19-34 years. Saturated fatty acids and oleic acid may have been consumed in equal proportions, but polyunsaturated fatty acids did not appear to be consumed in proportion to either saturated fatty acids or oleic acid. Individual's average copper, zinc and magnesium intake levels also showed little seasonal variation (Tables 19-30). Mean copper intake was the highest in the fall quarter for all age/sex categories except for females aged 35-50 years and males aged 65 years and over. Zinc intakes were often highest fall quarter, indicating that copper and zinc may have been consumed in approximately equal proportions in the diet. Although some trends in seasonal variation appeared, the differences were small and at best can only be considered for thought.

Completeness of Nutrient Composition Data

Frequently consumed food items were examined to determine the completeness of nutrient composition data. Cholesterol, saturated fatty acid, polyunsaturated fatty acid, magnesium and zinc composition data were found to be complete. Calculated average copper intakes may be lower than the actual intakes due to unavailable copper composition data for some frequently consumed foods.

One of the problems with diet surveys is that adequate data on nutrient content of foods, especially of nutrients such as copper and zinc, does not exist. As indicated in the review of literature, there were substantial data on lipid composition of many foods, but inadequate data available on lipid composition of baked products, fast foods, lamb, sausage, soups and snack foods (Stewart, 1981). Magnesium content data were available for a considerable number of foods, but few foods have been analyzed for copper and zinc (Stewart, 1981). The Michigan State University Nutrient Data Bank lists unknown for foods that do not have composition values for the nutrient in question. Unknown values were counted as zero when calculating mean intakes. Since the completeness of composition data for the nutrients examined in this study may have an effect on the results, a listing of food items missing composition data and frequency consumption of these food items were completed as discussed in the methods. Food items with missing composition data which were consumed greater than one percent of total food item consumption frequency in any age/sex classification are listed in Appendix II. Appendix II also showed the nutrient composition values missing for the most commonly consumed food items with specified missing composition data.

The lipid composition data in the USDA-MSU Converted Nutrient Data Bank appeared to be complete. Some food items frequently consumed had missing data for cholesterol, polyunsaturated fatty acid and saturated fatty acid content, but most of these food items were not significant sources of these dietary components. The fatty acid and cholesterol content of bread, rolls, rice and cornflakes is usually minimal. Several fruits and vegetables (orange juice, apples, bananas, potatoes, tomatoes, tomato catsup and lettuce) were frequently consumed and did not list cholesterol, saturated fatty acid and polyunsaturated fatty acid content. However, fruits and vegetables are insignificant sources of lipids. Mustard, sugar and jellies also do not contain significant lipid and were not a concern to the accuracy of calculated lipid intake levels in this study. Beverages missing lipid composition data included: coffee, tea, beer, carbonated beverages and diet carbonated beverages. Cholesterol, polyunsaturated fatty acid and saturated fatty acid composition of these beverages are insignificant. The cholesterol content of margarine posed no problem as plant fats contain no cholesterol.

Food items missing lipid composition data that may have affected the results of this study included bacon, peanut butter, chocolate chip cookies and potato chips. The cholesterol content of bacon was not added in this survey; cholesterol content of bacon is available (approximately 6.0 grams/slice) and it is unknown why it was missing in the data base. Males aged 12-18 years consumed bacon more frequently than other age/sex categories; bacon was consumed 974 times among 2545 individuals ages 12-18 years. If 2 slices were considered the average serving size of bacon, the average cholesterol intake would increase by approximately 4.6 milligrams per day. The difference in mean cholesterol intake in other age/sex categories would be even smaller since the frequency of bacon consumption was less. Therefore, the alteration in cholesterol intakes would be small because of the small number of food items missing lipid composition data. It can be concluded that incomplete cholesterol, saturated fatty acid and polyunsaturated fatty acid composition data of the USDA-MSU Converted Nutrient Data bank did not affect this study. It was possible that the calculated values were lower than what was actually consumed. However, White et al., (1981) found cholesterol content of diets to be higher when calculated than when the diet was chemically analyzed.

Magnesium content data were missing for these frequently consumed food items: 2% milk, frankfurters, gravies, mashed potatoes, mayonnaise, coffee, tea, diet carbonated beverages, carbonated beverages and beer. None of these foods are considered to be a rich source of magnesium, although magnesium occurs abundantly in foods. The magnesium content of coffee, tea, carbonated beverages and beer would depend upon the magnesium content of the water used in their preparation. This would vary dependent upon the hardness of the water and would be very difficult to ascertain. Lowfat milk did contain magnesium and the magnesium content was listed in the USDA-MSU Converted Nutrient Data Bank. It was unknown why the magnesium content of 2% milk was missed in the calculation of mean intakes. Lowfat milk was consumed most frequently among children aged 6-11 years, 2% milk was consumed 2500 times in a sample of 3790 children. Magnesium content of milk was approximately 37 milligrams per 8 ounces. With a serving of milk considered to be 8 ounces, the mean content of magnesium for children aged 6-11 years would increase approximately 24 milligrams. Comparisons of the mean intake in this study for children aged 6-11 years (223 milligrams) with that found by the USDA, (1980) for the same age group (224 milligrams) indicated no difference in calculated magnesium intake values. As discussed in the materials and methods section, no significant differences in magnesium intake were found between the USDA data base and the USDA-MSU Converted

Nutrient Data Bank; therefore, the USDA-MSU Converted Nutrient Data Bank was considered valid. It appeared that magnesium composition values of the data base were complete.

Copper composition values were missing for cheese, bacon, scrambled eggs, rice, potato chips, mustard, butter, margarine, coffee, tea, beer, diet carbonated beverages and carbonated beverages. Copper is widely distributed in foods, the richest sources of copper are oysters, nuts, liver, kidney, corn oil margarine and dried legumes (NRC, 1980). Therefore, the mean copper intakes found in this study could be low due to exclusion of copper composition of several frequently consumed food items, especially margarine. The contribution of beverages to the total copper intake would vary with the mineral content of the water source. Nevertheless, copper composition of food may actually be lower than found in food composition tables; Klevay et al. (1980) found calculated copper values to be greater than analyzed values of duplicate diets. Available data on the amount of copper in food may be erroneous and daily intake results may not include several significant sources of copper. Although the USDA-MSU Converted Nutrient Data Bank contained current available information, it must be kept in mind that copper composition data were not adequate and actual mean copper intakes may vary from those reported here.

Diets assessed for zinc content by using food composition tables compared favorably with assayed value of the same diets (Brown et al., 1976; White, 1976; Haeflein and Rasmussen, 1977). The frequently consumed food items consisting of bacon, potato chips, coffee, tea, beer, diet carbonated beverages and carbonated beverages were missing composition values for zinc. The National Research Council has stated that the zinc content of most municipal water is negligible and that the best sources of zinc are meat, liver, eggs and seafood (NRC, 1980). Therefore, beverage intake should not have much affect on mean zinc intake. None of the frequently consumed food items above should have had much affect on calculated mean zinc intake values, except for bacon. At 0.006 milligrams zinc per slice of bacon the change in mean zinc intake would be minimal. It can be concluded that zinc composition of food items in the USDA-MSU Converted Nutrient Data Bank was complete. Although the data were complete, the biological availability of zinc was not examined. Certain foods, such as meat and seafoods, are much better sources of available zinc than vegetable products (NRC, 1980). It may be helpful in future studies of nutrient consumption if other factors such as bioavailability, storage and cooking method are considered when assessing levels of consumption.

SUMMARY AND CONCLUSIONS

The 1977-78 Nationwide Food Consumption Survey (NFCS) of 37,919 individuals (weighted by the USDA to correct nonrepresentativeness in the sample population) indicated that age and sex had an impact on cholesterol, polyunsaturated fatty acid, saturated fatty acid, linoleic acid, oleic acid, copper, zinc and magnesium intakes of the U.S. population. Diet information obtained from each individual included the kind and amount of food eaten. Diet intake methodology included a 24-hour diet recall and two day diet records, thus providing dietary intake information for three consecutive days. Since the sample was based on household data, the individuals surveyed were not a random sample of the U.S. population. The large sample size and the averaging of data for three days aided in the reliable use of these data.

The data were analyzed at the University of Missouri-Columbia to determine the average daily intakes of 8 dietary components. The dietary components which were assessed included: cholesterol, polyunsaturated fatty acids, saturated fatty acids, linoleic acid, oleic acid, copper, zinc and magnesium. This analysis was performed for 12 age/sex classifications to determine the impact of age and sex on nutrient intakes. Nutritive values were calculated from the MSU Nutrient Data Bank. This required the conversion of NFCS food intake information to the MSU data bank. Conversion of USDA Nutrient Data Bank items was accomplished using a MSU Nutrient Data Bank food item or a proportion of MSU Nutrient Data Bank food items for each food consumed 25 times or more in the entire study. The accuracy of the conversion was compared initially by examination of ratios between the 2 data bases for 15 nutrients: kilocalories, protein, fat, carbohydrate, calcium, iron, magnesium, phosphorous, vitamin A, thiamin, riboflavin, vitamin B_6 preformed niacin, vitamin B_{12} and ascorbic acid. Validity of the conversions was assessed by calculating mean values and standard deviation for a random population of 800 individuals using the USDA data base and the USDA-MSU Converted Nutrient Data Bank. No statistically significant differences were found indicating that the conversions were valid.

The results revealed that mean cholesterol intakes of females and children were within the level recommended by the American Heart Association (less than 300 milligram cholesterol per day). Mean cholesterol intakes for males exceeded this recommendation. Since average cholesterol intake was higher in age/sex categories that also had higher average kilocalories intake, the mean cholesterol intake per 1000 kilocalories was examined. There was a progressive increase in mean cholesterol intake per 1000 kilocalories with increasing age after the age of 5 years except for females aged 65 years and over. Differences seen in mean cholesterol intake of males and females were not as evident when examining cholesterol intake per 1000 kilocalories of the diet. The males in each age classification had a higher ratio of cholesterol to kilocalories than did females in the same age classification, but the amount of cholesterol per 1000 kilocalories did not vary greatly among the sexes.

The average fat content of the diet for adults decreased with age. All age/sex classifications examined in this study exceeded the recommendation of the American Heart Association that total kilocalories from fat be 30 percent or lower. Saturated fatty acids and polyunsaturated fatty acids contributed approximately 14 percent and 5-6 percent of total kilocalories, respectively. Linoleic acid was found to be consumed in adequate amounts; the average linoleic acid content of diets in the U.S. was not excessive. Few studies have examined oleic acid. Oleic acid was found to contribute between one-fourth and one-third of the total fat intake. Fat that was unidentified, or was not classified as saturated, polyunsaturated or monosaturated (oleic) fatty acids accounted for 21-24 percent of the total fat intake.

For the lipid components saturated fatty acids, polyunsaturated fatty acids, linoleic acid and oleic acid, there was a progressive decrease in mean intake with increasing age for adults. This reflected decreasing food intake with increasing age. Average intakes for females and children were less than the average intakes for males, also reflecting the greater kilocalorie intakes found for males.

In recent years, there has been much concern generated from the scientific community regarding lipid components of the diet and their relationship to coronary heart disease. This study and previous research confirm that cholesterol, fat and saturated fatty acid intakes of the diet may be greater than deemed desirable. More research on the cause and effect of lipid components on CHD as well as continued research on changes in the U.S. diet are needed.

The results of this study indicate that a large percentage of the U.S. population consumed less copper than was considered adequate. A large proportion of the U.S. population also failed to meet 100 percent of the NRC-RDA for zinc. Females consumed less zinc and copper than did males. This is attributed to lower average kilocalorie intake of females. The zinc to copper ratio has been linked to CHD. The ratio of zinc to copper for children aged 0-5 years and aged 6-11 years was 6.7 and 6.9, respectively; the ratio for adults ranged from 7.6 to 9.3. Some believe that an increase in copper content of the diet resulting in a decreased zinc to copper ratio may be desirable in the prevention of heart disease.

Magnesium intakes of the U.S. population were less then 100 percent of the NRC-RDA. This was in agreement with other reports; the significance of this level of magnesium intake has not been established.

Examination of dietary intake for each of the four seasons in all age/sex classifications showed minimal seasonal variation. It was concluded that there was little seasonal variation in the mean intakes of cholesterol, saturated fatty acids, polyunsaturated fatty acids, oleic acid, linoleic acid, copper, zinc and magnesium.

Since the completeness of nutrient composition data may have an effect on resulting average intakes, frequency consumption of food items and a listing of food items missing composition data were completed. Cholesterol, saturated fatty acid, polyunsaturated fatty acid, magnesium and zinc data were found to be complete. Copper intakes may be lower than the actual values due to unavailable copper composition data and old analytical data.

Further investigations might include a more in depth analysis of the data in relation to socioeconomic and demographic characteristics of the population. It would be interesting to study the contribution of foods eaten away from home in comparison to foods eaten at home on cholesterol and fatty acid content of the diet.

The NFCS survey data and the USDA-MSU Converted Nutrient Data Bank could be utilized to provide intake information for other nutrients of interest, such as sodium and potassium. Examination of the validity of the data base for other dietary components could provide useful information in regard to completeness of composition data.

The USDA intends to begin continuous monitoring of individual dietary intake for the U.S. population. Analysis of future food consumption surveys for cholesterol, polyunsaturated fatty acids, saturated fatty acids, oleic acid, linoleic acid, copper, zinc and magnesium could be used to assess changes in food consumption patterns. This would be especially useful if serum cholesterol data for individuals were also available. Recognizing the health implications of excess or deficient intakes of the dietary components in question, it would be beneficial to continually compare where the United States population stands with regard to dietary goals and incidence of coronary heart disease. No tentative conclusions can be drawn concerning the results of this study to CHD.

APPENDICES

APPENDIX I

Sources of Cholesterol, Lipid and Mineral Values of Foods

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APPENDIX II

Food Items with a Consumption Frequency Greater than One Percent for Any Age/Sex Classification and Nutrients of Interest for which the Food Item had Missing Data

Food Item	Nutrients with Missing Values
Milk, lowfat, 2%	Magnesium
American Processed Cheese	Copper
Bacon	Cholesterol, Copper, Zinc, Polyunsaturated Fatty Acids
Frankfurters	Magnesium
Meat or Poultry Gravies	Magnesium
Scrambled Egg	Copper
Peanut Butter	Cholesterol, Saturated Fatty Acids, and Polyunsaturated Fatty Acids
Bread, White	Cholesterol, Polyunsaturated Fatty Acids
Bread, White, Enriched	Cholesterol, Polyunsaturated Fatty Acids
Rolls	Cholesterol

APPENDIX II Continued

Food Items with a Consumption Frequency Greater than One Percent for Any Age/Sex Classification and Nutrients of Interest for which the Food Item had Missing Data

Food Item	Nutrients with Missing Values
Chocolate Chip Cookie	Cholesterol, Saturated Fatty Acids, Polyunsaturated Fatty Acids
Rice	Cholesterol, Copper
Corn Flakes	Cholesterol, Saturated Fatty Acids Polyunsaturated Fatty Acids
Orange Juice	Cholesterol, Saturated Fatty Acids Polyunsaturated Fatty Acids
Apples	Cholesterol, Saturated Fatty Acids Polyunsaturated Fatty Acids
Bananas	Cholesterol, Saturated Fatty Acids Polyunsaturated Fatty Acids
Potato Chips	Cholesterol, Saturated Fatty Acids Polyunsaturated Fatty Acids, Copper, Zinc
Mashed Potato	Cholesterol, Magnesium
Tomatoes	Cholesterol, Saturated Fatty Acids Polyunsaturated Fatty Acids
Tomato Catsup	Cholesterol, Saturated Fatty Acids Polyunsaturated Fatty Acids
Lettuce	Cholesterol, Saturated Fatty Acids Polyunsaturated Fatty Acids

APPENDIX II Continued

Food Items with a Consumption Frequency Greater than One Percent for Any Age/Sex Classification and Nutrients of Interest for which the Food Item had Missing Data

Food Item	Nutrients with Missing Values
Mustard	Cholesterol, Saturated Fatty Acids Polyunsaturated Fatty Acids, Copper
Butter	Copper
Margarine	Cholesterol, Copper
Mayonnaise	Magnesium
Granulated Sugar	Cholesterol, Saturated Fatty Acids Polyunsaturated Fatty Acids
Jellies	Cholesterol, Saturated Fatty Acids Polyunsaturated Fatty Acids
Coffee	Cholesterol, Saturated Fatty Acids Polyunsaturated Fatty Acids Copper, Zinc, Magnesium
Tea	Cholesterol, Saturated Fatty Acids Polyunsaturated Fatty Acids Copper, Zinc, Magnesium
Diet Carbonated Beverages	Cholesterol, Saturated Fatty Acids Polyunsaturated Fatty Acids Copper, Zinc, Magnesium

APPENDIX II Continued

Food Items with a Consumption Frequency Greater than One Percent for Any Age/Sex Classification and Nutrients of Interest for which the Food Item had Missing Data

Food Item	Nutrients with Missing Values
Carbonated Beverages	Cholesterol, Saturated Fatty Acids Polyunsaturated Fatty Acids Copper, Zinc, Magnesium
Beer	Cholesterol, Saturated Fatty Acids Polyunsaturated Fatty Acids Copper, Zinc, Magnesium

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