VITAL AND HEALTH STATISTICS

Total Serum Cholesterol Levels of Adults 20–74 Years of Age

United States, 1976–80

This report presents descriptive data on total serum cholesterol levels by demographic and socioeconomic variables, and oral contraceptive use for women. This information is from the second National Health and Nutrition Examination Survey, a national probability sample survey of the civilian noninstitutionalized population of the United States conducted in 1976–80.

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Cooperation of the U.S. Bureau of the Census

Under the legislation establishing the National Health Survey, the Public Health Service is authorized to use, insofar as possible, the services or facilities of other Federal, State, or private agencies.

In accordance with specifications established by the National Center for Health Statistics, the U.S. Bureau of the Census participated in the design and selection of the sample and carried out the household interview stage of the data collection and certain parts of the statistical processing.

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Symbols

- - -	Data not available
. . .	Category not applicable
-	Quantity zero
0.0	Quantity more than zero but less than 0.05
Z	Quantity more than zero but less than 500 where numbers are rounded to thousands
*	Figure does not meet standard of reliability or precision
#	Figure suppressed to comply with confidentiality requirements

Total Serum Cholesterol Levels of Adults 20–74 Years of Age

by Robinson Fulwood,[a] William Kalsbeek,[b] Basil Rifkind,[c] Ronette Russell-Briefel,[a] Richard Muesing,[d] John LaRosa,[d] and Kenneth Lippel[c]

Introduction

Serum cholesterol concentration is one of the known risk factors for coronary heart disease (CHD). Numerous major studies have indicated a strong and direct association between levels of total serum cholesterol and CHD development.[1–5] The most impressive evidence comes from prospective studies such as the Framingham Study,[1] which showed that the higher the level of cholesterol in an individual, the greater the risk of subsequently developing coronary heart disease. The National Institutes of Health Consensus Development Conference on Lowering Blood Cholesterol[6] has concluded (after reviewing data from animal, epidemiological, and clinical studies, including the most recent results from the Lipid Research Clinics Primary Prevention Trial) that elevated blood cholesterol is a major cause of CHD, independent of other risk factors such as hypertension and cigarette smoking. It also indicated that there is sufficient evidence to conclude that lowering elevated cholesterol levels will reduce the risk of heart attacks caused by CHD.

The National Health and Nutrition Examination Surveys are a national source for collection and analysis of data on risk factors for CHD. This report presents findings on serum cholesterol levels collected during the second National Health and Nutrition Examination Survey, 1976–80, a national cross-sectional probability survey of the civilian noninstitutionalized population of the United States.

The serum cholesterol data are shown and discussed by age, sex, race, poverty status, annual family income, educational level, and by oral contraceptive use for women. Estimates of mean levels and prevalences of moderate and high risk cholesterol levels are weighted to be nationally representative. All analyses of data presented in the text take into account the complex design of the survey. Categorical data analysis, which incorporates the entire variance-covariance structure (see appendix I), was used to test these statistics. In some instances, results from tests of hypotheses using this method may yield different conclusions from methods that do not take the covariance terms into account. The reliability criteria for estimates are presented in appendix II, and all demographic and socioeconomic terms are defined in appendix III.

Serum cholesterol distributions are provided as reference data for use by public health and scientific officials in their efforts to better understand the role of serum lipid concentrations in the development of cardiovascular disease and to monitor trends in cholesterol levels in the United States. They enable researchers to identify subgroups of the population who are at risk for medical problems and to identify distributional differences among population subgroups of epidemiological interest. These distributions may also be used as benchmarks for international comparisons, and as possible indicators of changes in factors known to influence serum cholesterol, such as diet.

Serum cholesterol levels of persons in the civilian noninstitutionalized population of the United States, as measured by the National Health Examination Survey 1960–62 and the first National Health and Nutrition Examination Survey 1971–74, have been published.[7–9]

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Highlights

Some important serum cholesterol findings by demographic (age and race) and socioeconomic (defined by annual family income, educational level, and poverty status) variables for men and women and oral contraceptive use for women are summarized below. Statistically significant differences ($p < 0.05$) in mean serum cholesterol levels, and the percent of adults with serum cholesterol levels that put them at moderate or high risk of developing coronary heart disease (as defined by the National Institutes of Health Consensus Development Conference on Lowering Blood Cholesterol, 1984)[6] are presented. Observed differences (which may be of interest even though they may not be statistically significant) and descriptive statements about the distribution of cholesterol values are also presented.

Mean levels

- Mean serum cholesterol levels were significantly higher in each succeeding age group until age 45–54 years for men and until age 55–64 years for women; the levels declined with age after 55–64 years for both men and women. The overall means for men and women 20–74 years were 211 and 215 mg/dl, respectively.
- Differences in mean serum cholesterol between the races were not statistically significant for men or women.
- Women using oral contraceptives were found to have higher mean serum cholesterol levels than nonusers. This relationship was true for each of the age groups: 20–24, 25–34, and 35–44 years. Differences, ranging from 9 to 15 mg/dl between users and nonusers of oral contraceptives were statistically significant. Even though the confidence limits for ages 25–34 years overlapped, categorical data analysis confirmed that the differences in the mean between users and nonusers was statistically significant when covariances were included in the test.
- Generally, three socioeconomic status (SES) variables (poverty income ratio, annual family income, and education) used in the comparisons of the mean serum cholesterol levels by age, sex, and race showed that higher SES individuals had the higher mean serum cholesterol levels.
- Men and women at or above the poverty level had higher mean serum cholesterol levels than those below the poverty level. However, the only statistically significant difference in the means was found for men 65–74 years. Men with an annual family income of $20,000 or more per year also had a higher mean serum cholesterol level than those with an annual family income of less than $6,000 per year. The differences in the means between income levels were statistically significant for men ages 35–44 and 45–54 years.
- Other comparisons by income for women and by educational level for both men and women did not show any consistent patterns by age.
- For the four race-sex groups, age-adjusted mean levels by poverty status and annual family income generally show higher mean cholesterol levels for the higher levels of these SES variables. However, lower age-adjusted mean levels were generally observed at the higher educational level.

Prevalence levels

- An estimated 19.1 percent of men and 21.8 percent of women had serum cholesterol levels that put them at high risk of developing coronary heart disease. An additional 14.6 percent of men and 14.7 percent of women had levels that placed them at moderate risk. These percents indicate that an estimated 27.4 million adults in the United States in the late 1970's had cholesterol levels that put them at high risk for developing heart disease, and an additional 19.6 million had cholesterol levels that put them at moderate risk. (NOTE: To interpret these estimates appropriately, one should read the Discussion section of this report, which explains the impact of serum-plasma difference on estimating the prevalence of risk cholesterol levels.)

Sources of data

The second National Health and Nutrition Examination Survey (NHANES II),[10] conducted between February 1976 and February 1980, is the most recent of a series of national health examination surveys conducted by the National Center for Health Statistics.[11–15] The target population for the survey was the civilian noninstitutionalized population of the United States (including Alaska and Hawaii) 6 months–74 years of age. All interviews and examinations, tests and procedures, and laboratory determinations followed standardized protocols.

NHANES II, like previous examination surveys, consisted of two components: interviews in the household, and physical examinations and interviews in examination centers. The household interview component involved collecting socioeconomic and demographic information on the family and sample persons within the family and completing a medical history questionnaire for sample persons. The U.S. Bureau of the Census performed the initial household interviews and aided in the scheduling of appointments for examination. The examination component was performed in mobile examination centers specially designed for this study. Thus, environmental and equipment contributions to differences between examination findings from one sample location to another were minimized. The full-time examination teams were specifically trained to follow the study protocols, which provided for standardization and evaluation of their performance. The examination consisted of a series of standardized tests and procedures that included:

- A general medical examination and screening by a physician to obtain additional medical history information.
- Body measurements.
- A dietary interview.
- Selected diagnostic tests such as electrocardiogram, x ray, speech, hearing, allergy, and pulmonary function.
- Laboratory tests on whole blood, serum, and urine specimens.

Thus NHANES II provided the opportunity to assess the population's health and nutritional status and also to assess some aspects of change over time.

The entire NHANES II sample consisted of 27,801 persons ages 6 months–74 years of which 91 percent were interviewed. Of these, 20,322 persons were interviewed and examined, resulting in a response rate of 73.1 percent. The cholesterol sample consisted of 17,390 persons ages 20–74 years of whom 11,864 persons had blood drawn for serum cholesterol determination, providing a response rate of 68.2 percent. More detail on the sample design and conduct of the survey is presented in appendix I.

Serum cholesterol determinations

Collaborative analysis of cholesterol data

The National Center for Health Statistics (NCHS) and the National Heart, Lung, and Blood Institute agreed to jointly collect, chemically analyze, and process NHANES II serum specimens for total and high density lipoprotein cholesterols and serum triglyceride.[16]

Succinctly, NCHS planned and directed the collection of the NHANES II serum lipids data. The National Heart, Lung, and Blood Institute provided support and coordinated the chemical analysis through its Lipid Research Clinic Laboratory at George Washington University and the editing and processing of the data through its Lipid Research Clinics Central Processing Unit, Department of Biostatistics at the University of North Carolina.

Collection and shipping

The collection and shipping of the serum specimens were carefully handled according to standardized procedures. The field laboratory staff of the mobile examination centers of NCHS obtained blood samples from each survey participant by venipuncture. The blood samples were allowed to clot, and the samples were then centrifuged. The serum was recovered from each sample, and then an aliquot was put into a plastic screw-capped vial and placed in a freezer within 1 hour of collection.

At approximately 2-week intervals, the laboratory technicians placed the serum specimens collected over the preceding period in a Styrofoam[e] shipping container with Dry ice[e] and shipped them to the Lipid Research Clinic Laboratory at George Washington University, Washington, D.C., for chemical analysis.

Laboratory analysis

The serum cholesterol analysis was performed in a central laboratory on zeolite-treated isopropanol extracts according to the protocol described for the Lipid Research Clinics Program.[17] Once the samples were received in the laboratory, they were placed in a freezer at −15° C until analyzed, usually within 2 weeks of receipt. Before analysis, the serum specimens were allowed to thaw at room temperature and then were mixed thoroughly by vortexing.

The zeolite-treated isopropanol extracts were analyzed on a Technicon Autoanalyzer II,[e] which used a Lieberman-Burchard[e] color reagent. Instrumental linearity response was established at the beginning of each analytical run with cholesterol standards in isopropanol (100, 200, 300, and 400 mg/dl) provided by the Lipid Standardization Section of the Centers for Disease Control. A serum calibrator was used to automatically adjust instrumental response to reference Abell-Kendall cholesterol values.[18] Extracts of a high and low serum cholesterol internal control pool were positioned in each sample tray; results from analyses out of the control range were rejected and the analyses were repeated. The serum calibrator and internal control pools with assigned Abell-Kendall reference values were provided by the Centers for Disease Control.

Method of analysis

To investigate the relationship of certain demographic and socioeconomic variables to serum cholesterol levels, a weighted least squares approach using categorical data analysis was used. A Wald Q-statistic (a modified chi-square statistic) was used to test the hypothesis of no difference in the mean or prevalence levels at the .05 level of significance. Table A shows the variables for which hypothesis testing was performed. It is important to note that the chi-square statistic is not invariant across sample sizes, thus given the same difference across subgroups, the statistic is more likely to be significant as the sample size increases. Understanding this point is essential to proper interpretation of some of the differences that appear to

Table A. Hypothesis testing by selected variables

Variable	*Mean serum cholesterol level*	*Prevalence of risk cholesterol level*
Age	X	X
Sex	X	X
Race	X	X
Oral contraceptive (women only)	X	
Poverty status	X	X
Annual family income	X	
Educational level	X	X

[e]The use of trade names is for identification only and does not imply endorsement by the Public Health Service of the U.S. Department of Health and Human Services.

be significant from inspection but are not when tested for statistical significance.

The socioeconomic comparisons performed were for poverty status defined by the Poverty Index Ratio as nonpoverty (at or above the poverty level) if the ratio is equal to or greater than one or poverty (below poverty) if it is less than one, for less than $6,000 versus $20,000 or more per year of annual family income, and for less than 12 years of education versus 12 years or more of education. (See appendix III for definitions.) The oral contraceptive use analysis compares the mean of current (at the time of the survey) users and nonusers. Those who did not currently use oral contraceptives but had previously used them are included with nonusers.

For the socioeconomic analyses, the usual 10-year age grouping was collapsed into larger age classifications for black persons because of sample size and other reliability limitations. Where age-specific levels are not presented, the age-adjusted values are presented.

Other analytic considerations

1. The second National Health and Nutrition Examination Survey (NHANES II) measured serum levels of blood cholesterol, which are approximately 3 percent higher than plasma cholesterol levels.[19] The NIH Consensus Development Conference Statement[6] defines risk levels by blood cholesterol level rather than by serum or plasma cholesterol level. However, because the plasma cholesterol distributions of the Lipid Research Clinics prevalence study were used to define the risk levels, the inference is that these risk levels refer to plasma cholesterol levels.[20]

   To investigate the potential differences in the prevalence estimates of moderate and high risk individuals using serum cholesterol determinations based on plasma definitions, the plasma risk levels were converted to the serum equivalent using a 3-percent adjustment factor. The results of making such an adjustment are presented in detail in the Discussion section. However, to be consistent in the reporting of cholesterol levels and to avoid confusion, the NHANES II serum cholesterol levels were not adjusted for serum-plasma differences for the reporting of results of moderate and high risk cholesterol levels.
2. As is generally the case with survey data, not all sample persons participated in the examination phase, and thus information was not obtained on the desired number of sample persons. However, the data were adjusted for nonresponse. The serum cholesterol data in this report are based on results from 11,864 individuals ages 20–74 years. Of this total, 2.3 percent of these values were imputed. The sample persons with serum cholesterol values were poststratified to bring the estimate of the number in the population into close agreement with the U.S. Bureau of Census estimate of the number of persons ages 20–74 years in the civilian noninstitutionalized population of the United States.
3. Finally, statistics in this report were age adjusted to permit comparison among subgroups and to control for age confounding. The age-adjusted means and percents were calculated by the direct method and standardized to the midpoint of the NHANES II population. Descriptions of the methods used for nonresponse adjustments, poststratification, imputation, and age adjustment are given in appendix I.

Findings

This section contains information about the differences in the mean serum cholesterol levels or prevalence of high cholesterol levels that were tested for statistical significance using the categorical data analysis as described in appendix I. It also contains observed or descriptive information about the mean, prevalence, or distribution of serum cholesterol levels that may be of clinical or epidemiological interest. All differences in means or prevalence levels that were tested for statistical significance are indicated throughout this section by using such terms as "statistically different" or "statistically significant." All other differences were observed.

Mean serum cholesterol levels

Age, sex, and race

The mean serum cholesterol levels of men by race and age, and of women by race and age are shown in tables 1 and 2; figures 1 and 2 show mean levels of men and women by age.

- The mean serum cholesterol levels were significantly higher in each successive age group until ages 45–54 years for men and until ages 55–64 years for women. The mean values peaked at 55–64 years with a level of 229 mg/dl for men and 249 mg/dl for women. The differences in the mean levels were larger for men in younger ages and larger for women in the older ages (figure 1).
- The overall mean serum cholesterol levels were observed to be slightly higher for women than for men (215 versus 211 mg/dl), but this relationship did not hold for all age groups. The magnitudes of the differences in the mean between the sexes varied somewhat with age. Women had higher levels in the youngest and oldest age groups while men's levels were higher in the middle age groups (figure 1). The observed differences in age-adjusted and in unadjusted means between men and women were about the same.
- The mean serum cholesterol levels did not differ significantly between the races within the age groups considered for either men or women (figure 2). The patterns over the

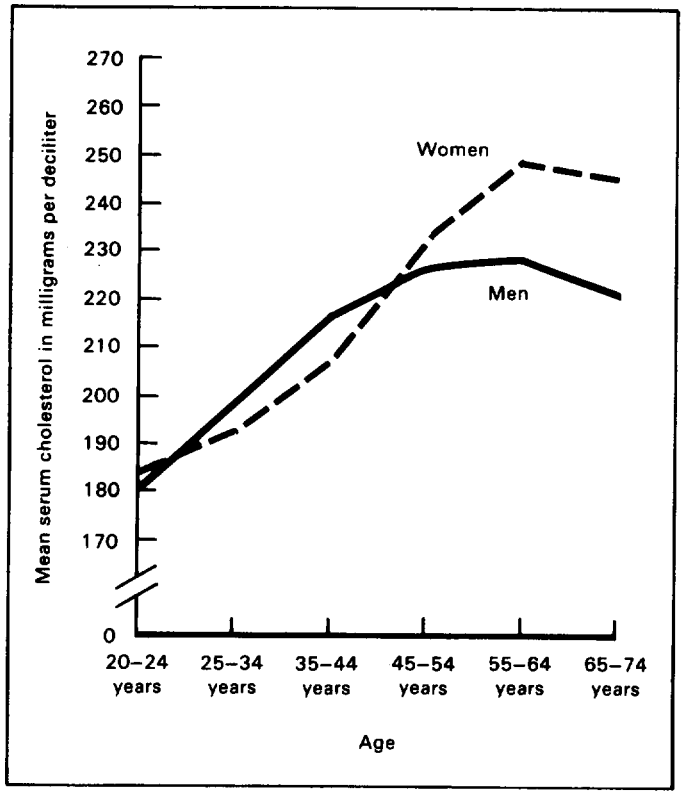


Figure 1. Mean serum cholesterol levels for adults by sex and age: United States, 1976–80

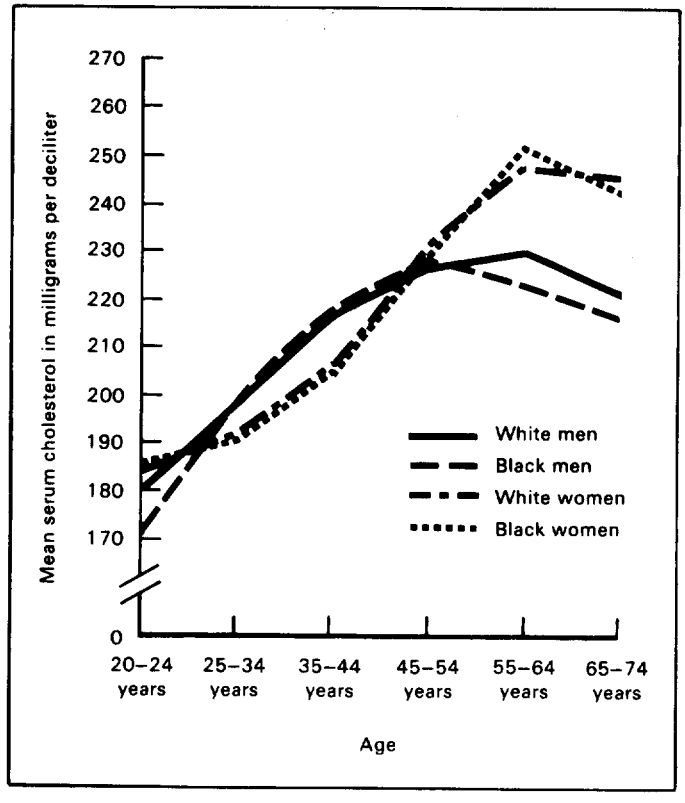


Figure 2. Mean serum cholesterol levels for adults by sex, race, and age: United States, 1976–80

race-sex groups by age were essentially the same as observed in figure 1.

- The 10th, 50th, and 90th percentiles as displayed in figure 3 show the same patterns as the means. The differences by age once again were larger for women than for men, and the crossover occurring in the middle age groups was repeated.
- The mean levels adjusted to the age distribution of the U.S. population at the midpoint of the second National Health and Nutrition Examination Survey (1978) are as follows for the four race-sex groups: white men, 211 mg/dl; black men, 209 mg/dl; white women, 215 mg/dl; and black women, 214 mg/dl.

Oral contraceptive use

The mean serum cholesterol levels for women 20–44 years using and not using oral contraceptives at the time of the survey are presented in table 3 and figure 4.

- Women using oral contraceptives had higher mean serum cholesterol levels than those not using oral contraceptives. The differences in the serum cholesterol between users and nonusers ranged from 9–15 mg/dl and were statistically significant in each age category (figure 4).
- The age-adjusted means for white users and nonusers were 205 and 192 mg/dl, respectively, and 198 and 193 mg/dl for black users and nonusers, respectively. The user-nonuser difference was statistically significant for white women only.
- The age-adjusted mean cholesterol for oral contraceptive users was 7 mg/dl higher for white women than for black women. This difference in the mean for users between the races was not statistically significant (table B).

Poverty status

The mean serum cholesterol levels as related to the poverty status are shown in tables 4 and 5.

- Comparison between poverty and nonpoverty levels showed that only the difference in the means for men 65–74 years was statistically significant. Mean serum cholesterol level for nonpoverty men was higher by 10 mg/dl. No statistically significant differences in the mean were found for women (table 4).
- For the race-sex groups in table 5, the six age categories were collapsed into three: 20–44, 45–64, and 65–74 years. The differences in the mean levels between poverty and nonpoverty levels were statistically significant only for white men 65–74 years. Nonpoverty white men in this age group had the higher levels (figure 5). None of the observed differences for black men between poverty levels was statistically significant. Although large, the difference in mean levels of black women 45–64 years was not statistically significant. The mean levels for white women 65–74 years did differ significantly between the poverty levels. Women at the nonpoverty level had the higher mean level (figure 6).
- Comparisons between the races for either men or women within each poverty status category showed no significant differences in the mean levels for any of the age groups (figures 5 and 6).

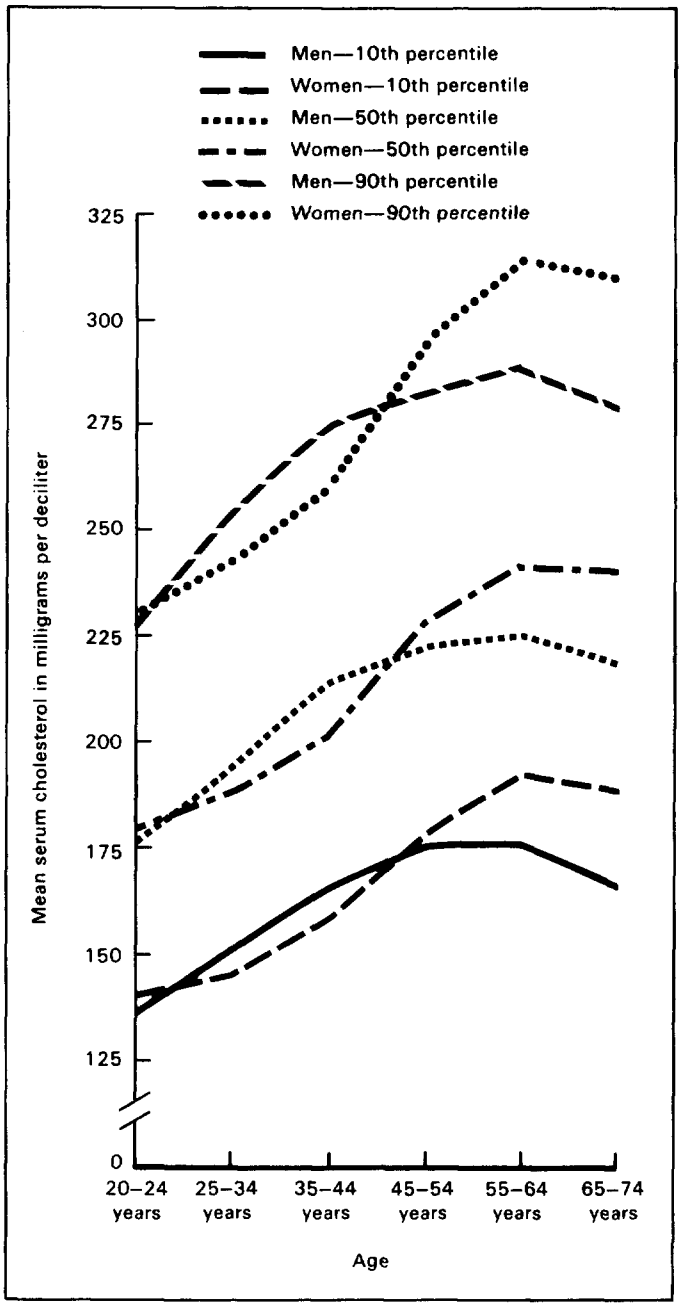
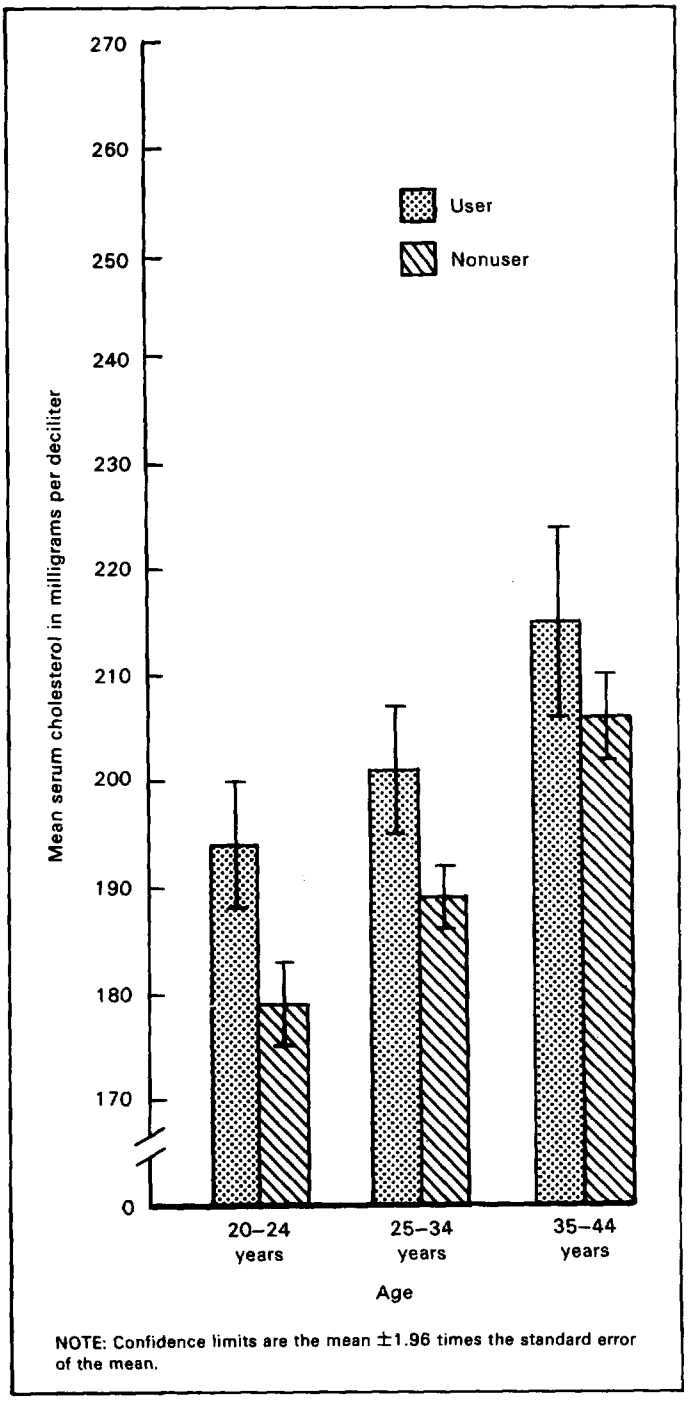


Figure 3. Comparison of the 10th, 50th, and 90th percentiles of serum cholesterol levels by sex and age: United States, 1976–80

Annual family income

The mean serum cholesterol levels as related to annual family income are shown in tables 6 and 7.

- The mean levels of men for each age category fluctuate as income level increased from under $6,000 (lowest) to $20,000 or more per year (highest). Despite the inconsistent patterns, a comparison of the means between these two income levels showed that men with $20,000 or more per year had consistently higher mean levels at every age group (figure 7). These levels were statistically significant for men 35–44 and 45–54 years.



NOTE: Confidence limits are the mean ±1.96 times the standard error of the mean.

Figure 4. Mean serum cholesterol levels of women 20–44 years by age and oral contraceptive use: United States, 1976–80

- The mean levels for women did not show a consistent relationship as income levels increased from under $6,000 to $20,000 or more per year. No age-specific differences in mean levels between the highest and lowest income levels were statistically significant (figure 8).
- Comparisons between the lowest and highest income levels for white persons showed significant differences in the means for white men ages 20–44 and 45–64 years. Men with an income of $20,000 or more per year had the higher levels. No significant differences in the means were found for white women.

Table B. Age-adjusted mean cholesterol levels of women by race and oral contraceptive use: United States, 1976–80

Race	Oral contraceptive use: User	Oral contraceptive use: Nonuser	Test results
	Cholesterol in milligrams per deciliter		
White	205	192	S
Black	198	193	NS
Test results	NS	NS	...

NOTE: S = significant at $p < 0.05$; NS = not significant.

- Due to sample size constraints, no age-specific analysis was done for black persons. However, a comparison of the age-adjusted means of the four race-sex groups showed that men (regardless of race) had significantly higher mean levels at an income of $20,000 or more than at under $6,000 per year. The differences of age-adjusted means were not statistically significant for white or black women (figure 9).

Education

The mean serum cholesterol levels as related to educational level are shown in tables 8–10.

- The overall observed mean serum cholesterol level is inversely related to educational level for men and women ages 20–74 years. The consistent decline in the mean was eliminated when the levels were adjusted for the differences in the age distributions (table 8).
- Only the difference in the means for men 55–64 years was statistically significant between those with less than 12 years and those with 12 years or more of education. The mean for this age group was higher for those with 12 years or more of education. No age-specific differences in the means were statistically significant for women (table 9).
- The mean level was significantly higher for black women 20–44 years with less than 12 years than for those with 12 years or more of education (table 10). No age-specific significant differences in the means between educational levels were found for white men or white women (figures 10 and 11). Inadequate sample size for black persons 65–74 years with 12 years or more of education limits the comparison for this group. The other age groups for black men did not show statistically significant differences between these two educational levels.
- Within each educational level, the differences in the mean serum cholesterol levels between the races for each age group were not statistically significant for men or women (table 10).
- Comparison of the age-adjusted mean levels for each race-sex group between those with 12 years or more of education and those with less than 12 years showed no significant differences. Those with 12 years or more of education had the lower observed mean level except for white men (table 10).

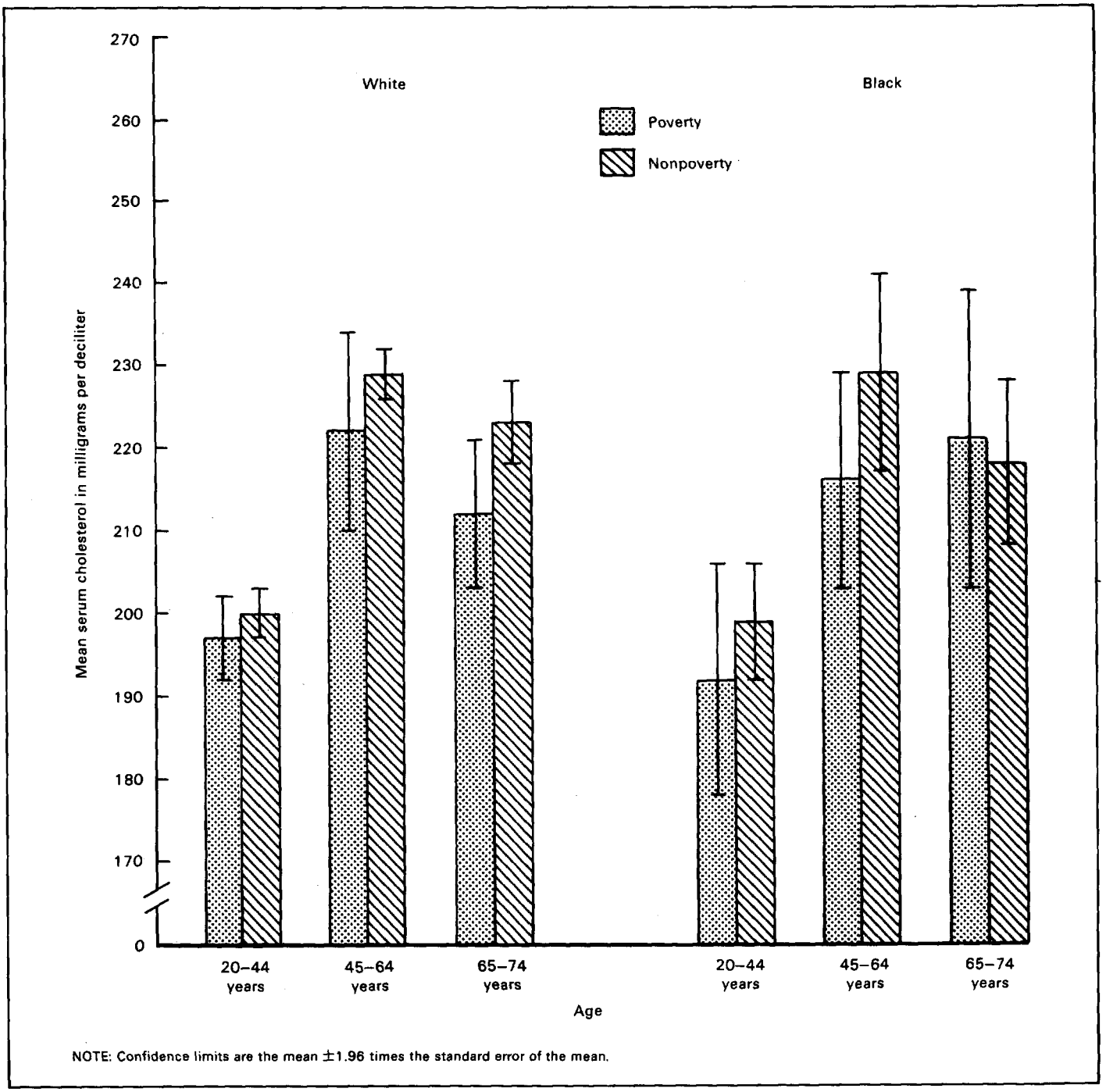


Figure 5. Mean serum cholesterol levels of men by age, race, and poverty status: United States, 1976–80

Prevalence of moderate and high risk levels

Age, sex, and race

The percent of adults in the U.S. population with a cholesterol level placing them at moderate or high risk of developing coronary heart disease (CHD) is presented in tables 11 and 12. Moderate risk cholesterol levels are defined as values between the 75th and 90th percentiles of the cholesterol distribution, and high risk cholesterol levels as values greater than the 90th percentile. These values were established by the National Institutes of Health Consensus Development Conference on Lowering Blood Cholesterol[6] (table C). The values were applied to the serum cholesterol data from the second National Health and Nutrition Examination Survey to estimate the percent of adults in the United States with cholesterol levels that place them at moderate or high risk of developing CHD.

- The percent of men and women ages 20–74 years with cholesterol levels at moderate risk were about the same (14.6 versus 14.7 percent); however, a higher percent of women ages 20–74 years than men had cholesterol levels at high risk (21.8 versus 19.1 percent). The age-adjusted

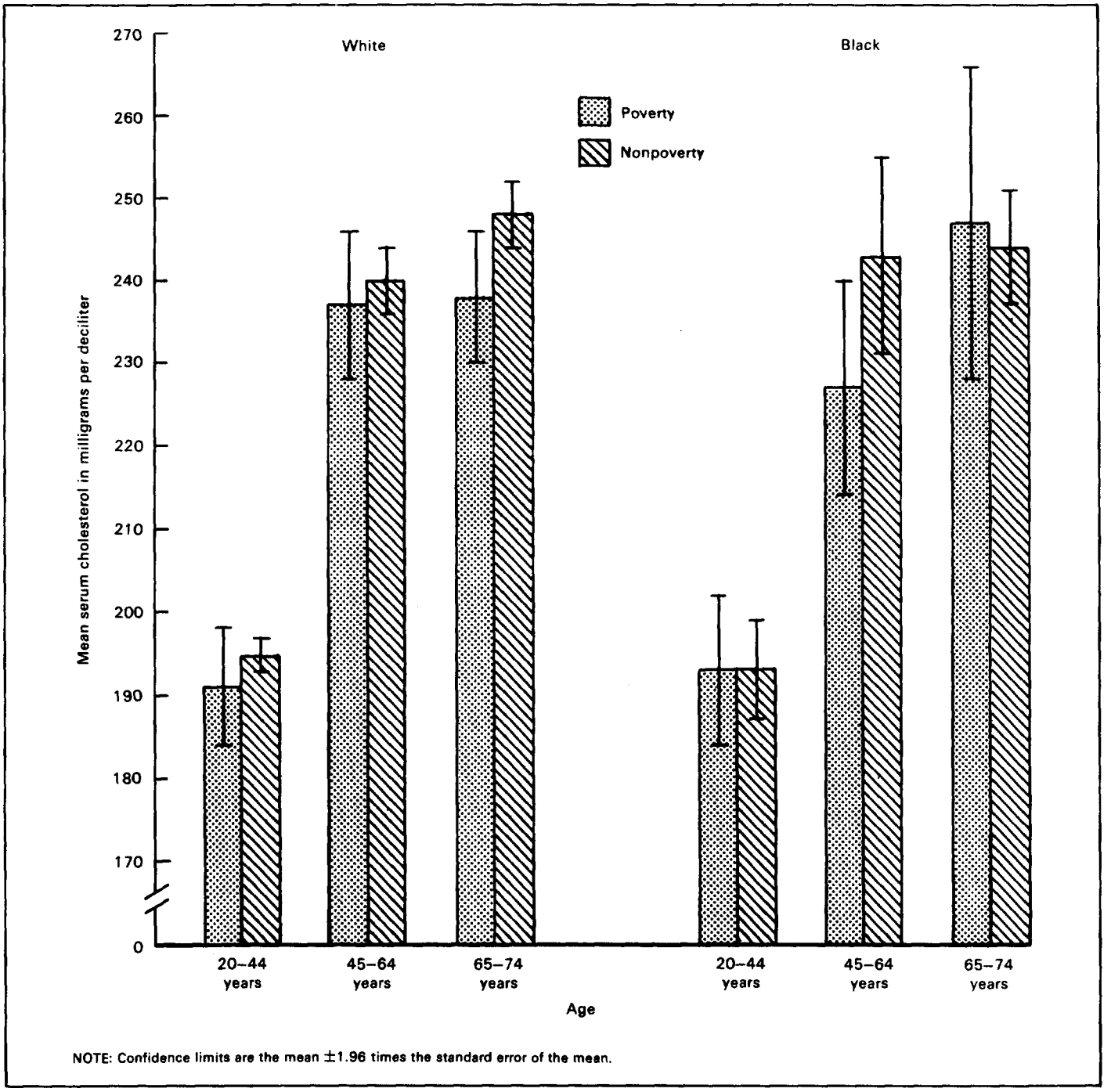


Figure 6. Mean serum cholesterol levels of women by age, race, and poverty status: United States, 1976–80

percents did not differ significantly from the overall unadjusted levels (table 11).

- The age-specific percent for men for both moderate and high risk cholesterol and for women at moderate risk did not show a consistent pattern with age; however, the percent of women with a high risk cholesterol level increased consistently with each age group after 25–34 years (table 11).
- The greatest difference in percents by age between men and women occurred at the older two age groups: 55–64 and 65–74 years (figure 12).
- In general, the percents of white persons with cholesterol levels at moderate risk were higher than those of black persons; however, the differences in percents between the races for each sex were not statistically significant. No clear distinction in percents by race could be found for persons with cholesterol levels at high risk. The unadjusted percents ranged from 19.0 for white men to 22.1 for white women, while the adjusted levels were quite similar (table 12).
- Above ages 20–44 years, the age-specific percents for the four race-sex groups indicate that a higher percent of women than men (regardless of race) have high risk cholesterol levels. This relationship is particularly noticeable in the oldest age group (figure 13). However, the difference

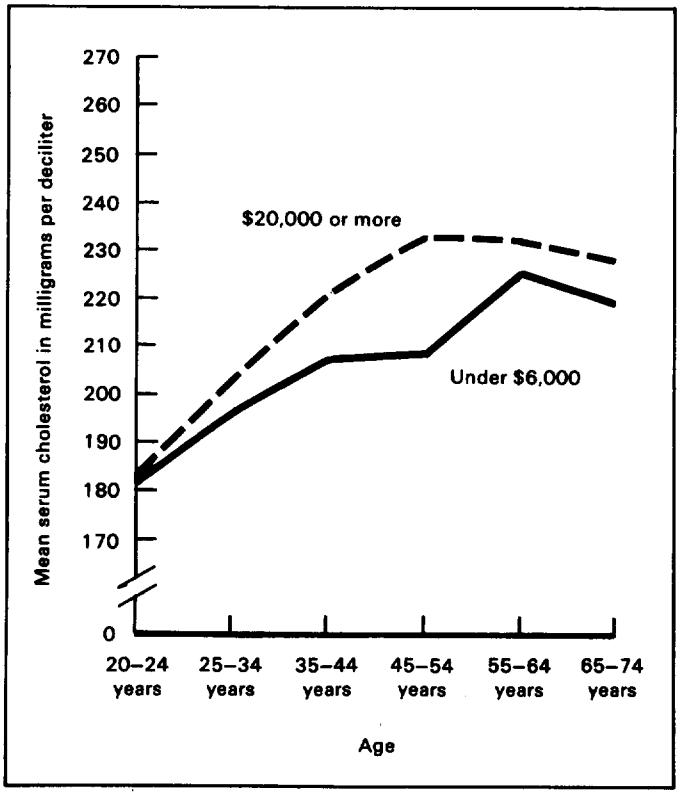


Figure 7. Mean serum cholesterol levels for men by age and annual family income: United States, 1976–80

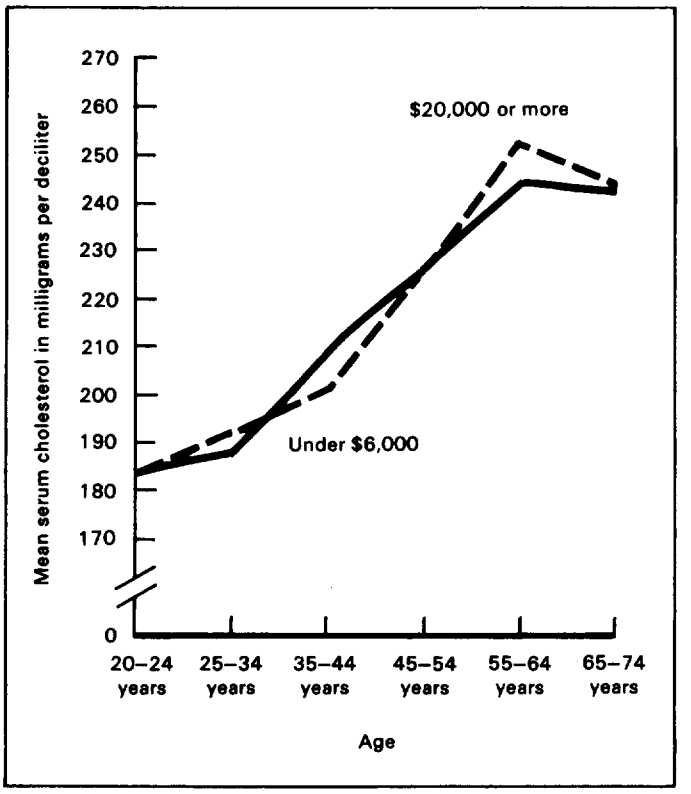


Figure 8. Mean serum cholesterol levels for women by age and annual family income: United States, 1976–80

in percents between the races for each sex group was not statistically significant. Earlier findings of significant differences in percent for men and women with cholesterol levels at high risk are now further confirmed when these data are stratified by race—that is, the significant difference in percents between the men and women is apparent even when the data are stratified by race.

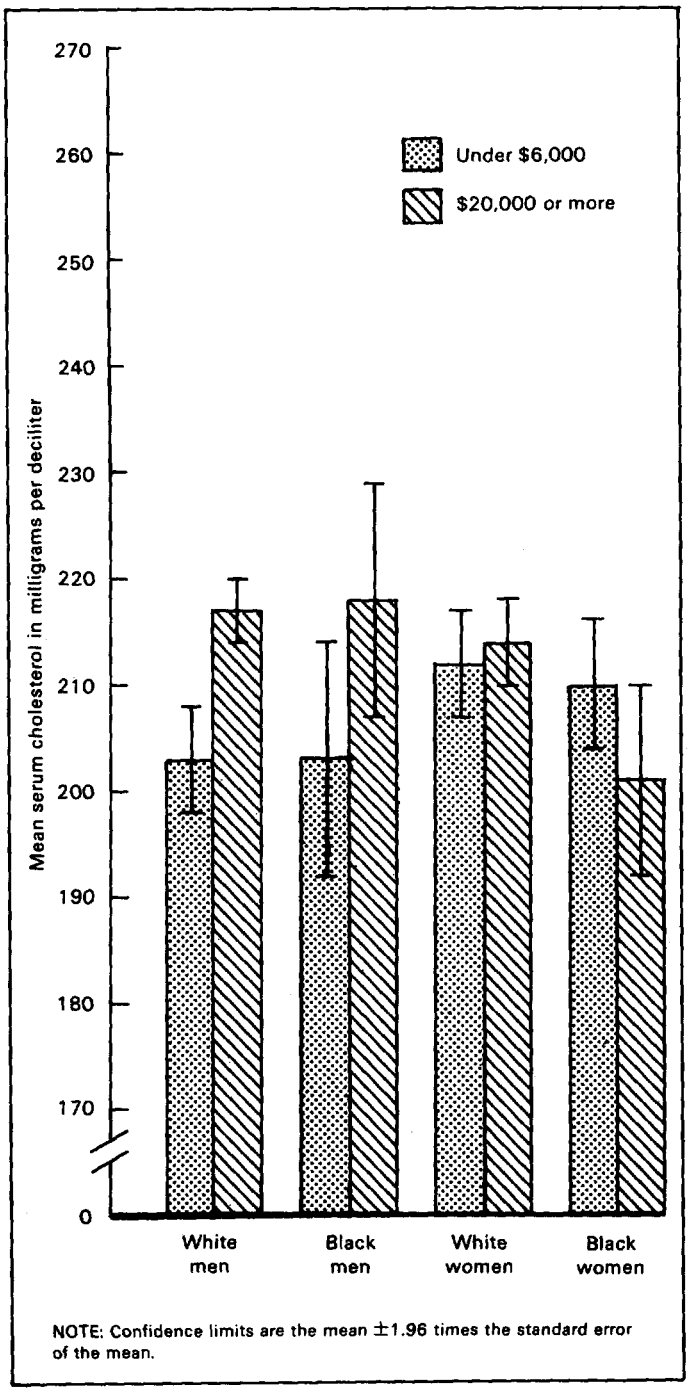
Poverty status and education

In this section, the prevalence of high risk cholesterol levels of adults are analyzed by socioeconomic status. The percent of adults with cholesterol levels that put them at high risk of developing CHD are shown by poverty status and educational level in tables 13 and 14.

- The unadjusted levels show that 14.9 percent of men and 19.1 percent of women in poverty have cholesterol levels at high risk. For nonpoverty men and women, comparable percents are 19.6 and 22.1, respectively. The age-specific prevalences are shown in figure 14. Age-adjusted percents differed only slightly from the unadjusted (table 13). The difference in percents was statistically significant between poverty status groups for men only, for both the adjusted and unadjusted percents.
- The overall prevalence of high risk cholesterol levels is greater for women 20–74 years than for men, regardless of educational level. However, the prevalence was higher for men with 12 years of education than for those with less than 12 years. The opposite was true for women. No statistically significant differences in the age-adjusted percents were found between educational levels for men or women.
- The specific trends for high risk cholesterol levels for men and women by age are shown in figure 15. There were no statistically significant differences in percents between educational levels for men or women for any age groups.

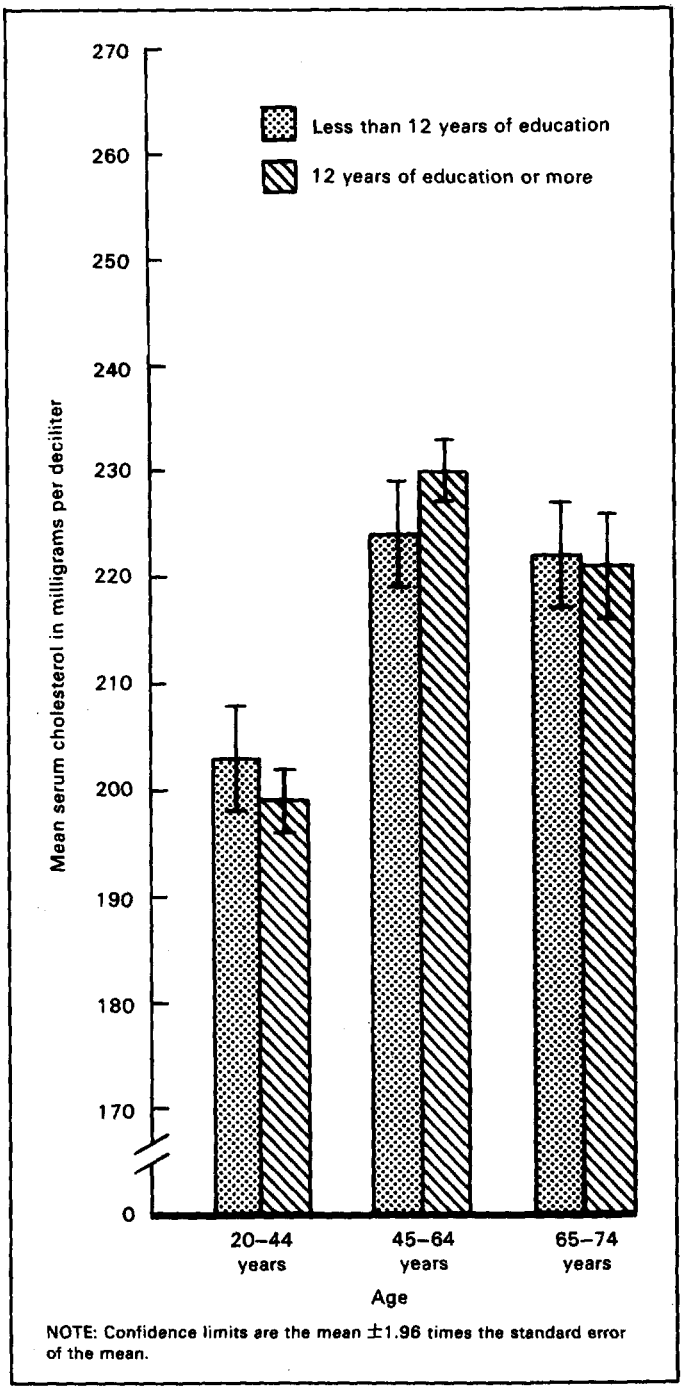
Cumulative distribution

The cumulative percent distributions of serum cholesterol levels are shown in tables 15 and 16 for men and women by age and race. The distributions are shown for selected cutoff levels and allow the user to choose his own cutoff level for high or moderate risk groups or simply to understand the nature of the distribution.



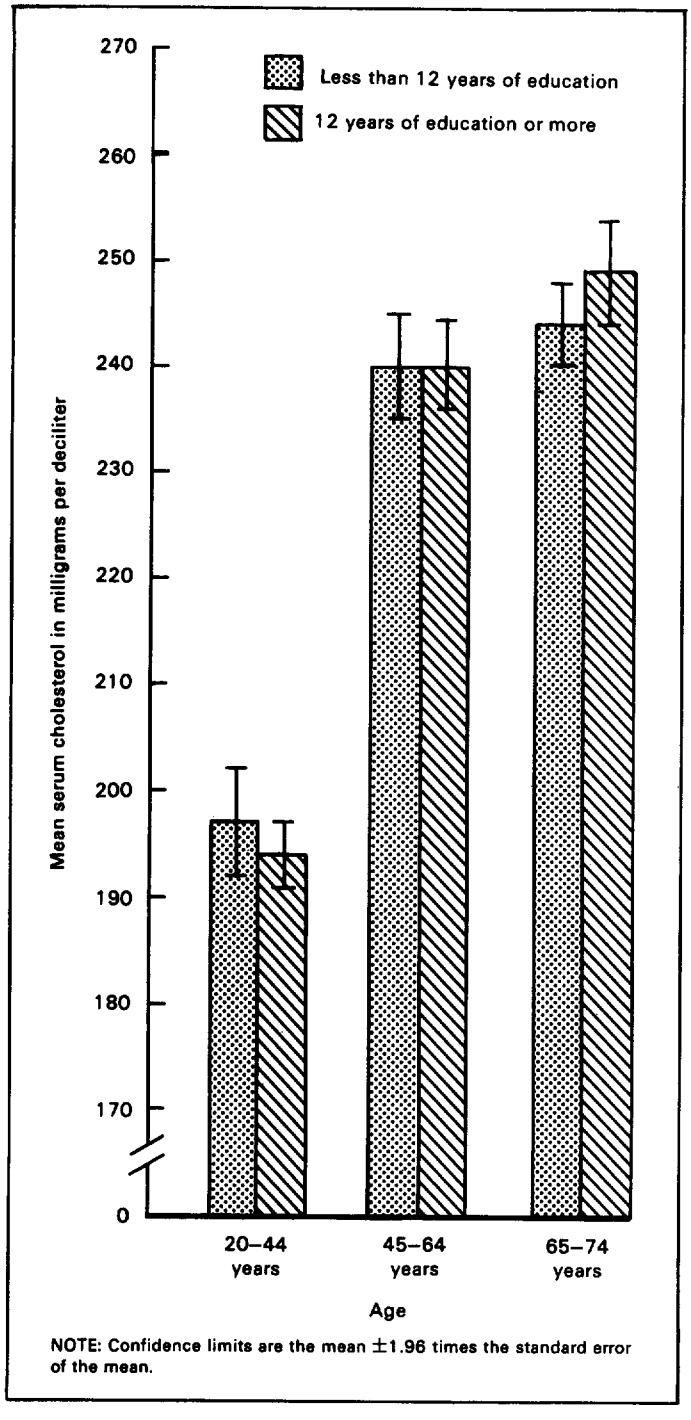
NOTE: Confidence limits are the mean ±1.96 times the standard error of the mean.

Figure 9. Age-adjusted mean serum cholesterol levels of adults for each race-sex group by annual family income: United States, 1976–80



NOTE: Confidence limits are the mean ±1.96 times the standard error of the mean.

Figure 10. Mean serum cholesterol levels of white men by age and educational level: United States, 1976–80

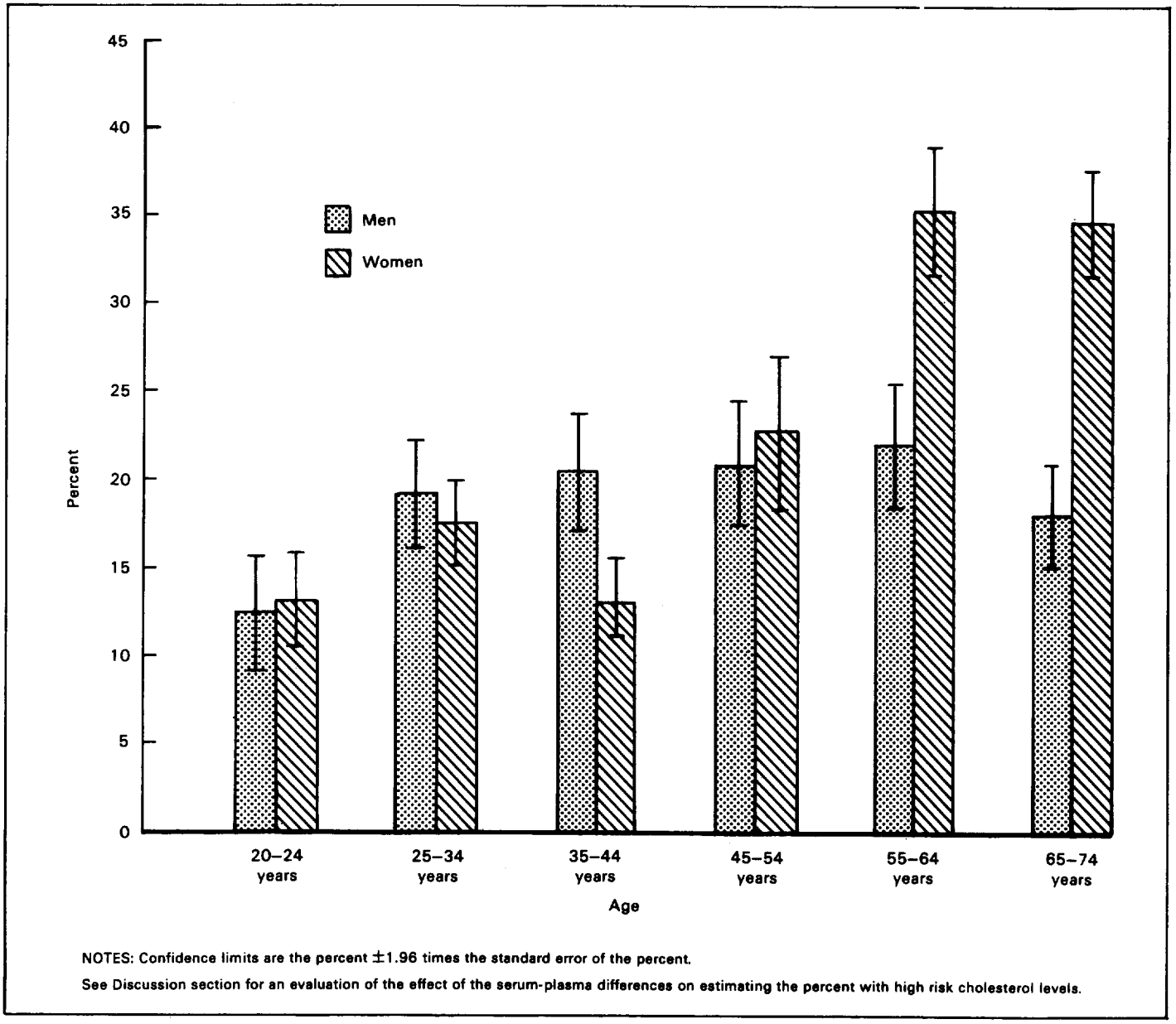


NOTE: Confidence limits are the mean ±1.96 times the standard error of the mean.

Figure 11. Mean serum cholesterol levels of white women by age and educational level: United States, 1976–80

Table C. Risk cutpoints of plasma cholesterol established by the NIH Consensus Development Conference on Lowering Blood Cholesterol, December 1984

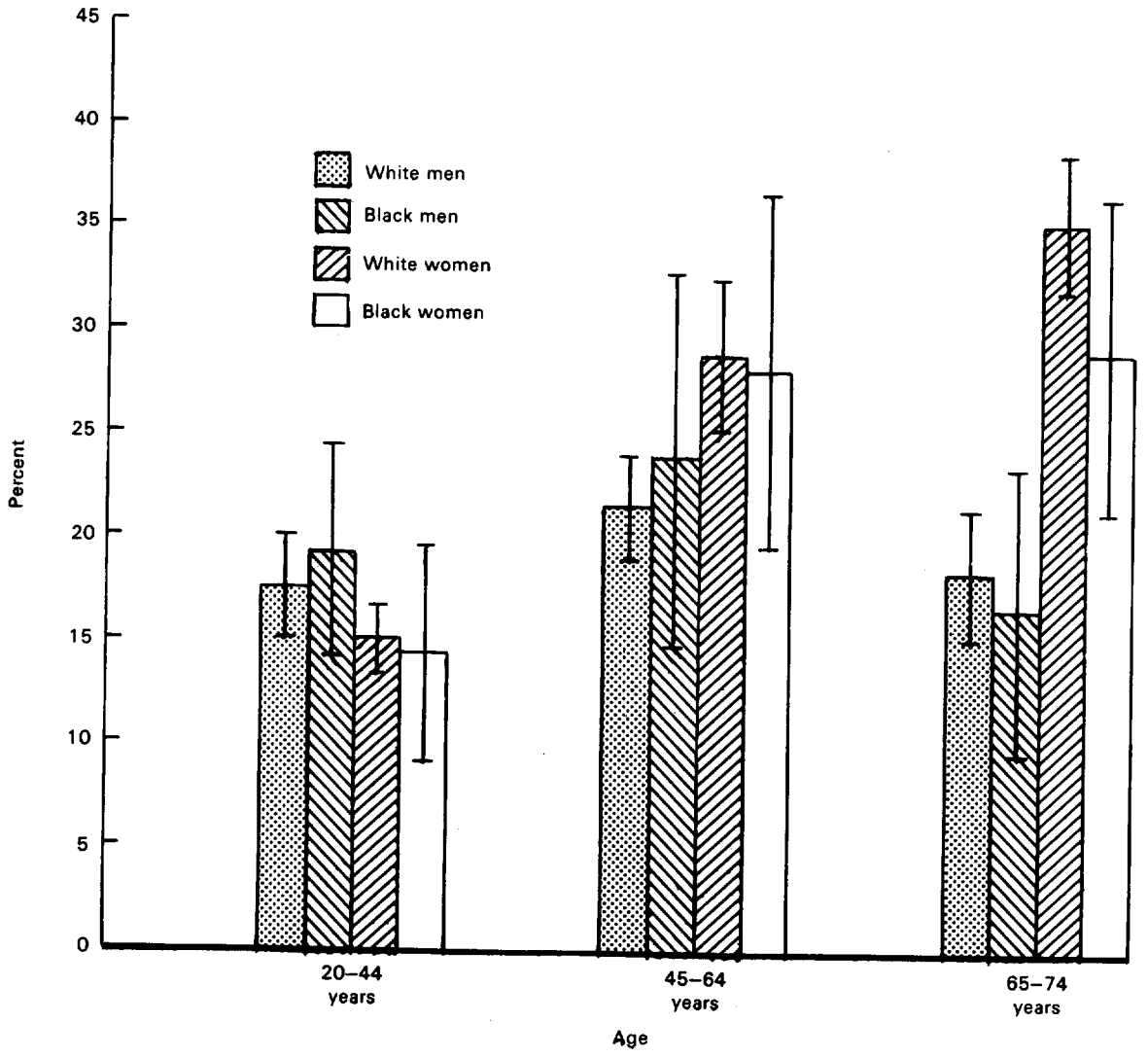
Age	*Moderate risk*	*High risk*
	Cholesterol in milligrams per deciliter	
20–29 years	201–220	Greater than 220
30–39 years	221–240	Greater than 240
40 years and over	241–260	Greater than 260



NOTES: Confidence limits are the percent ±1.96 times the standard error of the percent.

See Discussion section for an evaluation of the effect of the serum-plasma differences on estimating the percent with high risk cholesterol levels.

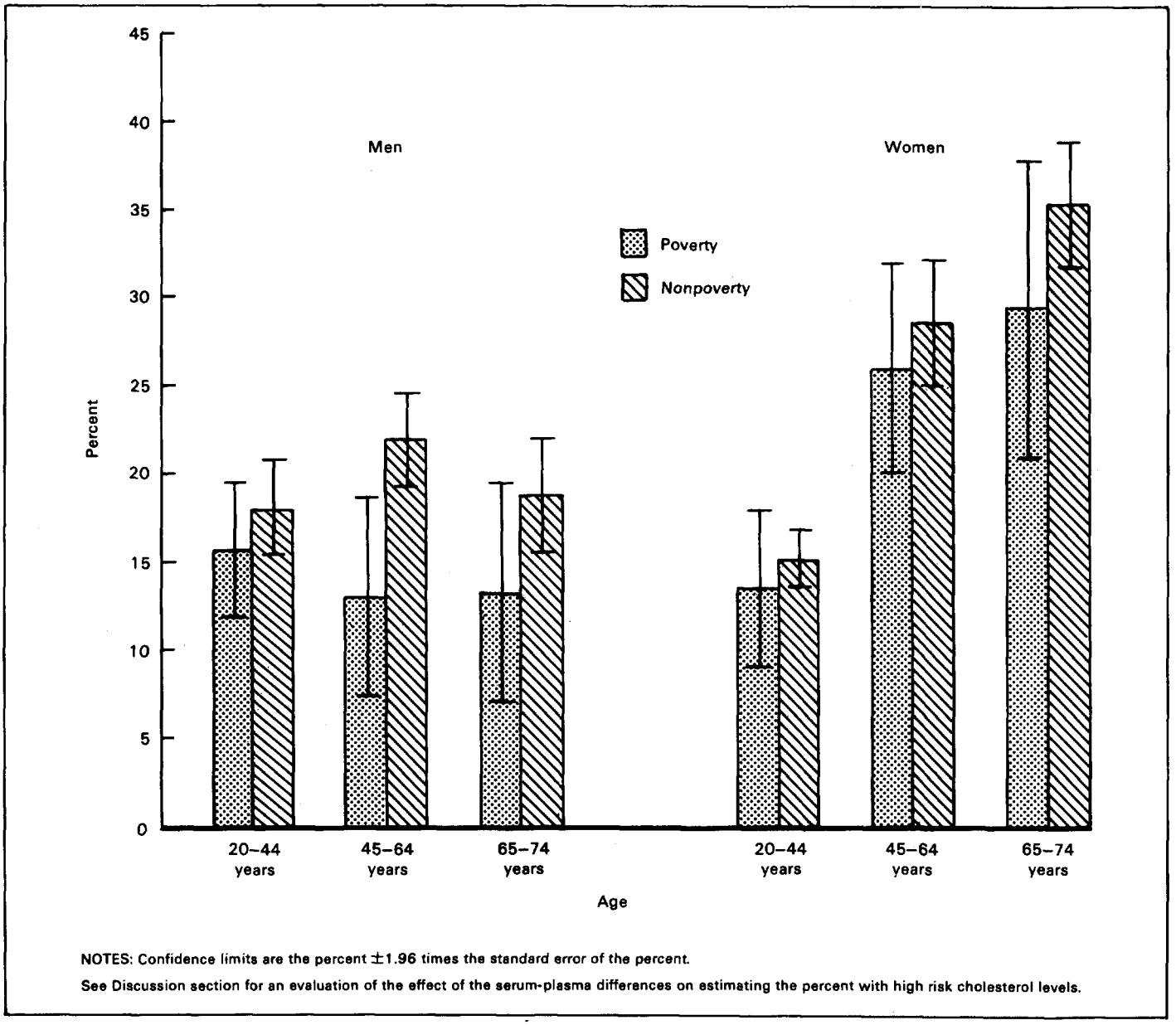
Figure 12. Percent of adults with serum cholesterol levels at high risk by sex and age: United States, 1976–80



NOTES: Confidence limits are the percent ±1.96 times the standard error of the percent.

See Discussion section for an evaluation of the effect of the serum-plasma differences on estimating the percent with high risk cholesterol levels.

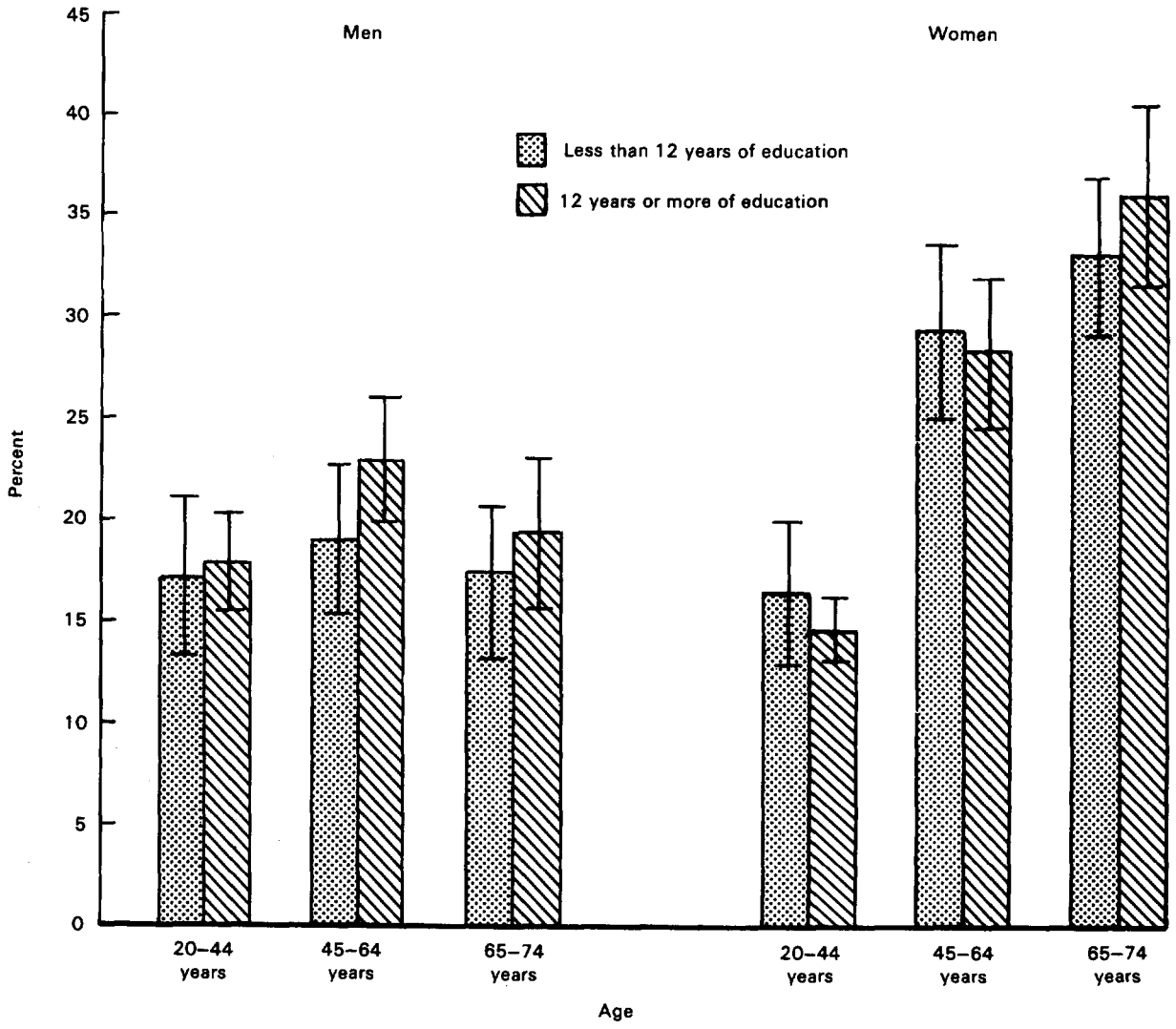
Figure 13. Percent of adults with serum cholesterol levels at high risk by race, sex, and age: United States, 1976–80



NOTES: Confidence limits are the percent ±1.96 times the standard error of the percent.

See Discussion section for an evaluation of the effect of the serum-plasma differences on estimating the percent with high risk cholesterol levels.

Figure 14. Percent of adults with serum cholesterol levels at high risk by sex, age, and poverty status: United States, 1976–80



NOTES: Confidence limits are the percent ±1.96 times the standard error of the percent.

See Discussion section for an evaluation of the effect of the serum-plasma differences on estimating the percent with high risk cholesterol levels.

Figure 15. Percent of adults with serum cholesterol levels at high risk by sex, age, and educational level: United States, 1976–80

Discussion

Data on serum cholesterol levels collected during the second National Health and Nutrition Examination Survey (NHANES II), 1976–80, for adults 20–74 years are presented and analyzed by age, sex, race, oral contraceptive use, and socioeconomic variables.

These cross-sectional data provide important baseline information on the distribution of serum cholesterol levels in the U.S. population at a particular point in time. Because serum cholesterol concentrations have been identified as one of the major risk factors of coronary heart disease in the population,[4,5,21-23] these kinds of reference data are essential to clinicians and epidemiologists whose primary emphasis is identifying research hypotheses and establishing intervention or treatment levels for subgroups of the population at higher risk of developing certain health or disease conditions. These data should not be confused with longitudinal data.

Age, sex, and race

The mean serum cholesterol levels of adult men averaged 211 mg/dl versus 215 mg/dl for adult women. These levels did not differ significantly by race. The differences in mean serum cholesterol levels by sex were more noticeable in the older age groups than the younger. The patterns of these serum cholesterol levels are generally comparable to those of the population-based Lipid Research Clinics prevalence study.[24] The prevalence of high cholesterol values in the U.S. population has been reported previously.[7,8] However, these prevalence levels were based on an arbitrary benchmark, such as above 260 mg/dl or more. Researchers, however, have used a variety of benchmarks varying from conservative levels, such as 200–220 mg/dl, to much higher levels, such as 250–270 mg/dl. Thus the estimates of "elevated" or "high" cholesterol levels varied tremendously.

To be consistent in the reporting of the prevalence of elevated blood cholesterol levels and to relate these levels to the risk of developing coronary heart disease (CHD), researchers have recently established cholesterol guidelines to help physicians and public health practitioners decide when to treat individuals. These guidelines, established in 1984 by the National Institutes of Health (NIH) Consensus Development Conference on Lowering Blood Cholesterol,[6] are shown in table C.

The NIH Consensus Development Conference statement does not distinguish between serum and plasma cholesterol in the presentation of either epidemiological research or cholesterol risk levels. The practical application of the NIH guidelines is that the cholesterol risk levels are used by clinicians and researchers as stated regardless of whether the cholesterol level being evaluated is serum or plasma. In addition, many automated blood batteries are routinely performed on serum. As mentioned in the Other analytic considerations section, the NIH plasma risk levels were inflated by 3 percent to approximate serum values. These adjusted cutoff points are shown in table D.

For this report, consistency in reporting and practicality were more important than adjusting NHANES II serum cholesterol values to plasma cholesterol values. However, it was important to determine how serum-plasma cholesterol differences would affect prevalence estimates of moderate and high risk cholesterol levels.

After calculating prevalence estimates using the serum cutoff and then comparing these estimates with those calculated using the NIH plasma cutoff, it was found that using plasma definition levels to estimate the prevalence of moderate and high risk cholesterol for the NHANES II serum data overestimates the prevalence of moderate risk cholesterol by 1.8 percentage points for men and 1.2 percentage points for women. High risk cholesterol is overestimated by 3.6 percentage points for men and 3.9 percentage points for women. These percentages correspond to overestimates of approximately 2.0 million at moderate risk and 5.0 million at high risk (7.0 million adults overall), if the NHANES II serum cholesterol data are evaluated based on the plasma cholesterol risk definitions (table E). These figures are provided so that the reader may appropriately interpret the prevalence estimates of cholesterol levels and easily make comparisons with other reports using serum cholesterol data to estimate risk levels.

Even though the NHANES program shows that the prevalence of high risk cholesterol levels has been decreasing in the past 20 years,[25] using the NIH guidelines to estimate risk levels in the U.S. population, one finds that an estimated 27.4 million adults had cholesterol levels placing them at high risk of devel-

Table D. Risk cutpoints of serum cholesterol by age

Age	Moderate risk	High risk
	Cholesterol in milligrams per deciliter	
20–29 years	206–227	Greater than 227
30–39 years	228–247	Greater than 247
40 years and over	248–268	Greater than 268

Table E. Overestimates in percentage points and estimated number of adults 20–74 years with cholesterol levels at moderate and high risk based on applying plasma (table C) versus serum (table D) cholesterol cutoff points to the second National Health and Nutrition Examination Survey cholesterol distribution by sex

Sex	Moderate risk		High risk	
	Percentage points	Estimated population in thousands	Percentage points	Estimated population in thousands
Men	1.8	1,145	3.6	2,290
Women	1.2	840	3.9	2,730

oping heart disease in the late 1970's. An additional 19.6 million adults were at moderate risk.

A key research issue is whether reducing these high cholesterol levels would protect these individuals from premature death. The recently completed Lipid Research Clinics Coronary Primary Prevention Trial at the National Heart, Lung, and Blood Institute has established that reducing high cholesterol levels will reduce the probability of death from CHD.[26] Results of the study indicated that by reducing blood cholesterol levels by 9 percent, not only were heart attacks reduced by 19 percent, but other endpoints such as angina and coronary bypass surgery were also reduced. Observation studies prior to the Lipid Research Clinics Coronary Primary Prevention Trial (LRC-CPPT) did not prove that lowering total and low density lipoprotein cholesterol would subsequently reduce the incidence of CHD, mostly because of their design.[5,27,28] A consensus of the scientific evidence available from metabolic, experimental, epidemiological, and clinical studies indicates that lowering blood cholesterol will definitely reduce the probability of heart attacks caused by CHD.

Oral contraceptive use

Oral contraceptives have been identified as a potential risk factor for cardiovascular disease because of metabolic effects on serum lipids and lipoproteins.[29,30] Although studies have not established a direct relationship, they have indicated that for those women who are already at risk of developing CHD, oral contraceptives may enhance the risk of developing CHD. The NHANES II data on women 20–44 years show a 9–15 mg/dl higher mean serum cholesterol level for users of oral contraceptives than for nonusers. The user-nonuser difference was statistically significant at each age level. The fact that women taking oral contraceptives have higher mean cholesterol levels than their nonuser cohorts suggests that the higher cholesterol level, at least in part, may be responsible for their increased risk of developing CHD. Studies have shown, however, that lipoprotein fractions are more sensitive to oral contraceptive use than total cholesterol. Given the effect of oral contraceptives on serum lipids, it has been suggested that oral contraceptives should be recommended with caution for women with known risk factors of cardiovascular disease.[29,30] Results in this report are from data collected in the late 1970's. It is well known that the dosage or metabolic potency of oral contraceptives has changed over the past 10 years.[31] Whether the relationships found in this report hold for the 1980's will be the subject of future reports.

Socioeconomic status

Socioeconomic status (SES) has long been assumed to be related to numerous health and nutrition variables. However, there are no national studies other than NHANES I[9] that have descriptively related the mean serum cholesterol levels to the adult population's SES. In general, NHANES II data showed fairly consistent agreement among the three socioeconomic variables in that higher levels of SES are associated with higher mean serum cholesterol levels. Men and women at or above the poverty level had consistently higher mean serum cholesterol levels than those below the poverty level for each successive age category. Men with an annual family income of $20,000 per year also had consistently higher mean levels than those with an income of less than $6,000 per year. Other age-specific socioeconomic comparisons did not show any consistent patterns for men or women.

An interesting finding from the socioeconomic comparison of the mean levels for each of the four race-sex groups is that for the high-risk age group for cardiovascular morbidity and mortality, ages 45–64 years, the mean serum cholesterol level was consistently higher for higher SES white men than for lower SES white men (table F). In fact, all four race-sex groups showed a higher mean level at or above the poverty level than below the poverty level. In general, most epidemiological and

Table F. Mean serum cholesterol levels of adults ages 45–64 years by sex, race, poverty status, annual family income, and educational level: United States, 1976–80

Race and sex	Socioeconomic variable					
	Poverty status		Annual family income		Educational level	
	Below poverty	At or above poverty	Less than $6,000	$20,000 or more	Less than 12 years	12 years or more
	Mean serum cholesterol in milligrams per deciliter					
White men	222	**229	221	223	221	230
Black men	216	229	217	*	226	229
White women	237	240	240	236	240	240
Black women	227	243	234	*	242	236

*Unreliable cell.
**Statistically significant ($p < .05$).

Table G. Percent, standard error of percent, and estimated population in millions of persons 20–74 years with serum cholesterol levels at high risk, by poverty status, educational level, and sex: United States, 1976–80

Poverty status and educational level	Men			Women		
	Percent	Standard error of percent	Estimated population in millions	Percent	Standard error of percent	Estimated population in millions
Total	19.1	0.9	12.1	21.8	0.9	15.3
Poverty status[1]						
Poverty	14.9	1.6	0.8	19.1	2.1	1.7
Nonpoverty	19.6	1.0	10.9	22.1	0.9	12.9
Educational level[2]						
Less than 12 years	18.1	1.4	3.2	25.6	1.4	5.2
12 years or more	19.5	1.0	8.8	20.3	0.9	10.0

[1]Unknown poverty status is excluded.
[2]Unknown educational levels are excluded.

clinical studies have concentrated on white men in an attempt to better understand the relationship of certain risk factors to the development of heart disease.[1–5,21,22–27]

Table G shows a breakdown by SES of the percent of the population and the estimated population in millions with cholesterol levels that put them at high risk for developing CHD. These kinds of data should prove very useful in conjunction with current health promotion efforts to educate the general public about the risk associated with having high cholesterol levels.

Because these data are from the late 1970's, it is important to realize that the impact of health initiatives in the 1980's aimed at improving the health and nutrition status of the U.S. population have yet to be evaluated. A more concentrated look in future studies at the diet, eating patterns, attitudes, and lifestyles of the general population and of specific subgroups within the population may help to better understand and explain some of the relationships between SES and serum cholesterol concentrations.

References

[1]W. B. Kannel, W. P. Castelli, T. Gordon, and P. M. McNamara: Serum cholesterol, lipoproteins, and the risk of coronary heart disease: The Framingham Study. *Ann. Intern. Med.* 74:1, 1971.

[2]A. Keys: Coronary heart disease in seven countries. *Circulation* (Supp. 1) 41:211, 1970.

[3]S. H. Kinch, J. T. Doyle, and H. E. Hilleboe: Risk factors in ischaemic heart disease. *Am. J. Publ. Health* 53:438, 1963.

[4]D. McGee and T. Gordon: *The Framingham Study,* Sec. 31. The results of the Framingham Study applied to four other U.S. based epidemiologic studies of coronary heart disease. DHEW Pub. No. (NIH) 76–1083, 1976.

[5]Pooling Project Research Group: Relationship of blood pressure, serum cholesterol, smoking habit, relative weight, and ECG abnormalities to incidence of major coronary events. *J. Chron. Disease* 31:201, 1978.

[6]National Institutes of Health, Consensus Development Conference Statement on Lowering Blood Cholesterol to Prevent Heart Disease. Dec. 12, 1984.

[7]National Center for Health Statistics, F. E. Moore and T. Gordon: Serum cholesterol levels of adults, United States, 1960–62. *Vital and Health Statistics.* Series 11, No. 22. PHS Pub. No. 1000. Public Health Service. Washington. U.S. Government Printing Office, Mar. 1967.

[8]National Center for Health Statistics, S. Abraham, C. L. Johnson, and M. D. Carroll: Total serum cholesterol levels of adults 18–74 years, United States, 1971–74. *Vital and Health Statistics.* Series 11, No. 205. DHEW Pub. No. (PHS) 78–1652. Public Health Service. Washington. U.S. Government Printing Office, Apr. 1978.

[9]National Center for Health Statistics, R. Fulwood, S. Abraham, and C. L. Johnson: Serum cholesterol levels of persons 4–74 years of age, by socioeconomic characteristics, United States, 1971–74. *Vital and Health Statistics.* Series 11, No. 217. DHEW Pub. No. (PHS) 80–1667. Public Health Service. Washington. U.S. Government Printing Office, Mar. 1980.

[10]National Center for Health Statistics, A. McDowell, A. Engel, J. T. Massey, and K. Maurer: Plan and operation of the Second National Health and Nutrition Examination Survey, 1976–80. *Vital and Health Statistics.* Series 1, No. 15. DHHS Pub. No. (PHS) 81–1317. Public Health Service. Washington. U.S. Government Printing Office, July 1981.

[11]National Center for Health Statistics: Plan and initial program of the Health Examination Survey. *Vital and Health Statistics.* Series 1, No. 4. DHEW Pub. No. (HRA) 74–1038. Public Health Service. Washington. U.S. Government Printing Office, Nov. 1973.

[12]National Center for Health Statistics: Plan, operation, and response results of a program of children's examinations. *Vital and Health Statistics.* Series 1, No. 5. PHS Pub. No. 1000. Public Health Service. Washington. U.S. Government Printing Office, Oct. 1967.

[13]National Center for Health Statistics: Plan and operation of a Health Examination Survey of U.S. youths 12–17 years of age. *Vital and Health Statistics.* Series 1, No. 8. PHS Pub. No. 1000. Public Health Service. Washington. U.S. Government Printing Office, Sept. 1969.

[14]National Center for Health Statistics, H. W. Miller: Plan and operation of the Health and Nutrition Examination Survey, United States, 1971–73. *Vital and Health Statistics.* Series 1, Nos. 10a and 10b. DHEW Pub. No. (HSM) 73–1310. Health Services and Mental Health Administration. Washington. U.S. Government Printing Office, Feb. 1973.

[15]National Center for Health Statistics, A. Engel, R. S. Murphy, K. Maurer, and E. Collins: Plan and operation of the HANES I Augmentation Survey of Adults 25–74 years, United States, 1974–75. *Vital and Health Statistics.* Series 1, No. 14. DHEW Pub. No. (PHS) 78–1314. Public Health Service. Washington. U.S. Government Printing Office, June 1978.

[16]National Center for Health Statistics: Memorandum of understanding between the National Center for Health Statistics and the National Heart, Lung, and Blood Institute. Public Health Service Act 42 U.S.C. 242K, Sec. 306. Feb. 27, 1981.

[17]*Manual of Laboratory Operations,* Vol. 1, Lipid Research Clinics Program, Lipid and Lipoprotein Analysis. DHEW Publications No. (NIH) 75–628, 1974.

[18]P. S. Bachorik, D. D. S. Wood, J. Kuchmak, et al.: Automated determinations of total plasma cholesterol. A serum calibration technique. *Clin. Chem. Acta* 96:145, 1979.

[19]Laboratory Methods Committee of the Lipid Research Clinics, Program of the National Heart, Lung, and Blood Institute: Cholesterol and triglyceride concentrations in serum plasma pairs. *Clin. Chem.* 23:60–63, 1977.

[20]G. Heiss, I. Tamir, C. E. Davis, et al.: Lipoprotein-cholesterol distributions in selected North American populations—The Lipid Research Clinics Program Prevalence Study. *Circulation* 61(2):302–315, 1980.

[21]A. Keys, H. L. Taylor, and H. Blackburn: Coronary heart disease among Minnesota business and professional men followed for 15 years. *Circulation* 28:381–395, 1963.

[22]T. Gordon and J. I. Vertex: *The Framingham Study—An Epidemiological Investigation of Cardiovascular Disease,* Sec. 23, Serum cholesterol, systolic blood pressure, and Framingham relative weight as discriminators of cardiovascular disease. Bethesda, Md. National Institutes of Health, 1969.

[23]J. L. Goldstein, W. R. Hazzard, et al.: Hyperlipidemia in coronary heart disease, I. Lipid levels in 500 survivors of myocardial infarction. *J. Clin. Invest.* 52:1544–1568, July 1973.

[24]*Lipid Research Clinics Population Studies Data Book,* Vol. I, The Prevalence Study, Aggregate distributions of lipids, lipoproteins and selected variables in 11 North American populations. NIH Pub. No. 80–1527. Public Health Service. Washington. U.S. Government Printing Office, July 1980.

[25]S. Abraham, B. Rifkind, M. Feinleib, et al.: Decline in Serum Cholesterol Levels 1960–80. American Heart Association Presentation. Anaheim, Calif., Nov. 1983.

[26]Lipid Research Clinics Program: The Lipid Research Clinics coronary primary prevention trial results, II. The relationship of reduction in incidence of coronary heart disease to cholesterol lowering. *JAMA* 251(3):365–374, Jan. 20, 1984.

[27]Multiple Risk Factor Intervention Trial Research Group: Risk factor change and morbidity results. Multiple Risk Factor Intervention Trial. *JAMA* 248(12), Sept. 24, 1982.

[28]A. Keys, C. Aravanis, H. Blackburn, et al.: Probability of middle-aged men developing coronary heart disease in five years. *Circulation* 45(4):815–828, 1972.

[29]P. Wahl, C. Walden, R. Knopp, et al.: Effects of estrogen/progestin potency on lipids/lipoprotein cholesterol. *N. Engl. J. Med.* 308(15):862–867, 1983.

[30]R. M. Krauss, S. Roy, D. R. Mishell, Jr., et al.: Effects of low-dose oral contraceptives on serum lipids and lipoproteins. Differential changes in high density lipoproteins subclasses. *Am. J. Obstet. Gynecol.* 145:446, 1983.

[31]M. Feinleib and M. G. Kovar: Presentation on National Estimates of the Prevalence of Risk Factors for Cardiovascular Disease Among Women in the United States. Symposium on Coronary Heart Disease in Women. Bethesda, Md., Jan. 1986.

[32]National Center for Health Statistics, M. G. Kovar and G. S. Poe: The National Health Interview Survey design, 1973–84, and procedures, 1975–83. *Vital and Health Statistics.* Series 1, No. 18. DHHS Pub. No. (PHS) 85–1320. Public Health Service. Washington. U.S. Government Printing Office, July 1985.

[33]R. Goodman and L. Kish: Controlled selection—A technique in probability sampling. *J. Am. Stat. Assoc.* 45:350–372, 1950.

[34]R. N. Forthofer: Investigations of nonresponse bias in NHANES II. *Am. J. Epidem.* 117(4):507–515, 1983.

[35]U.S. Department of Health, Education and Welfare: *A Comparison and Analysis of Examined and Nonexamined Persons on Medical History Characteristics for the First Round of the Health and Nutrition Examination Survey.* Contract No. HSM–110–73–371. Rockville, Md. Westat Inc., Jan. 24, 1974.

[36]Health Services and Mental Health Administration: *The HANES Study.* Final report prepared by Institute for Survey Research, Temple University, Philadelphia, Apr. 1975.

[37]National Center for Health Statistics: H. W. Miller and P. Williams, Factors related to response in a health examination survey, United States, 1960–62. *Vital and Health Statistics.* Series 2, No. 36. PHS Pub. No. 1000. Public Health Service. Washington. U.S. Government Printing Office, Aug. 1969.

[38]Department of Health, Education, and Welfare, National Center for Health Statistics, W. L. Schaible: Memorandum to Arthur J. McDowell, Division of Health Examination Statistics. June 21, 1974.

[39]Brenda Cox: The Weighted Sequential Hot Deck Imputation Procedure. Presentation at the American Statistical Association annual meetings. Aug. 1980. Contract No. HRA 230–76–0268, a part of RTI Project No. 245U–1320, by R. Williams and R. Folson, Jr. Research Triangle Institute, Dec. 1980.

[40]M. Holt: SURREGR—Standard Errors of Regression Coefficients From Sample Survey Data. Research Triangle Park, N.C. Research Triangle Institute, May 1977. Revised Apr. 1982.

[41]G. G. Koch, D. H. Freeman, and J. L. Freeman: Strategies in the multivariate analysis of data from complex surveys. *Int. Stat. Rev.* 43(1):59–78, 1975.

[42]D. H. Freeman, J. L. Freeman, D. B. Brock, and G. G. Koch: Strategies in the multivariate analysis of data from complex surveys, II. An application to the United States National Health Interview Survey. *Int. Stat. Rev.* 44:317–330, 1976.

[43]National Center for Health Statistics, J. A. Bean: Distribution and properties of variance estimators for complex multistage probability samples, an empirical distribution. *Vital and Health Statistics.* Series 2, No. 65. DHEW Pub. No. (HRA) 75–1339. Health Resources Administration. Washington. U.S. Government Printing Office, Mar. 1975.

[44]National Center for Health Statistics, G. Jones: HES Variance and Cross Tabulation Program, version 2, p. 11. Mar. 10, 1977. Unpublished.

[45]R. S. Woodruff: Simple method for approximating variance of a complicated estimate. *J. Am. Statist. Assoc.* 66:411–414, June 1971.

[46]National Center for Health Statistics, J. R. Landis, J. M. Lepkowski, S. A. Eklund, and S. A. Stehouwer: A statistical methodology for analyzing data from a complex survey: The First National Health and Nutrition Examination Survey. *Vital and Health Statistics.* Series 2, No. 92. DHHS Pub. No. (PHS) 82–1366. Public Health Service. Washington. U.S. Government Printing Office, Sept. 1982.

[47]National Center for Health Statistics, R. Fulwood, S. Abraham, and C. Johnson: Height and weight of adults ages 18–74 years by socioeconomic and geographic variables. *Vital and Health Statistics.* Series 11, No. 224. DHHS Pub. No. (PHS) 81–1674. Public Health Service. Washington. U.S. Government Printing Office, Aug. 1981.

[48]H. Scheffe: *The Analysis of Variance.* New York. John Wiley & Sons, Inc., 1959.

[49]W. Johnson and G. Koch: Analysis of qualitative data: Linear functions. *Health Serv. Res.* 5(4):358–369, Winter 1970.

[50]A. Wald: Tests of statistical hypothesis concerning several parameters when the number of observations is large. *Trans. Am. Math. Soc.* 54:426, 1943.

[51]National Center for Health Statistics, P. J. McCarthy: Replication, an approach to the analysis of data from complex surveys. *Vital and Health Statistics.* Series 2, No. 14. PHS Pub. No. 1000. Public Health Service. Washington. U.S. Government Printing Office, Apr. 1966.

[52]D. H. Freeman and D. B. Brock: The role of the covariance matrix estimation in the analysis of complex sample survey data, in N. K. Nambodoodiu, ed., *Survey Sampling and Measurement,* pp. 121–140. New York. Academic Press, Inc. 1978.

[53]U.S. Bureau of the Census: Money income and poverty status of families and persons in the United States: 1976, 1977, 1978, 1979, and 1980 (Advance Report). *Current Population Reports.* Series P–60, Nos. 107, 116, 120, 125, and 127. Washington. U.S. Government Printing Office, 1977, 1978, 1979, 1980, and 1981.

[54]M. Orshansky: Counting the poor, another look at the poverty profile. *Social Security Bull.,* Jan. 1965.

[55]M. Orshansky: Who's who among the poor: A demographic view of poverty. *Social Security Bull.*, July 1965.

[56]U.S. Bureau of the Census: "Special studies." *Current Population Reports.* Series P–23, No. 28. Washington. U.S. Government Printing Office, Aug. 12, 1969.

[57]Executive Office of the President, Bureau of the Budget: Circular No. A–46, Transmitted Memorandum No. 9. Aug. 29, 1969, and Exhibit L (rev.).

[58]National Center for Health Statistics: Total Nutrient Intake, Food Frequency, and Other Related Dietary Data Tape. Tape No. 5701–NHANES, 1976–80, Public use data tape documentation. Public Health Service. Feb. 1982.

List of detailed tables

Table 1. Mean serum cholesterol levels of men, standard errors of the mean, age-adjusted values, selected percentiles, number of examined persons, and estimated population, by race and age: United States, 1976–80

Race and age	Examined persons	Estimated population	Mean	Standard error of the mean	Percentile								
					5th	10th	15th	25th	50th	75th	85th	90th	95th
All races[1]	Number	Number in thousands	Serum cholesterol in milligrams per deciliter										
20–74 years	5,604	63,611	211	1.2	144	156	165	179	206	239	258	271	291
20–24 years	676	9,331	180	1.7	129	136	145	155	176	202	215	227	246
25–34 years	1,067	15,895	199	1.5	141	152	159	172	194	220	240	254	275
35–44 years	745	11,367	217	2.0	153	166	173	187	215	244	262	275	293
45–54 years	690	11,114	227	1.8	159	176	182	197	223	255	271	283	303
55–64 years	1,227	9,607	229	1.8	164	176	184	198	225	254	277	288	307
65–74 years	1,199	6,297	221	1.8	153	167	175	191	217	249	265	279	301
White													
20–74 years	4,883	55,808	211	1.2	145	157	166	179	207	239	258	271	291
20–24 years	581	8,052	180	1.8	131	138	146	155	176	202	216	229	244
25–34 years	901	13,864	199	1.7	144	153	161	172	194	220	239	254	273
35–44 years	653	9,808	217	1.8	153	166	173	187	214	244	260	272	291
45–54 years	617	9,865	227	1.8	160	177	181	198	222	254	271	283	303
55–64 years	1,086	8,642	230	2.0	164	178	185	199	225	255	278	289	307
65–74 years	1,045	5,576	222	2.0	153	167	175	191	217	250	266	281	301
Black													
20–74 years	607	6,102	208	2.5	133	146	156	171	200	238	260	273	301
20–24 years	79	1,043	171	*3.7	*	128	134	149	170	193	210	211	*
25–34 years	139	1,546	199	*4.1	129	136	144	163	192	226	248	259	301
35–44 years	70	1,112	218	*8.3	*	156	168	176	202	238	275	283	*
45–54 years	62	1,044	229	*7.1	*	174	184	195	232	261	268	279	*
55–64 years	129	801	223	*4.8	157	168	172	183	218	254	271	299	312
65–74 years	128	555	217	4.2	149	163	173	183	216	244	261	277	299
Age-adjusted values:													
All races, 20–74 years	...	...	211	1.1	...	...	...	...	...	...	...	...	...
White, 20–74 years	...	...	211	1.1	...	...	...	...	...	...	...	...	...
Black, 20–74 years	...	...	209	2.5	...	...	...	...	...	...	...	...	...

[1]Includes data for races not shown separately.

Table 2. Mean serum cholesterol levels of women, standard errors of the mean, age-adjusted values, selected percentiles, number of examined persons, and estimated population, by race and age: United States, 1976–80

Race and age	Examined persons	Estimated population	Mean	Standard error of the mean	Percentile								
					5th	10th	15th	25th	50th	75th	85th	90th	95th
All races[1]	Number	Number in thousands	Serum cholesterol in milligrams per deciliter										
20–74 years	6,260	69,994	215	1.2	143	156	166	179	210	245	266	282	305
20–24 years	738	9,994	184	1.9	132	140	145	157	180	204	216	230	250
25–34 years	1,170	16,856	192	1.4	135	145	154	164	188	215	233	243	263
35–44 years	844	12,284	207	1.8	147	158	164	177	202	231	248	260	276
45–54 years	763	11,918	232	2.2	164	178	188	199	228	257	275	290	306
55–64 years	1,329	10,743	249	2.0	180	193	203	215	242	277	299	314	336
65–74 years	1,416	8,198	246	1.6	173	189	198	214	241	274	295	309	327
White													
20–74 years	5,418	60,785	216	1.3	143	156	166	179	210	246	267	282	305
20–24 years	624	8,408	184	2.1	133	140	147	159	181	204	215	230	249
25–34 years	1,000	14,494	192	1.5	135	145	153	164	188	215	235	244	261
35–44 years	726	10,584	207	1.9	147	157	164	177	203	231	248	259	277
45–54 years	647	10,369	232	2.6	166	179	188	199	228	257	274	290	308
55–64 years	1,176	9,601	249	1.7	180	193	203	215	244	277	298	312	330
65–74 years	1,245	7,329	246	1.7	174	190	199	214	242	275	296	309	328
Black													
20–74 years	729	7,579	212	3.1	140	154	166	176	205	237	263	279	308
20–24 years	94	1,304	185	*4.9	*	136	144	156	178	204	220	237	*
25–34 years	145	1,953	191	*4.1	129	144	156	167	190	212	226	235	267
35–44 years	103	1,415	206	*4.5	143	158	170	175	194	233	254	274	279
45–54 years	100	1,215	230	*7.2	150	172	181	200	226	263	277	291	306
55–64 years	135	959	251	*8.0	178	185	198	211	233	280	318	336	345
65–74 years	152	733	243	4.2	173	189	198	211	237	269	290	308	323
Age-adjusted values:													
All races, 20–74 years	...	...	215	1.2	...	...	...	...	...	...	...	...	...
White, 20–74 years	...	...	215	1.2	...	...	...	...	...	...	...	...	...
Black, 20–74 years	...	...	214	2.7	...	...	...	...	...	...	...	...	...

[1]Includes data for races not shown separately.

Table 3. Mean serum cholesterol levels of women, standard errors of the mean, age-adjusted values, number of examined persons, and estimated population, by race, age, and oral contraceptive use: United States, 1976–80

Race and age	Oral contraceptive use: User — Examined persons	User — Estimated population	User — Mean	User — Standard error of the mean	Nonuser — Examined persons	Nonuser — Estimated population	Nonuser — Mean	Nonuser — Standard error of the mean
All races[1]	Number	Number in thousands	Serum cholesterol in milligrams per deciliter		Number	Number in thousands	Serum cholesterol in milligrams per deciliter	
20–44 years	508	7,043	200	2.3	2,244	32,092	193	1.3
20–24 years	233	3,181	194	2.9	505	6,814	179	2.2
25–34 years	226	3,165	201	3.3	944	13,692	189	1.6
35–44 years	49	698	215	*4.4	795	11,586	206	1.9
White								
20–44 years	434	5,991	201	2.5	1,916	27,495	193	1.3
20–24 years	198	2,686	194	3.2	426	5,722	179	2.1
25–34 years	191	2,682	203	3.6	809	11,812	189	1.6
35–44 years	45	623	217	*4.9	681	9,961	206	2.0
Age-adjusted values:								
All races, 20–44 years	...	...	204	2.3	...	...	192	1.3
White, 20–44 years	...	...	205	2.5	...	...	192	1.2
Black, 20–44 years	...	...	198	*4.9	...	...	193	2.7

[1] Includes data for races not shown separately.

Table 4. Mean serum cholesterol levels of adults, standard errors of the mean, age-adjusted values, number of examined persons, and estimated population, by sex, age, and poverty status: United States, 1976–80

Sex and age	Poverty status[1]											
	Total				Poverty				Nonpoverty			
	Examined persons	Estimated population	Mean	Standard error of the mean	Examined persons	Estimated population	Mean	Standard error of the mean	Examined persons	Estimated population	Mean	Standard error of the mean
	Number	Number in thousands	Serum cholesterol in milligrams per deciliter		Number	Number in thousands	Serum cholesterol in milligrams per deciliter		Number	Number in thousands	Serum cholesterol in milligrams per deciliter	
Men												
20–74 years	5,394	61,184	211	1.2	609	5,478	205	2.4	4,785	55,706	212	1.2
20–24 years	656	9,032	180	1.7	112	1,369	181	3.7	544	7,664	180	1.8
25–34 years	1,036	15,461	199	1.6	91	1,106	203	4.8	945	14,355	199	1.6
35–44 years	721	11,016	218	2.1	63	821	211	5.1	658	10,195	219	2.1
45–54 years	649	10,383	227	1.9	46	645	217	8.4	603	9,738	228	2.0
55–64 years	1,177	9,221	229	1.8	129	779	224	5.2	1,048	8,443	230	2.0
65–74 years	1,155	6,071	222	1.9	168	759	213	3.9	987	5,312	223	2.1
Women												
20–74 years	6,012	67,468	215	1.2	953	8,919	209	2.6	5,059	58,549	216	1.2
20–24 years	715	9,663	184	1.9	146	1,838	182	4.0	569	7,825	185	1.9
25–34 years	1,144	16,478	191	1.5	162	1,997	188	3.6	982	14,482	192	1.7
35–44 years	821	11,920	207	1.8	119	1,543	208	4.7	702	10,377	207	1.9
45–54 years	737	11,539	231	2.3	82	1,115	227	5.7	655	10,424	232	2.2
55–64 years	1,259	10,115	249	1.7	188	1,181	241	4.5	1,071	8,934	250	1.7
65–74 years	1,336	7,752	246	1.7	256	1,245	239	4.3	1,080	6,507	247	1.7
Age-adjusted values:												
Men, 20–74 years	...	...	211	1.1	...	...	208	2.6	...	...	212	1.1
Women, 20–74 years	...	...	214	1.1	...	...	211	2.2	...	...	215	1.1

[1] Unknown poverty status is excluded.

Table 5. Mean serum cholesterol levels of adults, standard errors of the mean, age-adjusted values, number of examined persons, and estimated population, by sex, race, age, and poverty status: United States, 1976–80

Sex, race, and age	Poverty status[1]							
	Poverty				Nonpoverty			
	Examined persons	*Estimated population*	*Mean*	*Standard error of the mean*	*Examined persons*	*Estimated population*	*Mean*	*Standard error of the mean*
	Number	Number in thousands	Serum cholesterol in milligrams per deciliter		Number	Number in thousands	Serum cholesterol in milligrams per deciliter	
MEN								
White								
20–74 years	427	3,935	206	2.6	4,295	49,969	212	1.2
20–44 years	183	2,305	197	2.5	1,897	28,592	200	1.3
45–64 years	126	1,080	222	6.0	1,504	16,524	229	1.3
65–74 years	118	551	212	4.4	894	4,853	223	2.4
Black								
20–74 years	163	1,285	203	5.0	403	4,399	209	3.5
20–44 years	69	765	192	*7.2	202	2,727	199	3.4
45–64 years	48	341	216	*6.8	126	1,325	229	*6.0
65–74 years	46	179	221	*9.3	75	347	218	*4.9
WOMEN								
White								
20–74 years	673	6,372	210	3.5	4,548	52,379	216	1.2
20–44 years	290	3,775	191	3.5	1,999	28,787	195	1.2
45–64 years	188	1,607	237	4.6	1,564	17,624	240	1.8
65–74 years	195	990	238	4.0	985	5,967	248	1.8
Black								
20–74 years	262	2,348	208	3.8	423	4,862	211	3.8
20–44 years	128	1,479	193	*4.6	205	3,089	193	3.2
45–64 years	77	640	227	*6.7	137	1,332	243	*5.9
65–74 years	57	230	247	*9.6	81	440	244	*3.8
Age-adjusted values:								
White men, 20–74 years	...	...	207	2.8	...	...	212	1.1
Black men, 20–74 years	...	...	203	4.9	...	...	211	3.3
White women, 20–74 years	...	...	211	3.0	...	...	215	1.1
Black women, 20–74 years	...	...	210	4.3	...	...	215	3.4

[1] Unknown poverty status is excluded.

Table 6. Mean serum cholesterol levels of adults, standard errors of the mean, age-adjusted values, number of examined persons, and estimated population, by sex, age, and annual family income: United States, 1976–80

Sex and age	Annual family income[1]											
	Total				Under $6,000				$6,000–$9,999			
	Examined persons	Estimated population	Mean	Standard error of the mean	Examined persons	Estimated population	Mean	Standard error of the mean	Examined persons	Estimated population	Mean	Standard error of the mean
	Number	Number in thousands	Serum cholesterol in milligrams per deciliter		Number	Number in thousands	Serum cholesterol in milligrams per deciliter		Number	Number in thousands	Serum cholesterol in milligrams per deciliter	
Men												
20–74 years	5,396	61,214	211	1.2	905	7,268	205	2.2	1,111	11,857	206	1.9
20–24 years	657	9,044	180	1.7	154	1,853	182	2.6	138	2,035	172	3.4
25–34 years	1,037	15,479	199	1.6	100	1,270	197	5.1	197	3,160	197	3.0
35–44 years	721	11,016	218	2.1	48	595	207	*5.8	92	1,453	214	5.0
45–54 years	649	10,383	227	1.9	58	836	209	*5.8	83	1,200	222	5.7
55–64 years	1,177	9,221	229	1.8	193	1,136	226	5.2	229	1,819	223	3.3
65–74 years	1,155	6,071	222	1.9	352	1,579	219	2.7	372	2,191	223	2.6
Women												
20–74 years	6,012	67,468	215	1.2	1,478	12,453	216	2.2	1,348	15,357	217	2.0
20–24 years	715	9,663	184	1.9	208	2,610	184	2.8	154	2,385	180	3.2
25–34 years	1,144	16,478	191	1.5	171	2,086	189	4.0	202	3,178	191	3.2
35–44 years	821	11,920	207	1.8	101	1,266	209	5.0	135	2,247	201	3.7
45–54 years	737	11,539	231	2.3	105	1,422	227	5.7	137	2,260	237	4.1
55–64 years	1,259	10,115	249	1.7	320	2,078	244	4.0	329	2,720	247	3.0
65–74 years	1,336	7,752	246	1.7	573	2,989	243	2.2	391	2,567	247	2.7
Age-adjusted values:												
Men, 20–74 years	...	...	211	1.1	...	...	205	2.3	...	...	207	2.2
Women, 20–74 years	...	...	214	1.1	...	...	212	1.9	...	...	213	1.7

[1]Unknown annual family incomes are excluded.

Table 6. Mean serum cholesterol levels of adults, standard errors of the mean, age-adjusted values, number of examined persons, and estimated population, by sex, age, and annual family income: United States, 1976–80—Con.

Sex and age	Annual family income[1]—Con.											
	$10,000–$14,999				$15,000–$19,999				$20,000 or more			
	Examined persons	Estimated population	Mean	Standard error of the mean	Examined persons	Estimated population	Mean	Standard error of the mean	Examined persons	Estimated population	Mean	Standard error of the mean
Men	Number	Number in thousands	Serum cholesterol in milligrams per deciliter		Number	Number in thousands	Serum cholesterol in milligrams per deciliter		Number	Number in thousands	Serum cholesterol in milligrams per deciliter	
20–74 years	1,113	11,809	208	1.9	906	11,158	213	2.1	1,361	19,121	218	1.7
20–24 years	145	1,857	184	3.8	83	1,143	180	4.8	137	2,156	183	4.1
25–34 years	267	3,613	196	2.6	224	3,237	200	2.7	249	4,198	203	2.8
35–44 years	138	1,965	219	4.8	169	2,410	217	3.7	274	4,593	221	3.6
45–54 years	107	1,551	222	7.0	153	2,401	226	4.5	248	4,394	234	3.0
55–64 years	246	1,726	227	2.8	181	1,475	236	4.8	328	3,066	233	3.4
65–74 years	210	1,096	219	3.2	96	491	224	4.7	125	714	228	4.3
Women												
20–74 years	1,140	12,806	217	2.3	812	9,827	213	1.6	1,234	17,025	211	1.6
20–24 years	139	1,775	185	4.2	88	1,141	193	4.6	126	1,753	184	2.7
25–34 years	258	3,567	193	3.0	222	3,185	191	3.4	291	4,462	192	3.0
35–44 years	180	2,397	210	5.2	132	1,816	215	4.5	273	4,193	203	2.6
45–54 years	143	2,072	240	4.6	125	1,903	227	5.2	227	3,882	227	4.5
55–64 years	229	1,856	252	3.4	154	1,252	250	5.2	227	2,209	252	3.1
65–74 years	191	1,140	253	4.2	91	530	242	4.9	90	526	245	5.1
Age-adjusted values:												
Men, 20–74 years	...	...	210	1.7	...	...	212	1.9	...	...	216	1.3
Women, 20–74 years	...	...	218	2.2	...	...	216	1.6	...	...	214	1.6

[1]Unknown annual family incomes are excluded.

Table 7. Mean serum cholesterol levels of adults, standard errors of the mean, age-adjusted values, number of examined persons, and estimated population, by sex, race, age, and annual family income: United States, 1976–80

Sex, race, and age	Annual family income[1]							
	Under $6,000				$20,000 or more			
	Examined persons	Estimated population	Mean	Standard error of the mean	Examined persons	Estimated population	Mean	Standard error of the mean
	Number	Number in thousands	Serum cholesterol in milligrams per deciliter		Number	Number in thousands	Serum cholesterol in milligrams per deciliter	
MEN								
White								
20–74 years	833	7,026	205	2.3	1,257	17,509	218	1.5
20–44 years	280	3,651	191	2.3	598	9,878	206	1.9
45–64 years	225	1,791	221	5.7	542	6,956	233	2.1
65–74 years	328	1,584	219	2.8	117	675	228	4.5
Black								
20–74 years	197	1,487	205	5.0	67	965	217	*7.8
20–44 years	63	709	189	*9.2	41	659	202	*11.9
45–64 years	64	509	217	*4.1	23	293	*	*
65–74 years	70	270	224	*6.9	3	13	*	*
WOMEN								
White								
20–74 years	1,311	11,467	218	2.7	1,136	15,693	212	1.8
20–44 years	398	5,284	190	3.0	633	9,544	196	2.0
45–64 years	379	3,274	240	3.4	420	5,675	236	3.0
65–74 years	534	2,908	244	2.2	83	474	246	5.4
Black								
20–74 years	333	2,849	212	3.9	66	870	199	*6.6
20–44 years	132	1,528	190	4.6	43	629	189	*5.8
45–64 years	103	859	234	7.4	21	233	*	*
65–74 years	98	462	244	5.8	2	8	*	*
Age-adjusted values:								
White men	...	...	203	2.4	...	...	217	1.3
Black men	...	...	203	5.6	...	...	218	5.8
White women	...	...	212	2.3	...	...	214	1.8
Black women	...	...	210	3.2	...	...	201	4.8

[1]Unknown annual family incomes are excluded.

Table 8. Mean serum cholesterol levels of adults, standard errors of the mean, age-adjusted values, number of examined persons, and estimated population, by sex, age, and educational level: United States, 1976–80

Sex and age	Educational level[1]							
	Total				0–8 years			
	Examined persons	Estimated population	Mean	Standard error of the mean	Examined persons	Estimated population	Mean	Standard error of the mean
Men	Number	Number in thousands	Serum cholesterol in milligrams per deciliter		Number	Number in thousands	Serum cholesterol in milligrams per deciliter	
20–74 years	5,557	63,021	211	1.2	1,241	9,480	218	2.3
20–24 years	672	9,264	180	1.7	25	290	179	*6.8
25–34 years	1,065	15,875	199	1.6	64	860	205	6.8
35–44 years	735	11,208	218	2.0	88	1,146	217	4.8
45–54 years	680	10,934	227	1.8	144	2,016	218	4.0
55–64 years	1,218	9,517	229	1.8	394	2,674	224	2.8
65–74 years	1,187	6,223	221	1.8	526	2,493	222	3.0
Women								
20–74 years	6,197	69,328	215	1.2	1,254	9,867	232	2.7
20–24 years	733	9,895	184	1.9	23	247	*	*
25–34 years	1,164	16,754	192	1.4	75	978	186	*3.8
35–44 years	836	12,173	207	1.8	102	1,125	210	5.2
45–54 years	759	11,867	232	2.2	150	2,107	236	4.2
55–64 years	1,309	10,564	249	2.0	370	2,579	249	4.5
65–74 years	1,396	8,074	246	1.6	534	2,830	242	2.4
Age-adjusted values:								
Men, 20–74 years	...	...	211	1.1	...	...	210	3.0
Women, 20–74 years	...	...	215	1.2	...	...	215	2.1

[1]Unknown educational levels are excluded.

Table 8. Mean serum cholesterol levels of adults, standard errors of the mean, age-adjusted values, number of examined persons, and estimated population, by sex, age, and educational level: United States, 1976–80—Con.

Sex and age	Educational level[1]—Con.							
	9–11 years				12 years			
	Examined persons	Estimated population	Mean	Standard error of the mean	Examined persons	Estimated population	Mean	Standard error of the mean
	Number	Number in thousands	Serum cholesterol in milligrams per deciliter		Number	Number in thousands	Serum cholesterol in milligrams per deciliter	
Men								
20–74 years	839	8,434	215	2.5	1,671	19,908	210	1.5
20–24 years	85	1,071	179	3.8	240	3,268	176	2.8
25–34 years	109	1,394	197	4.1	355	5,007	199	2.5
35–44 years	106	1,471	220	5.0	267	4,052	218	2.8
45–54 years	114	1,686	233	4.2	222	3,533	225	3.6
55–64 years	209	1,620	226	3.7	347	2,752	234	3.0
65–74 years	216	1,192	220	2.7	240	1,296	224	3.7
Women								
20–74 years	1,030	10,502	220	1.9	2,230	27,333	215	1.6
20–24 years	79	1,035	189	5.3	278	3,703	183	2.8
25–34 years	168	2,031	193	3.2	481	6,911	192	1.9
35–44 years	147	2,001	207	5.6	360	5,405	206	2.3
45–54 years	144	2,051	231	4.1	309	5,102	235	3.3
55–64 years	232	1,858	245	5.6	465	4,099	251	2.3
65–74 years	260	1,527	247	3.1	337	2,113	251	2.9
Age-adjusted values:								
Men, 20–74 years	...	...	211	2.1	...	...	211	1.4
Women, 20–74 years	...	...	215	2.0	...	...	216	1.3

[1]Unknown educational levels are excluded.

Table 8. Mean serum cholesterol levels of adults, standard errors of the mean, age-adjusted values, number of examined persons, and estimated population, by sex, age, and educational level: United States, 1976–80—Con.

Sex and age	Educational level[1]—Con.			
	13 years or more			
	Examined persons	Estimated population	Mean	Standard error of the mean
Men	Number	Number in thousands	Serum cholesterol in milligrams per deciliter	
20–74 years	1,806	25,199	208	1.3
20–24 years	322	4,635	184	2.0
25–34 years	537	8,614	199	1.8
35–44 years	274	4,540	216	2.8
45–54 years	200	3,698	232	3.7
55–64 years	268	2,471	230	3.5
65–74 years	205	1,241	219	3.3
Women				
20–74 years	1,683	21,625	205	1.4
20–24 years	353	4,910	184	2.2
25–34 years	440	6,835	192	2.1
35–44 years	227	3,642	206	2.6
45–54 years	156	2,607	223	4.2
55–64 years	242	2,027	246	3.4
65–74 years	265	1,604	246	3.6
Age-adjusted values:				
Men, 20–74 years	...	...	212	1.2
Women, 20–74 years	...	...	213	1.3

[1]Unknown educational levels are excluded.

Table 9. Mean serum cholesterol levels of adults, standard errors of the mean, age-adjusted values, number of examined persons, and estimated population, by sex, age, and educational level: United States, 1976–80

Sex and age	Educational level[1]							
	Less than 12 years				12 years or more			
	Examined persons	Estimated population	Mean	Standard error of the mean	Examined persons	Estimated population	Mean	Standard error of the mean
	Number	Number in thousands	Serum cholesterol in milligrams per deciliter		Number	Number in thousands	Serum cholesterol in milligrams per deciliter	
Men								
20–74 years	2,080	17,914	216	1.9	3,477	45,107	209	1.1
20–24 years	110	1,361	179	3.4	562	7,903	180	1.7
25–34 years	173	2,254	200	3.3	892	13,621	199	1.6
35–44 years	194	2,616	219	3.7	541	8,591	217	2.2
45–54 years	258	3,703	225	3.2	422	7,231	229	2.4
55–64 years	603	4,294	225	2.5	615	5,223	232	2.3
65–74 years	742	3,686	221	2.4	445	2,537	222	2.5
Women								
20–74 years	2,284	20,369	226	1.8	3,913	48,959	211	1.2
20–24 years	102	1,282	189	4.7	631	8,613	183	1.9
25–34 years	243	3,009	190	2.8	921	13,746	192	1.7
35–44 years	249	3,126	208	4.4	587	9,047	206	2.0
45–54 years	294	4,158	233	3.5	465	7,709	231	2.6
55–64 years	602	4,437	247	3.7	707	6,127	250	1.8
65–74 years	794	4,357	244	2.0	602	3,717	249	2.3
Age-adjusted values:								
Men, 20–74 years	...	...	210	2.0	...	...	212	1.1
Women, 20–74 years	...	...	215	1.8	...	...	215	1.2

[1]Unknown educational levels are excluded.

Table 10. Mean serum cholesterol levels of adults, standard errors of the mean, age-adjusted values, number of examined persons, and estimated population, by sex, race, age, and educational level: United States, 1976–80

Sex, race, and age	Educational level[1]							
	Less than 12 years				12 years or more			
	Examined persons	Estimated population	Mean	Standard error of the mean	Examined persons	Estimated population	Mean	Standard error of the mean
	Number	Number in thousands	Serum cholesterol in milligrams per deciliter		Number	Number in thousands	Serum cholesterol in milligrams per deciliter	
MEN								
White								
20–74 years	1,703	14,733	217	2.1	3,149	40,646	209	1.2
20–44 years	374	4,951	203	2.6	1,751	26,597	199	1.4
45–64 years	716	6,685	224	2.8	974	11,619	230	1.7
65–74 years	613	3,096	222	2.7	424	2,431	221	2.6
Black								
20–74 years	342	2,823	215	3.3	252	3,170	202	4.3
20–44 years	93	1,133	203	*6.7	189	2,500	194	3.3
45–64 years	139	1,213	226	*4.1	47	599	229	8.4
65–74 years	110	477	214	*4.2	16	72	*	*
WOMEN								
White								
20–74 years	1,845	16,494	226	1.9	3,526	43,752	212	1.3
20–44 years	469	5,838	197	2.4	1,864	27,354	194	1.3
45–64 years	715	6,967	240	2.7	1,093	12,848	240	2.1
65–74 years	661	3,689	244	2.1	569	3,550	249	2.4
Black								
20–74 years	397	3,342	227	3.6	319	4,144	199	3.6
20–44 years	111	1,356	204	*4.7	229	3,297	190	3.2
45–64 years	164	1,379	242	*7.3	63	733	236	*9.7
65–74 years	122	606	243	5.1	27	113	248	*5.9
Age-adjusted values:								
White men	...	...	212	2.1	...	...	212	1.1
Black men	...	...	212	4.2	...	...	210	3.7
White women	...	...	216	1.9	...	...	215	1.3
Black women	...	...	220	3.4	...	...	211	3.4

[1]Unknown educational levels are excluded.

Table 11. Percent of adults with cholesterol levels at moderate and high risk, standard errors, number of examined persons, and estimated population, by sex and age: United States, 1976–80

Sex and age	Examined persons at risk	Estimated population	Persons at moderate risk	Standard error of percent	Persons at high risk	Standard error of percent
	Number	Number in thousands	Percent		Percent	
Men						
20–74 years	5,604	63,611	14.6	0.5	19.1	0.9
20–24 years	676	9,331	13.3	1.1	12.4	1.7
25–34 years	1,067	15,895	14.6	1.2	19.2	1.6
35–44 years	745	11,367	17.1	1.4	20.5	1.7
45–54 years	690	11,114	14.7	1.4	21.0	1.8
55–64 years	1,227	9,607	13.6	1.1	22.0	1.8
65–74 years	1,199	6,297	13.0	1.3	18.1	1.5
Women						
20–74 years	6,260	69,994	14.7	0.5	21.8	0.9
20–24 years	738	9,994	15.7	1.5	13.2	1.4
25–34 years	1,170	16,856	10.8	0.9	17.6	1.2
35–44 years	844	12,284	14.0	1.5	13.4	1.1
45–54 years	763	11,918	17.4	1.6	22.7	2.2
55–64 years	1,329	10,743	16.6	1.0	35.4	1.9
65–74 years	1,416	8,198	16.2	1.0	34.7	1.6
Age-adjusted values:						
Men	...	...	14.5	0.5	19.1	0.9
Women	...	...	14.7	0.5	21.7	0.9

NOTE: See Discussion section for an evaluation of the effect of the serum-plasma differences on estimating the percent with moderate or high risk cholesterol levels.

Table 12. Percent of adults with cholesterol levels at moderate and high risk, standard errors, number of examined persons, and estimated population, by sex, race, and age: United States, 1976–80

Sex, race, and age	*Examined persons at risk*	*Estimated population*	*Persons at moderate risk*	*Standard error of percent*	*Persons at high risk*	*Standard error of percent*
MEN						
White	Number	Number in thousands	Percent		Percent	
20–74 years	4,883	55,808	14.7	0.6	19.0	1.0
20–44 years	2,135	31,724	15.2	0.8	17.6	1.3
45–64 years	1,703	18,508	14.3	0.8	21.5	1.3
65–74 years	1,045	5,576	13.4	1.4	18.4	1.6
Black						
20–74 years	607	6,102	12.1	1.6	20.5	2.2
20–44 years	288	3,701	12.8	2.6	19.4	2.6
45–64 years	191	1,845	11.3	2.2	23.9	4.6
65–74 years	128	555	9.7	2.8	16.6	3.5
WOMEN						
White						
20–74 years	5,418	60,785	14.9	0.5	22.1	0.9
20–44 years	2,350	33,486	13.1	0.9	15.1	0.8
45–64 years	1,823	19,970	17.4	1.0	28.9	1.8
65–74 years	1,245	7,329	16.1	1.2	35.4	1.7
Black						
20–74 years	729	7,579	13.5	1.8	19.9	2.7
20–44 years	342	4,672	12.5	2.0	14.5	2.7
45–64 years	235	2,174	13.7	3.3	28.2	4.4
65–74 years	152	733	18.9	2.9	29.0	3.9
Age-adjusted values:						
White men	...	...	14.7	0.6	18.9	1.0
Black men	...	...	12.0	1.5	20.6	2.2
White women	...	...	14.8	0.5	21.8	0.9
Black women	...	...	13.6	1.8	20.5	2.6

NOTE: See Discussion section for an evaluation of the effect of the serum-plasma differences on estimating the percent with moderate or high risk cholesterol levels.

Table 13. Percent of adults with cholesterol levels at high risk, standard errors, number of examined persons, and estimated population, by sex, age, and poverty status: United States, 1976–80

Sex and age	Poverty status							
	Poverty				Nonpoverty			
	Examined persons at risk	*Estimated population*	*Persons at high risk*	*Standard error of percent*	*Examined persons at risk*	*Estimated population*	*Persons at high risk*	*Standard error of percent*
Men	Number	Number in thousands	Percent		Number	Number in thousands	Percent	
20–74 years	609	5,478	14.9	1.5	4,785	55,706	19.6	1.0
20–44 years	266	3,295	15.9	2.0	2,147	32,214	18.3	1.4
45–64 years	175	1,424	13.2	2.9	1,651	18,180	22.2	1.4
65–74 years	168	759	13.4	3.2	987	5,312	19.0	1.7
Women								
20–74 years	953	8,919	19.1	2.0	5,059	58,549	22.1	0.9
20–44 years	427	5,378	13.7	2.3	2,253	32,684	15.4	0.8
45–64 years	270	2,296	26.3	3.0	1,726	19,357	28.9	1.8
65–74 years	256	1,245	29.6	4.3	1,080	6,507	35.5	1.8
Age-adjusted values:								
Men	...	...	14.8	1.6	...	...	19.6	1.0
Women	...	...	19.4	2.0	...	...	21.9	0.9

NOTE: See Discussion section for an evaluation of the effect of the serum-plasma differences on estimating the percent with high risk cholesterol levels.

Table 14. Percent of adults with cholesterol levels at high risk, standard errors, number of examined persons, and estimated population, by sex, age, and educational level: United States, 1976–80

Sex and age	Educational level							
	Less than 12 years				12 years or more			
	Examined persons at risk	Estimated population	Persons at high risk	Standard error of percent	Examined persons at risk	Estimated population	Persons at high risk	Standard error of percent
Men	Number	Number in thousands	Percent		Number	Number in thousands	Percent	
20–74 years	2,080	17,914	18.1	1.4	3,477	45,107	19.5	0.9
20–44 years	477	6,231	17.3	2.0	1,995	30,116	18.0	1.2
45–64 years	861	7,997	19.2	1.9	1,037	12,454	23.1	1.6
65–74 years	742	3,686	17.1	1.9	445	2,537	19.5	1.9
Women								
20–74 years	2,284	20,369	25.6	1.4	3,913	48,959	20.3	0.9
20–44 years	594	7,416	16.6	1.8	2,139	31,406	14.8	0.8
45–64 years	896	8,596	29.5	2.2	1,172	13,835	28.5	1.9
65–74 years	794	4,357	33.3	2.0	602	3,717	36.4	2.3
Age-adjusted values:								
Men	...	...	17.9	1.5	...	...	19.8	0.9
Women	...	...	22.6	1.5	...	...	21.6	0.9

NOTE: See discussion section for evaluation of the effect of the serum-plasma differences on estimating the percent with high risk cholesterol levels.

Table 15. Cumulative percent distribution of serum cholesterol levels of men, according to race and age, and number of examined persons and estimated population: United States, 1976–80

	Race and selected cholesterol level cutoff	Age								
		20–74 years			20–24 years			25–34 years		
		Number of examined persons	Estimated population in thousands	Cumulative percent	Number of examined persons	Estimated population in thousands	Cumulative percent	Number of examined persons	Estimated population in thousands	Cumulative percent
	All races[1]									
01	Total	5,604	63,611	100.0	676	9,331	100.0	1,067	15,895	100.0
02	Under 100	7	60	0.1	4	42	0.4	1	12	0.1
03	Under 120	44	479	0.8	16	193	2.1	14	194	1.2
04	Under 140	206	2,497	3.9	80	1,052	11.3	56	757	4.8
05	Under 160	602	7,472	11.7	207	2,828	30.3	173	2,427	15.3
06	Under 180	1,337	16,334	25.7	360	5,096	54.6	365	5,190	32.7
07	Under 200	2,341	28,000	44.0	491	6,843	73.3	610	9,011	56.7
08	Under 220	3,309	38,842	61.1	584	8,111	86.9	795	11,829	74.4
09	Under 240	4,119	47,791	75.1	631	8,750	93.8	905	13,464	84.7
10	Under 250	4,489	51,734	81.3	649	8,987	96.3	950	14,145	89.0
11	Under 260	4,759	54,540	85.7	658	9,103	97.6	980	14,584	91.7
12	Under 265	4,884	55,770	87.7	660	9,124	97.8	995	14,828	93.3
13	Under 270	4,988	56,893	89.4	661	9,132	97.9	1,007	15,000	94.4
14	Under 280	5,148	58,569	92.1	667	9,206	98.7	1,019	15,179	95.5
15	Under 290	5,284	60,278	94.8	669	9,235	99.0	1,037	15,485	97.4
16	Under 300	5,369	61,088	96.0	670	9,247	99.1	1,041	15,542	97.8
17	Under 320	5,494	62,366	98.0	674	9,299	99.7	1,053	15,687	98.7
18	Under 340	5,555	63,038	99.1	676	9,331	100.0	1,058	15,762	99.2
19	Under 360	5,575	63,233	99.4	676	9,331	100.0	1,061	15,817	99.5
20	Under 380	5,592	63,451	99.7	676	9,331	100.0	1,065	15,861	99.8
	White									
21	Total	4,883	55,808	100.0	581	8,052	100.0	901	13,864	100.0
22	Under 100	7	60	0.1	4	42	0.5	1	12	0.1
23	Under 120	32	336	0.6	11	134	1.7	8	120	0.9
24	Under 140	166	2,020	3.6	65	858	10.7	38	547	3.9
25	Under 160	497	6,226	11.2	171	2,334	29.0	138	2,018	14.6
26	Under 180	1,133	14,077	25.2	308	4,394	54.6	309	4,574	33.0
27	Under 200	2,005	24,307	43.6	420	5,898	73.2	513	7,871	56.8
28	Under 220	2,873	34,063	61.0	500	6,978	86.7	667	10,306	74.3
29	Under 240	3,584	41,875	75.0	543	7,562	93.9	764	11,789	85.0
30	Under 250	3,914	45,375	81.3	559	7,777	96.6	803	12,350	89.1
31	Under 260	4,154	47,865	85.8	567	7,870	97.7	827	12,704	91.6
32	Under 265	4,259	48,954	87.7	569	7,891	98.0	840	12,917	93.2
33	Under 270	4,348	49,874	89.4	569	7,891	98.0	852	13,089	94.4
34	Under 280	4,484	51,335	92.0	575	7,964	98.9	863	13,261	95.7
35	Under 290	4,606	52,928	94.8	576	7,975	99.0	878	13,544	97.7
36	Under 300	4,682	53,628	96.1	577	7,987	99.2	882	13,601	98.1
37	Under 320	4,793	54,780	98.2	579	8,020	99.6	891	13,723	99.0
38	Under 340	4,842	55,342	99.2	581	8,052	100.0	895	13,775	99.4
39	Under 360	4,858	55,489	99.4	581	8,052	100.0	897	13,819	99.7
40	Under 380	4,874	55,696	99.8	581	8,052	100.0	901	13,864	100.0

[1]Includes data for races not shown as separate categories.

Table 15. Cumulative percent distribution of serum cholesterol levels of men, according to race and age, and number of examined persons and estimated population: United States, 1976–80—Con.

Age—Con.												
35–44 years			45–54 years			55–64 years			65–74 years			
Number of examined persons	Estimated population in thousands	Cumulative percent	Number of examined persons	Estimated population in thousands	Cumulative percent	Number of examined persons	Estimated population in thousands	Cumulative percent	Number of examined persons	Estimated population in thousands	Cumulative percent	
745	11,367	100.0	690	11,114	100.0	1,227	9,607	100.0	1,199	6,297	100.0	01
-	-	-	-	-	-	1	3	0.0	1	3	0.0	02
3	36	0.3	-	-	-	6	36	0.4	5	20	0.3	03
19	267	2.3	11	202	1.8	16	98	1.0	24	121	1.9	04
55	826	7.3	37	585	5.3	54	412	4.3	76	393	6.2	05
156	2,376	20.9	98	1,421	12.8	154	1,186	12.3	204	1,065	16.9	06
294	4,444	39.1	204	3,109	28.0	333	2,484	25.9	409	2,108	33.5	07
407	6,091	53.6	328	5,201	46.8	566	4,319	45.0	629	3,291	52.3	08
540	8,195	72.1	442	7,017	63.1	785	6,067	63.2	816	4,298	68.3	09
589	8,944	78.7	507	7,977	71.8	886	6,935	72.2	908	4,746	75.4	10
627	9,538	83.9	553	8,769	78.9	962	7,442	77.5	979	5,105	81.1	11
639	9,728	85.6	571	9,049	81.4	994	7,697	80.1	1,025	5,344	84.9	12
658	10,012	88.1	584	9,335	84.0	1,026	7,917	82.4	1,052	5,497	87.3	13
687	10,434	91.8	615	9,801	88.2	1,074	8,269	86.1	1,086	5,680	90.2	14
705	10,766	94.7	638	10,245	92.2	1,120	8,700	90.6	1,115	5,847	92.9	15
719	10,964	96.5	652	10,472	94.2	1,147	8,901	92.6	1,140	5,962	94.7	16
735	11,209	98.6	670	10,759	96.8	1,190	9,275	96.5	1,172	6,137	97.5	17
741	11,306	99.5	683	10,949	98.5	1,214	9,490	98.8	1,183	6,201	98.5	18
741	11,306	99.5	685	10,981	98.8	1,221	9,554	99.4	1,191	6,245	99.2	19
743	11,329	99.7	689	11,092	99.8	1,223	9,585	99.6	1,196	6,273	99.6	20
653	9,808	100.0	617	9,865	100.0	1,086	8,642	100.0	1,045	5,576	100.0	21
-	-	-	-	-	-	1	3	0.0	1	3	0.1	22
3	36	0.4	-	-	-	5	26	0.3	5	20	0.4	23
16	235	2.4	10	179	1.8	15	88	1.0	22	113	2.0	24
44	675	6.9	31	493	5.0	49	364	4.2	64	342	6.1	25
131	1,979	20.2	86	1,248	12.7	128	968	11.2	171	914	16.4	26
251	3,767	38.4	180	2,756	27.9	288	2,173	25.1	353	1,842	33.0	27
360	5,310	54.1	297	4,724	47.9	497	3,832	44.3	552	2,912	52.2	28
476	7,071	72.1	396	6,260	63.5	692	5,421	62.7	713	3,772	67.6	29
521	7,766	79.2	453	7,097	71.9	784	6,206	71.8	794	4,179	74.9	30
556	8,297	84.6	494	7,809	79.2	852	6,674	77.2	858	4,510	80.9	31
566	8,466	86.3	510	8,063	81.7	879	6,907	79.9	895	4,709	84.4	32
582	8,713	88.8	521	8,247	83.6	906	7,086	82.0	918	4,847	86.9	33
604	9,034	92.1	548	8,663	87.8	948	7,403	85.7	946	5,010	89.8	34
619	9,316	95.0	571	9,107	92.3	990	7,821	90.5	972	5,166	92.6	35
631	9,482	96.7	583	9,283	94.1	1,016	8,008	92.7	993	5,266	94.4	36
646	9,705	98.9	600	9,562	96.9	1,053	8,333	96.4	1,024	5,437	97.5	37
651	9,772	99.6	611	9,726	98.6	1,074	8,532	98.7	1,030	5,484	98.3	38
651	9,772	99.6	612	9,733	98.7	1,080	8,589	99.4	1,037	5,523	99.1	39
652	9,785	99.8	616	9,843	99.8	1,082	8,600	99.5	1,042	5,552	99.6	40

Table 15. Cumulative percent distribution of serum cholesterol levels of men, according to race and age, and number of examined persons and estimated population: United States, 1976–80—Con.

	Race and selected cholesterol level cutoff	Age								
		20–74 years			20–24 years			25–34 years		
		Number of examined persons	Estimated population in thousands	Cumulative percent	Number of examined persons	Estimated population in thousands	Cumulative percent	Number of examined persons	Estimated population in thousands	Cumulative percent
	Black									
41	Total	607	6,102	100.0	79	1,043	100.0	139	1,546	100.0
42	Under 100	-	-	-	-	-	-	-	-	-
43	Under 120	11	134	2.2	5	59	5.6	5	66	4.2
44	Under 140	39	468	7.7	15	195	18.7	17	201	13.0
45	Under 160	96	1,115	18.3	33	451	43.2	33	383	24.8
46	Under 180	181	1,921	31.5	46	628	60.2	50	525	33.9
47	Under 200	289	3,019	49.5	61	816	78.2	83	898	58.1
48	Under 220	376	3,875	63.5	73	981	94.1	106	1,128	73.0
49	Under 240	454	4,646	76.1	76	1,013	97.1	117	1,247	80.7
50	Under 250	485	4,961	81.3	78	1,035	99.2	122	1,343	86.9
51	Under 260	506	5,126	84.0	78	1,035	99.2	127	1,403	90.7
52	Under 265	523	5,244	85.9	78	1,035	99.2	129	1,435	92.8
53	Under 270	535	5,430	89.0	79	1,043	100.0	129	1,435	92.8
54	Under 280	557	5,633	92.3	79	1,043	100.0	130	1,442	93.3
55	Under 290	569	5,705	93.5	79	1,043	100.0	133	1,465	94.8
56	Under 300	576	5,787	94.8	79	1,043	100.0	133	1,465	94.8
57	Under 320	587	5,885	96.4	79	1,043	100.0	135	1,478	95.6
58	Under 340	599	5,995	98.3	79	1,043	100.0	136	1,501	97.1
59	Under 360	603	6,043	99.0	79	1,043	100.0	137	1,511	97.8
60	Under 380	604	6,054	99.2	79	1,043	100.0	137	1,511	97.8

Table 15. Cumulative percent distribution of serum cholesterol levels of men, according to race and age, and number of examined persons and estimated population: United States, 1976–80—Con.

Age—Con.												
35–44 years			45–54 years			55–64 years			65–74 years			
Number of examined persons	Estimated population in thousands	Cumulative percent	Number of examined persons	Estimated population in thousands	Cumulative percent	Number of examined persons	Estimated population in thousands	Cumulative percent	Number of examined persons	Estimated population in thousands	Cumulative percent	
70	1,112	100.0	62	1,044	100.0	129	801	100.0	128	555	100.0	41
-	-	-	-	-	-	-	-	-	-	-	-	42
-	-	-	-	-	-	1	10	1.2	-	-	-	43
3	32	2.8	1	23	2.2	1	10	1.2	2	8	1.4	44
9	117	10.5	5	69	6.6	5	48	6.1	11	47	8.5	45
22	318	28.6	10	127	12.2	24	192	23.9	29	131	23.6	46
36	527	47.4	20	291	27.9	42	281	35.0	47	206	37.2	47
40	629	56.6	27	414	39.7	64	419	52.3	66	302	54.4	48
52	839	75.5	39	623	59.7	83	519	64.7	87	405	72.8	49
53	850	76.4	46	735	70.4	91	568	70.8	95	431	77.5	50
53	850	76.4	49	780	74.7	99	607	75.8	100	451	81.3	51
54	860	77.3	51	805	77.1	104	629	78.4	107	481	86.6	52
56	885	79.6	53	908	87.0	108	667	83.3	110	492	88.6	53
62	978	88.0	57	958	91.8	114	702	87.7	115	509	91.6	54
64	1,003	90.2	57	958	91.8	118	716	89.3	118	520	93.6	55
66	1,035	93.1	58	984	94.3	119	729	90.9	121	531	95.5	56
67	1,058	95.2	59	992	95.1	125	778	97.1	122	535	96.3	57
68	1,087	97.8	61	1,018	97.5	128	794	99.1	127	551	99.3	58
68	1,087	97.8	62	1,044	100.0	129	801	100.0	128	555	100.0	59
69	1,099	98.8	62	1,044	100.0	129	801	100.0	128	555	100.0	60

Table 16. Cumulative percent distribution of serum cholesterol levels of women, according to race and age, and number of examined persons and estimated population: United States, 1976–80

	Race and selected cholesterol level cutoff	Age								
		20–74 years			20–24 years			25–34 years		
		Number of examined persons	Estimated population in thousands	Cumulative percent	Number of examined persons	Estimated population in thousands	Cumulative percent	Number of examined persons	Estimated population in thousands	Cumulative percent
	All races[1]									
01	Total	6,260	69,994	100.0	738	9,994	100.0	1,170	16,856	100.0
02	Under 100	6	44	0.1	-	-	-	3	26	0.2
03	Under 120	34	505	0.7	8	129	1.3	17	251	1.5
04	Under 140	185	2,805	4.0	66	994	9.9	76	1,189	7.1
05	Under 160	587	8,025	11.5	183	2,566	25.7	227	3,251	19.3
06	Under 180	1,322	17,714	25.3	353	4,922	49.3	477	7,066	41.9
07	Under 200	2,282	29,379	42.0	511	6,961	69.6	744	10,848	64.4
08	Under 220	3,229	40,071	57.2	629	8,626	86.3	911	13,075	77.6
09	Under 240	4,172	50,074	71.5	690	9,334	93.4	1,040	14,873	88.2
10	Under 250	4,580	54,210	77.4	701	9,481	94.9	1,078	15,473	91.8
11	Under 260	4,933	57,775	82.5	708	9,582	95.9	1,104	15,879	94.2
12	Under 265	5,074	59,203	84.6	710	9,600	96.1	1,117	16,094	95.5
13	Under 270	5,214	60,451	86.4	711	9,610	96.2	1,125	16,204	96.1
14	Under 280	5,453	62,752	89.7	718	9,677	96.8	1,140	16,433	97.5
15	Under 290	5,630	64,350	91.9	723	9,758	97.6	1,148	16,555	98.2
16	Under 300	5,792	65,703	93.9	728	9,817	98.2	1,153	16,629	98.7
17	Under 320	6,022	67,855	96.9	734	9,934	99.4	1,164	16,783	99.6
18	Under 340	6,137	68,966	98.5	738	9,994	100.0	1,169	16,849	100.0
19	Under 360	6,188	69,390	99.1	738	9,994	100.0	1,169	16,849	100.0
20	Under 380	6,216	69,659	99.5	738	9,994	100.0	1,170	16,856	100.0
	White									
21	Total	5,418	60,785	100.0	624	8,408	100.0	1,000	14,494	100.0
22	Under 100	2	18	0.0	-	-	-	2	18	0.1
23	Under 120	26	404	0.7	7	100	1.2	15	216	1.5
24	Under 140	150	2,347	3.9	53	793	9.4	64	1,036	7.1
25	Under 160	505	6,968	11.5	151	2,116	25.2	201	2,893	20.0
26	Under 180	1,124	15,203	25.0	297	4,109	48.9	409	6,126	42.3
27	Under 200	1,940	25,161	41.4	432	5,881	69.9	633	9,283	64.1
28	Under 220	2,766	34,514	56.8	535	7,318	87.0	778	11,228	77.5
29	Under 240	3,578	43,033	70.8	583	7,861	93.5	885	12,703	87.6
30	Under 250	3,935	46,770	76.9	593	7,992	95.1	919	13,250	91.4
31	Under 260	4,248	50,004	82.3	598	8,072	96.0	945	13,656	94.2
32	Under 265	4,374	51,293	84.4	600	8,091	96.2	956	13,853	95.6
33	Under 270	4,497	52,391	86.2	601	8,101	96.3	963	13,955	96.3
34	Under 280	4,713	54,446	89.6	608	8,168	97.1	975	14,141	97.6
35	Under 290	4,867	55,841	91.9	612	8,230	97.9	982	14,240	98.3
36	Under 300	5,011	57,074	93.9	616	8,273	98.4	986	14,306	98.7
37	Under 320	5,207	58,909	96.9	620	8,348	99.3	995	14,428	99.5
38	Under 340	5,309	59,912	98.6	624	8,408	100.0	999	14,486	99.9
39	Under 360	5,354	60,258	99.1	624	8,408	100.0	999	14,486	99.9
40	Under 380	5,382	60,527	99.6	624	8,408	100.0	1,000	14,494	100.0

[1]Includes data for races not shown as separate categories.

Table 16. Cumulative percent distribution of serum cholesterol levels of women, according to race and age, and number of examined persons and estimated population: United States, 1976–80—Con.

Age—Con.												
35–44 years			45–54 years			55–64 years			65–74 years			
Number of examined persons	Estimated population in thousands	Cumulative percent	Number of examined persons	Estimated population in thousands	Cumulative percent	Number of examined persons	Estimated population in thousands	Cumulative percent	Number of examined persons	Estimated population in thousands	Cumulative percent	
844	12,284	100.0	763	11,918	100.0	1,329	10,743	100.0	1,416	8,198	100.0	01
1	10	0.1	-	-	-	-	-	-	2	8	0.1	02
2	34	0.3	5	83	0.7	-	-	-	2	8	0.1	03
20	344	2.8	12	203	1.7	4	32	0.3	7	42	0.5	04
93	1,368	11.1	31	482	4.0	26	207	1.9	27	153	1.9	05
234	3,332	27.1	85	1,319	11.1	70	517	4.8	103	557	6.8	06
411	5,847	47.6	194	3,016	25.3	189	1,399	13.0	233	1,309	16.0	07
561	8,010	65.2	323	4,961	41.6	385	3,016	28.1	420	2,382	29.1	08
676	9,747	79.3	456	7,094	59.5	627	5,055	47.1	683	3,970	48.4	09
727	10,545	85.8	520	8,071	67.7	741	5,921	55.1	813	4,718	57.5	10
758	11,022	89.7	578	9,074	76.1	867	6,914	64.4	918	5,305	64.7	11
773	11,240	91.5	604	9,479	79.5	908	7,249	67.5	962	5,541	67.6	12
784	11,410	92.9	625	9,794	82.2	950	7,564	70.4	1,019	5,869	71.6	13
810	11,829	96.3	656	10,257	86.1	1,027	8,192	76.3	1,102	6,363	77.6	14
813	11,859	96.5	686	10,700	89.8	1,095	8,744	81.4	1,165	6,734	82.1	15
821	11,982	97.5	707	11,022	92.5	1,151	9,139	85.1	1,232	7,115	86.8	16
832	12,119	98.7	737	11,523	96.7	1,235	9,843	91.6	1,320	7,653	93.3	17
838	12,218	99.5	744	11,637	97.6	1,279	10,321	96.1	1,369	7,947	96.9	18
841	12,258	99.8	752	11,745	98.5	1,300	10,496	97.7	1,388	8,048	98.2	19
842	12,269	99.9	755	11,799	99.0	1,313	10,629	98.9	1,398	8,111	98.9	20
726	10,584	100.0	647	10,369	100.0	1,176	9,601	100.0	1,245	7,329	100.0	21
-	-	-	-	-	-	-	-	-	-	-	-	22
1	24	0.2	3	65	0.6	-	-	-	-	-	-	23
15	276	2.6	9	175	1.7	4	32	0.3	5	34	0.5	24
82	1,217	11.5	24	411	4.0	24	197	2.0	23	134	1.8	25
204	2,927	27.7	69	1,108	10.7	56	443	4.6	89	490	6.7	26
351	4,954	46.8	166	2,681	25.9	158	1,215	12.7	200	1,147	15.6	27
483	6,864	64.9	275	4,355	42.0	334	2,658	27.7	361	2,091	28.5	28
581	8,352	78.9	386	6,159	59.4	547	4,449	46.3	596	3,509	47.9	29
630	9,128	86.2	439	6,989	67.4	646	5,234	54.5	708	4,176	57.0	30
657	9,543	90.2	491	7,891	76.1	758	6,146	64.0	799	4,695	64.1	31
668	9,710	91.7	515	8,267	79.7	795	6,462	67.3	840	4,912	67.0	32
677	9,851	93.1	532	8,527	82.2	835	6,764	70.5	889	5,194	70.9	33
698	10,187	96.3	559	8,931	86.1	907	7,361	76.7	966	5,659	77.2	34
699	10,197	96.3	584	9,317	89.8	968	7,863	81.9	1,022	5,995	81.8	35
707	10,319	97.5	601	9,596	92.5	1,019	8,236	85.8	1,082	6,344	86.6	36
716	10,437	98.6	625	10,020	96.6	1,092	8,849	92.2	1,159	6,827	93.1	37
721	10,526	99.5	631	10,118	97.6	1,132	9,278	96.6	1,202	7,095	96.8	38
724	10,566	99.8	638	10,214	98.5	1,149	9,391	97.8	1,220	7,192	98.1	39
725	10,577	99.9	641	10,269	99.0	1,162	9,524	99.2	1,230	7,255	99.0	40

Table 16. Cumulative percent distribution of serum cholesterol levels of women, according to race and age, and number of examined persons and estimated population: United States, 1976–80—Con.

	Race and selected cholesterol level cutoff	Age								
		20–74 years			20–24 years			25–34 years		
		Number of examined persons	Estimated population in thousands	Cumulative percent	Number of examined persons	Estimated population in thousands	Cumulative percent	Number of examined persons	Estimated population in thousands	Cumulative percent
	Black									
41	Total	729	7,579	100.0	94	1,304	100.0	145	1,953	100.0
42	Under 100	4	26	0.3	-	-	-	1	8	0.4
43	Under 120	7	71	0.9	-	-	-	2	36	1.8
44	Under 140	29	363	4.8	9	138	10.6	10	121	6.2
45	Under 160	71	904	11.9	25	343	26.3	23	317	16.2
46	Under 180	170	2,131	28.1	48	692	53.1	56	763	39.1
47	Under 200	294	3,520	46.4	67	906	69.5	93	1,294	66.3
48	Under 220	398	4,633	61.1	79	1,092	83.7	113	1,562	80.0
49	Under 240	509	5,783	76.3	88	1,213	93.0	131	1,783	91.3
50	Under 250	558	6,155	81.2	89	1,228	94.2	135	1,836	94.0
51	Under 260	590	6,387	84.3	91	1,249	95.8	135	1,836	94.0
52	Under 265	602	6,491	85.6	91	1,249	95.8	137	1,854	94.9
53	Under 270	617	6,615	87.3	91	1,249	95.8	138	1,861	95.3
54	Under 280	639	6,854	90.4	91	1,249	95.8	141	1,905	97.5
55	Under 290	657	6,987	92.2	92	1,268	97.2	141	1,905	97.5
56	Under 300	674	7,099	93.7	93	1,284	98.5	142	1,914	98.0
57	Under 320	703	7,330	96.7	94	1,304	100.0	144	1,946	99.6
58	Under 340	716	7,438	98.1	94	1,304	100.0	145	1,953	100.0
59	Under 360	721	7,503	99.0	94	1,304	100.0	145	1,953	100.0
60	Under 380	721	7,503	99.0	94	1,304	100.0	145	1,953	100.0

Table 16. Cumulative percent distribution of serum cholesterol levels of women, according to race and age, and number of examined persons and estimated population: United States, 1976–80—Con.

Age—Con.												
35–44 years			*45–54 years*			*55–64 years*			*65–74 years*			
Number of examined persons	*Estimated population in thousands*	*Cumulative percent*	*Number of examined persons*	*Estimated population in thousands*	*Cumulative percent*	*Number of examined persons*	*Estimated population in thousands*	*Cumulative percent*	*Number of examined persons*	*Estimated population in thousands*	*Cumulative percent*	
103	1,415	100.0	100	1,215	100.0	135	959	100.0	152	733	100.0	41
1	10	0.7	-	-	-	-	-	-	2	8	1.0	42
1	10	0.7	2	18	1.5	-	-	-	2	8	1.0	43
5	68	4.8	3	27	2.3	-	-	-	2	8	1.0	44
11	150	10.6	7	71	5.8	2	10	1.0	3	12	1.7	45
28	387	27.4	14	173	14.2	13	71	7.4	11	45	6.2	46
53	753	53.2	26	296	24.4	27	149	15.5	28	121	16.6	47
68	951	67.3	44	507	41.7	44	296	30.9	50	225	30.7	48
83	1,175	83.1	60	720	59.3	72	513	53.5	75	378	51.6	49
85	1,198	84.7	70	850	69.9	87	595	62.0	92	449	61.3	50
88	1,227	86.7	74	911	75.0	97	650	67.8	105	514	70.1	51
91	1,262	89.2	76	941	77.4	100	661	69.0	107	523	71.4	52
92	1,273	90.0	80	996	82.0	102	674	70.3	114	561	76.6	53
97	1,356	95.8	84	1,055	86.8	106	699	72.9	120	590	80.5	54
99	1,376	97.3	88	1,093	89.9	111	729	76.0	126	616	84.1	55
99	1,376	97.3	92	1,135	93.4	116	752	78.4	132	638	87.1	56
101	1,396	98.7	96	1,171	96.3	126	824	85.9	142	690	94.1	57
102	1,406	99.4	97	1,185	97.5	130	873	91.0	148	716	97.7	58
102	1,406	99.4	98	1,198	98.5	133	922	96.2	149	719	98.2	59
102	1,406	99.4	98	1,198	98.5	133	922	96.2	149	719	98.2	60

Appendixes

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Appendix I
Statistical notes

Survey design

The second National Health and Nutrition Examination Survey (NHANES II) utilized a stratified, multistage design that provided for the selection of samples at each stage with a known probability. In hierarchical order, the stages of selection were primary sampling units (PSU's—a PSU is a county or a small group of contiguous counties), census enumeration districts (ED's), segments (a segment is a cluster of households), households, and sample persons.

NHANES II is based on a subset of the sample PSU's in the National Health Interview Survey (NHIS).[32] The self-representing PSU's in NHIS were first split along county boundaries. Within each region, each of the counties was classified as being either a self-representing or a non-self-representing PSU. The PSU's that were non-self-representing were further combined into homogeneous classes or strata equal in size to the NHIS strata containing non-self-representing PSU's.

The effect of subdividing the 156 self-representing PSU's in NHIS and redefining the PSU's by using county boundaries resulted in a total of 397 PSU's, of which 198 were defined as self-representing and 199 were defined as non-self-representing. The latter were used to form 43 non-self-representing strata, which were combined with the other 220 non-self-representing PSU's in NHIS. The average population of a self-representing PSU was reduced from 838,000 to 584,000. The average size of these PSU's was reduced more than 60 percent in area, from 2,185 to 855 square miles.

These 461 first-stage units (redefined from NHIS strata) were further stratified into a total of 64 superstrata, and one PSU was selected from each of the superstrata using a modified Goodman-Kish controlled selection technique.[33] These 64 PSU's represented the geographic locations visited by the mobile examination centers during the survey period.

The U.S. Bureau of the Census had the major responsibility for selecting households and sample persons within each of the PSU's. Three sampling frames of housing units were used to select the sample within each of the PSU's. The list frame consisted of all housing units based on the 1970 census of the population.[32]

In the second stage, ED's within each stratum were selected proportional to their size. An ED is a geographical area that contains approximately 300 housing units. To oversample persons with low incomes, the ED's within each PSU were stratified into poverty and nonpoverty strata. The poverty strata contained ED's with 13 percent or more of persons below the poverty level, and the nonpoverty strata contained ED's with less than 13 percent of persons below the poverty level as determined by the 1970 census. The third stage of the design consisted of the selection of clusters of households (segments) within ED's. To ensure sampling reliability, clusters of 16 listed addresses were drawn from the sampling frames and then systematically subsampled at a rate of one out of two to produce a final segment of eight household address listings. At the fourth stage of sampling, a list of all eligible sample persons was made within each selected segment. The sample of persons to be examined was selected so that the younger and older age groups were oversampled and so that approximately one person per sample household was selected.

The sampling rates by age are as follows:

Age	*Rate*
6 months–5 years	3/4
6–59 years	1/4
60–74 years	3/4

Of the 27,801 persons included in the NHANES II sample, 25,286 (91 percent) were interviewed, and 20,322 (73.1 percent) were interviewed and examined. The NHANES II sample size and response data by age, sex, and race are shown in table I. The number of examined persons and population estimates are shown in each detailed table.

A more complete description of the sample survey design is included in *Vital and Health Statistics,* Series 1, No. 15.[10]

Estimation procedures

Because the design of NHANES is a complex, multistage probability sample, national estimates are derived through a multistage estimation procedure. The procedure has three basic components: (*a*) inflation by the reciprocal of the probability of selection, (*b*) adjustment for nonresponse, and (*c*) poststratification by age-sex-race. A brief description of each component follows.

Inflation by the reciprocal of the probability of selection

The probability of selection is the product of the probabilities of selection from each stage of selection in the design—PSU, segment, household, and sample person.

NOTE: A list of references follows the text.

Table I. Sample size and response rates for the second National Health and Nutrition Examination Survey, by age, sex, and race: United States, 1976–80

Age, sex, and race	Interview and examination status				
	Sample size	Interviewed[1]		Examined	
		Number	Percent	Number	Percent
Total	27,801	25,286	90.95	20,322	73.10
Age					
6–11 months	444	431	97.07	356	80.18
1–5 years	4,625	4,445	96.11	3,762	81.34
6–11 years	2,085	1,963	94.15	1,725	82.73
12–17 years	2,438	2,304	94.50	1,975	81.01
18–24 years	2,713	2,537	93.51	2,054	75.71
25–34 years	3,031	2,773	91.49	2,237	73.80
35–44 years	2,236	2,005	89.67	1,589	71.06
45–54 years	2,149	1,866	86.83	1,453	67.61
55–64 years	3,868	3,330	86.09	2,556	66.08
65–74 years	4,212	3,632	86.23	2,615	62.09
Sex					
Female	14,395	13,122	91.16	10,339	71.82
Male	13,406	12,164	90.74	9,983	74.47
Race					
White	23,537	21,350	90.71	17,105	72.67
Black	3,653	3,389	92.77	2,763	75.64
Other	611	547	89.53	454	74.30

[1]Completed medical history interview.

Adjustment for nonresponse

The estimates are inflated by a multiplication factor that brings estimates based on examined persons up to a level that would have been achieved if all sample persons had been examined. The nonresponse adjustment factor was calculated by dividing the sum of the reciprocals of the probability of selection for all selected sample persons within each of five income groups (under $6,000, $6,000–$9,999, $10,000–$14,999, $15,000–$24,999, and $25,000 and over), three age groups (6 months–5 years, 6–59 years, and 60–74 years), four geographic regions, and within or outside standard metropolitan statistical area by the sum of the reciprocals of the probability of selection for examined sample persons in the same income, age, region, and standard metropolitan statistical area groups. The percent distribution of the nonresponse adjustment factors is as follows:

Size of factor	Percent distribution
Total	100.0
1.00–1.24	26.8
1.25–1.49	54.8
1.50–1.74	10.9
1.75–1.99	4.4
2.00–2.49	2.2
2.50–2.99	0.9

Poststratification by age-sex-race

The estimates of the number of examined persons were ratio adjusted within each of 75 age-sex-race cells to independent estimates, provided by the U.S. Bureau of the Census, of the population as of March 1, 1978, approximate midpoint of the survey. The ratio adjustment used a multiplication factor in which the numerator was the U.S. population and the denominator was the sum of the weights adjusted for nonresponse for examined persons. This ratio estimation process brings the population estimates into close agreement with U.S. Bureau of the Census estimates of the civilian noninstitutionalized population of the United States and, in general, reduces sampling errors of NHANES II estimates.

Nonresponse bias

In any health examination survey conducted in a manner similar to NHANES, there exists the potential for three levels of nonresponse: (*a*) household interview nonresponse, (*b*) examination nonresponse, and (*c*) item nonresponse. Household interview nonresponse occurs when the household medical history questionnaire is not completed. Examination nonresponse occurs when those sample persons who respond to the household questions do not come to the examination center for an examination. Item nonresponse results when sample persons do not complete some portion of either the household interview questionnaires or the examination protocol or when the vial is lost or destroyed after completion of the examination. Intense efforts were undertaken during NHANES II to develop and implement procedures and inducements that would reduce all types of nonresponse and thereby reduce the potential for bias in the survey estimates. These procedures are discussed in the Plan and Operation of the second National Health and Nutrition

Examination Survey, 1976–1980, *Vital and Health Statistics,* Series 1, No. 15.[10]

In NHANES II there was a 9-percent (table I) medical history interview nonresponse and, despite the intense efforts to reduce the number of examination nonrespondents, 27 percent (table I) of the 27,801 persons selected for NHANES II were not examined. However, a comparison of the 1976 National Health Interview Survey (NHIS) and NHANES II[34] suggests that there is not a large nonresponse bias in some health-related variables because of the close agreement on selected interview items in NHANES II data with comparable items in the 1976 NHIS data. The 1976 NHIS data were used for the comparison because that survey included questions on diabetes (of interest in NHANES II) and because the nonresponse was 4 percent. It was assumed that the 4-percent nonresponse was randomly distributed.

Data from earlier studies also suggest no substantial nonresponse bias. An analysis of data on examined and nonexamined (but interviewed) persons was done using the first 35 stands of NHANES I.[35] It was found that the two groups were similar with respect to health characteristics being compared. In another study of examined and nonexamined persons selected for participation in NHANES I, no differences were found between the two groups with respect to health-related variables.[36] In another study,[37] factors relating to response in Cycle I of the National Health Examination Survey of 1960–62 were investigated. It was found that 36 percent of the nonexamined persons in that survey viewed themselves as being in excellent health compared with 31 percent of examined persons. A self-appraisal of being in poor health was made by 5 percent of nonexamined persons and by 6 percent of those who were examined.

In a different study of Cycle I,[38] comparisons between two extreme groups, those who participated in the survey with no persuasive effort and those who participated only after a great deal of persuasive effort, indicated that differences between the two groups generally had little effect on estimates based on numerous selected examination and questionnaire items. This was interpreted as evidence that no large bias exists between the two groups for the items investigated and was offered as further support for the belief that there is little bias introduced into the findings because of differences in health characteristics between examined and nonexamined persons. As shown in table I, there are differentials in response rates by age; however, the number of interviewed and examined sample persons was poststratified to the U.S. Bureau of the Census population to account for such differences.

Missing data

Examination surveys are subject to a loss of information not only through the failure to examine all sample persons, but also from the failure to obtain and record all items of information for examined persons. This item nonresponse is the second level of nonresponse. The percent of missing values for serum cholesterol in NHANES II is given in table II. The missing data are the result mostly of such things as loss of blood in shipping, broken equipment, and laboratory values out of quality control limits. The missing serum cholesterol values were imputed.

Imputation process

The 272 missing serum cholesterol values were imputed using a "hot deck" procedure.[39] The variables used in the imputation process were age, sex, and hormone/birth control pill use. Because less than 1 percent of males in NHANES II were taking hormones, the hormone variable was not used for imputing the missing values for males. Consequently, for males the variable used in the imputation process is age and for females the variables are age and birth control pill use.

The serum cholesterol file for males was sorted by age. The serum cholesterol file for females was divided into those who did and did not use the pill, then each file was sorted by age. When a missing cholesterol value was encountered, the preceding sample person's value was substituted. If there were consecutive missing values, an iterative process was used to assure that the preceding value was substituted only once. Table III shows that there was virtually no effect of imputation on the means and standard errors of the means. The process was done to complete the file. However, when comparisons are made among data from the first National Health Examination Survey, NHANES I, and NHANES II, the hormone variable in NHANES II was not used in imputing missing values for women because such data were not available in the first National Health Examination Survey.

Age adjustment

The age-adjusted means and percents presented in this report were calculated by the direct method and were adjusted to the age distribution of the civilian noninstitutionalized population in the United States at the midpoint of NHANES II using a computer program.[40–42] Because age distributions differ by sex and race, comparisons are made using age-adjusted values. Age-adjusted data for sex and race groups can be compared directly because the values assume identical age distributions for all subgroups. These adjusted or standardized values are meaningful only when comparing subgroups of the population to control for confounding by age.

Table II. Percent of missing values for serum cholesterol by age: United States, 1976–80

Age	*Examined persons*	*Missing values*
	Number	Percent
20–74 years	11,864	2.3
20–24 years	1,414	2.5
25–34 years	2,237	2.1
35–44 years	1,589	2.2
45–54 years	1,453	1.5
55–64 years	2,556	2.3
65–74 years	2,615	2.8

NOTE: A list of references follows the text.

Table III. Mean serum cholesterol levels of adults and standard errors of the means by sex, age, and imputation criteria: United States, 1976–80

Sex and age	Mean		Standard error of mean[1]		Sample size for imputed values
	With imputed values	Without imputed values	With imputed values	Without imputed values	
Male					
20–74 years	211	211	1.1	1.1	127
20–24 years	180	180	1.6	1.7	18
25–34 years	199	199	1.6	1.6	26
35–44 years	217	217	2.1	2.1	18
45–54 years	227	227	1.8	1.8	8
55–64 years	229	229	1.8	1.9	22
65–74 years	221	222	1.9	1.9	35
Female					
20–74 years	215	215	1.2	1.2	145
20–24 years	184	184	2.0	2.0	18
25–34 years	192	192	1.4	1.5	22
35–44 years	207	207	1.9	1.9	17
45–54 years	232	232	2.2	2.2	14
55–64 years	249	246	2.0	2.0	36
65–74 years	246	246	1.7	1.7	38

[1]Estimates of standard errors were generated using the balanced repeated replication technique.

Measures of variability

Because the statistics presented in this report are based on a sample, they may differ from the figures that would have been obtained if a complete census had been taken using the same survey instruments, instructions, interview and examination personnel, and procedures. The probability design of this survey permits the estimation of standard deviations and errors although the techniques must take the highly clustered, multistage probability sample design into account. The reader should be aware that estimates of variances and standard errors from this type of design are different from and generally larger than standard errors calculated under the assumption of simple random sampling.

Standard deviations

The standard deviation is a measure of the dispersion of the observations in a population and is useful in describing the width of the distribution of the values in a population. This measure can usually be estimated from a probability sample. As estimated in this report, the standard deviation also reflects part of the variation that arises in the measurement process. If the values follow a normal (that is, Gaussian) distribution (as the cholesterol values do) in a population, then one standard deviation above and below the mean encompasses approximately 68 percent of the distribution; two standard deviations, about 95 percent; and 2½ standard deviations, about 99 percent.

The estimates of standard deviations presented in the detailed tables were calculated using the pseudoreplication method, a balanced half-sample replication technique that is based upon variability among random subsamples of the total sample taking into consideration the complex survey design.[43–45]

Standard errors of estimated means

The standard error of an estimated mean is primarily a measure of the degree to which estimates, derived from the many different samples that a sampling design might yield, would vary from sample to sample. As calculated for this report, the standard error also reflects part of the variation that arises in the measurement process. The possible bias of estimates is not included.

As discussed by Landis, Lepkowski, and others,[46] assuming independence of estimated statistics (zero covariance) can be misleading, especially when analyzing data from complex sampling designs. However, because covariances are not presented in this report, and because some users may not have data tapes to generate covariances, an approximation could be made by using the simple Z-test for hypothesis testing. This test will be conservative if the covariances are positive.

Estimates of the standard errors of the means or percents used in this report are shown in each detailed table. The standard errors of the differences (assuming independence of the estimated means and percents) for constructing the Z-statistic can be calculated as follows: Let s_1 and s_2 be the estimated standard errors of two subdomain means $\bar{y}_1$ and $\bar{y}_2$. Let $\hat{d} = \bar{y}_1 - \bar{y}_2$ be the estimate of the difference between the two subpopulation means. The standard error of $\hat{d}$, assuming

$$\text{cov}(\bar{y}_1, \bar{y}_2) = 0$$

is estimated by

$$s_{\hat{d}} = \sqrt{s_1^2 + s_2^2}$$

Thus,

$$Z = \frac{\hat{d}}{s_{\hat{d}}}$$

NOTE: A list of references follows the text.

The user is reminded that the method discussed in the next section, however, is preferred to the above statistic for hypothesis testing, because it incorporates covariances between subpopulation sample means and could lead to different conclusions about the statistical significance of a difference.

The standard errors of the means and percents were calculated using the first two terms of a Taylor series expansion.[40] If the higher order terms of the expansion are negligible and the sample is of a reasonable size for the domains of interest, then this approximation provides variance estimates as reliable as those from the pseudoreplication method.[45]

The need for the balanced repeated replication or linearization technique for estimating standard errors arises because of the complexity of NHANES II sample survey design. It should be noted that the estimates of standard errors are themselves subject to errors that may be large if the number of cases is small or if the number of strata with observations in both paired PSU's is small. The estimated standard errors do not reflect any residual bias that might still be present after the correction for nonresponse. (See appendix II.)

Analytic methodology

Observed differences in the mean serum cholesterol levels and in the prevalence of elevated serum cholesterol levels by demographic and socioeconomic variables were tested for statistical significance. The method used to test differences is presented below. For the demographic variables, the effects of age and race were nested within sex. The effects were modeled in this manner because preliminary investigation showed interaction between sex and age in relation to serum cholesterol levels. The oral contraceptive use variable as well as the socioeconomic variables (poverty index defined by two categories: (*a*) income at or above, or below poverty level and (*b*) educational level defined as less than 12 years and at least 12 years) were nested within age and race.

For the most part, the following age categories were used: 20–24, 25–34, 35–44, 45–54, 55–64, and 65–74 years. When sample sizes for the above age groups were small, the data were collapsed into the following age categories: 20–44, 45–64, and 65–74 years. The oral contraceptive analysis was limited to women in the childbearing ages 20–44 years.

The analytic approach used was developed by Koch, Freeman, and Freeman,[41] and Freeman, Freeman, Brock, and Koch.[42] This approach has been used previously to analyze NHANES data.[46,47] A model for the mean difference between educational levels within race and age using three age groups, 20–44, 45–64, and 65–74 years, will be used to illustrate the approach. Assuming that the effects of age, race, and educational level on mean serum cholesterol can be expressed as a linear combination of unknown parameters plus error terms,[47] the full model can be expressed in matrix notation as

$$\mathbf{Y} = \mathbf{X}\beta + \mathbf{e} \tag{1}$$

where

$$\mathbf{Y}' = (\bar{y}_{111}, \bar{y}_{112}, \ldots, \bar{y}_{ijk}, \ldots \bar{y}_{322}) \tag{2}$$

represents the vector of 12 subpopulation means for serum cholesterol and

$$i = \begin{cases} 1 \text{ if age is 20–44 years} \\ 2 \text{ if age is 45–64 years} \\ 3 \text{ if age is 65–74 years} \end{cases}$$

$$j = \begin{cases} 1 \text{ if race is white} \\ 2 \text{ if race is black} \end{cases}$$

$$k = \begin{cases} 1 \text{ if educational level is less than 12 years} \\ 2 \text{ if educational level is 12 years or more} \end{cases}$$

The design matrix $\mathbf{X}$, used to model the effects of age, race, and educational level, is as follows:

$$\mathbf{X} = \begin{array}{c} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \end{array} \begin{array}{c} \overbrace{}^{\textit{Age}} \; \overbrace{}^{\textit{Race}} \; \overbrace{}^{\textit{Education}} \\ \begin{bmatrix} 1 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \end{array}$$

The model parameters β in equation (1) are estimated, using weighted least squares, as

$$\mathbf{b} = (\mathbf{X}'\mathbf{V}^{-1}\mathbf{X})^{-1}\mathbf{V}^{-1}\mathbf{X}'\mathbf{Y} \tag{3}$$

where

$\mathbf{V}^{-1}$ = a consistent estimate of the population variance-covariance matrix[48–52]

$$\mathbf{b}' = (b_1, b_2, \ldots, b_{12})$$

b_1 = a baseline figure for the second educational subgroup for white persons in the last age category

b_2, b_3 = the weighted least squares estimates of differential age effects for the first and second age groups

b_4, b_5, b_6 = the weighted least squares estimates of differential race effects nested within each of the three age groups

$b_7, \ldots, b_{12}$ = the weighted least squares estimates of differential educational effects nested within race and age groups

NOTE: A list of references follows the text.

Then, based on the full model of equation (1), with estimated parameters (3), the sample means can be expressed as follows:

$$\bar{y}_{111} = b_1 + b_2 + b_7$$

$$\bar{y}_{112} = b_1 + b_2$$

$$\vdots$$

$$\bar{y}_{321} = b_1 + b_6 + b_{12}$$

$$\bar{y}_{322} = b_1 + b_6$$

For example, $\bar{y}_{111}$ is the baseline figure plus effect for difference between first and third age group plus effect for difference between first and second educational group within the white, 20–44 years of age subpopulation group.

In this analysis, the ultimate objective could be the development of a parsimonious model that fits the data yet adequately represents the true variation displayed by the data; that is, a reduced form of the full model. The full model can be reduced by examining the estimated parameters and determining which parameters, when sampling and other variation are taken into consideration, are not significantly different from zero. The reduced model is then a more concise and easily recognized representation of the true differences present in the data.

For example, as a first step in reducing the full model of equation (1), it is of interest to see if each of the educational effects is equal to zero. These individual hypotheses are then

$$H_0 : \beta_i = 0 \qquad i = 7, \ldots, 12$$

which can be expressed, in general form, as

$$H_0 : \mathbf{C}\boldsymbol{\beta} = 0$$

Thus, for

$$H_0 : \beta_7 = 0$$

$$\mathbf{C} = [0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 1 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0]$$

If all individual hypotheses

$$H_0 : \beta_i = 0 \qquad i = 7, \ldots, 12$$

are not significant, then all educational effects can be removed from the model and the reduced model for mean serum cholesterol level will contain parameters for age and race effects only. Age and race effects in the reduced model can then be tested in a similar fashion. When the model has been reduced to its simplest form, the conclusions drawn on the reduced model would be similar to those obtained from the original data.

Appendix II
Data presentation and reliability

The estimates in this report numerically describe the distribution of serum cholesterol values in certain population groups. Among the descriptive measures are means (simple and age adjusted), percentiles, percent-prevalence rates, and cumulative percent distribution.

The mean value for a population group is the sum of each value times its weight in the group divided by the sum of the weights for that group. Age-adjusted means assume that each group has the same age distribution, thus adjusting for the effect of age and allowing comparison of combined mean values among population groups.

A percentile is a value that indicates the percent of people in a population with a value less than or equal to the percentile value. The prevalence rate for a population is the proportion of persons believed to be at risk for a particular condition or disease in the population or who exhibit the condition of disease or risk characteristic at a given time.

Finally, the cumulative percent distribution describes the percent of the population with values less than or equal to certain arbitrary benchmark values, thus allowing readers to choose their own cutoff points in estimating the prevalence of persons with elevated cholesterol.

Estimates of two additional measures are presented in this report. One is the standard deviation, which estimates the degree to which values vary in a population. A large standard deviation indicates that the distribution of values is broad and flat while a small estimated standard deviation implies a narrow, spiked distribution. The other measure is the estimated standard error of an estimated sample mean. The standard error is one measure of the statistical quality of an estimate, with smaller standard errors generally indicating better estimates. For further discussion of these measures see appendix I.

The statistical guidelines used in this document for reporting means, standard deviations, standard errors of the means, and percentiles are as follows:

1. Means

   a. If the sample size in the cell was less than 25, then the value of the estimated sample mean is not reported.

   b. If the sample size was 25–44, the sample mean is reported with an asterisk (*) to indicate that the statistic does not meet the reliability standard.

   c. If the sample size was 45 or more, the sample mean is presented without caveat.

2. Standard deviations and standard errors of the means

   a. If the sample size in the cell was less than 25, no estimated values for the standard deviation and standard error of the mean are presented.

   b. If the sample size was 25 or more and the observations were distributed among the primary sampling units (PSU's) so that fewer than 12 pseudostrata had observations in both of the paired PSU's, then the values are presented with an asterisk to indicate that the estimate may be unreliable.

   c. If the sample size was 25 or more and the observations were distributed among the PSU's so that 12 or more pseudostrata had observations in both of the paired PSU's, the standard deviation and standard error of the mean are presented without caveat.

3. Percentiles

   a. The following sample sizes were required for the presentation of percentile estimates given in this report:

Sample size	*Percentile*
10	50th
20	25th and 75th
35	15th and 85th
50	10th and 90th
100	5th and 95th

   b. If these minimum sample sizes were not met, there is an asterisk in the cell.

Appendix III
Definitions of demographic and socioeconomic terms

Age. Recorded twice for each examinee: age at last birthday at the time of examination and age at the time of the U.S. Bureau of the Census interview. The age criterion for inclusion in the sample used in this survey was defined as age at the time of U.S. Bureau of the Census interview. The adjustment and weighting procedures used to produce national estimates were based on age at the interview. Data in the detailed tables and text of the report are also shown by age at time of interview.

Race. Observed and recorded as "white," "black," or "other." Other includes Japanese, Chinese, American Indian, Korean, Eskimo, and all races other than white and black. Persons of Mexican descent were included with "white" unless definitely known to be American Indian or of another race. Blacks and persons of mixed black and other parentage were recorded as black. When a person of mixed racial background was uncertain about his or her race, the race of the father was recorded.

Sex. Recorded as observed by the interviewers.

Annual family income. Determined by asking the respondent to select one of 12 income categories listed on a card that represented his or her total combined family income for the past 12 months. Respondents were asked to include income from all sources such as wages, salaries, Social Security or retirement benefits, help from relatives, rent from property, and so forth. Income was not adjusted for inflation over the course of the survey.

Poverty index. Determined by the Poverty Income Ratio (PIR). Poverty statistics published in the U.S. Bureau of the Census reports[53] were based on the poverty index developed by the Social Security Administration in 1964. (For a detailed discussion of the Social Security Administration poverty standards, see references 54 and 55.) Modifications in the definition of poverty were adopted in 1969.[56] The standard data series in poverty for statistical use by all executive departments and establishments has been set.[57]

The two components of the PIR are the total income of the household adjusted for family characteristics (numerator), and the total income necessary to maintain a family with the given characteristics on a nutritionally adequate food plan[58] (denominator). The dollar value of the denominator of the PIR is constructed from a food plan (economy plan) necessary to maintain minimum recommended daily nutritional requirements. The economy plan is designated by the Department of Agriculture for "emergency or temporary use when funds are low." For families of three or more persons, the poverty level was set at three times the cost of the economy food plan. For smaller families and persons living alone, the cost of the economy food plan was adjusted to account for the relatively higher proportion of expenses that are fixed.

The denominator or poverty income cutoff adjusts the family poverty income maintenance requirements by the family size, the sex of the head of the family, the age of the head of the family in families with one or two members, and the place of residence (farm or nonfarm). Annual revisions of the poverty income cutoffs are based on the changes in the average cost of living as reflected in the Consumer Price Index.

The annual income considered to be the poverty level increases as the family size increases. If a family with any combination of characteristics has been designated as having a PIR or poverty level of 1.0, then the same family with twice the income would have a PIR of 2.0. Ratios of less than 1.0 can be described as "below poverty," ratios greater than or equal to 1.0 as "at or above poverty."

Poverty thresholds are computed on a national basis only. No attempt has been made to adjust these thresholds for regional, State, or other variations in the cost of living (except for the farm and nonfarm difference). None of the noncash public welfare benefits such as food stamp bonuses are included in the income of the low income families receiving these benefits. PIR has been adjusted by year and accounts in some part for inflation. Tables of weighted average threshold poverty cutoffs for 1976 through 1980 have been published.[58]

Birth control pill. The birth control pill question was worded as follows:

(*a*) Have you taken birth control pills during the past 6 months?

Only if the answer to this question was yes, was the sample person asked:

(*b*) Are you taking them now?

Serum cholesterol values were obtained for 533 females ages 20–74 years who were interviewed as part of the Health History Supplement of the Medical History for the second National Health and Nutrition Examination Survey and who answered "yes" to both questions.

Education level. Only grades attended in a regular public or private school where persons were given formal education

NOTE: A list of references follows the text.

during the day or night, either on a full-time or part-time basis, were included. A "regular" school advances a person toward an elementary or high school diploma or a college, university, or professional school degree. Education received in vocational, trade, or business schools outside the regular school system was not counted in determining the highest grade completed. If a person attended school in a foreign country, at an ungraded school, under a tutor, or under other special circumstances, the nearest equivalent of his or her highest grade attended was obtained.

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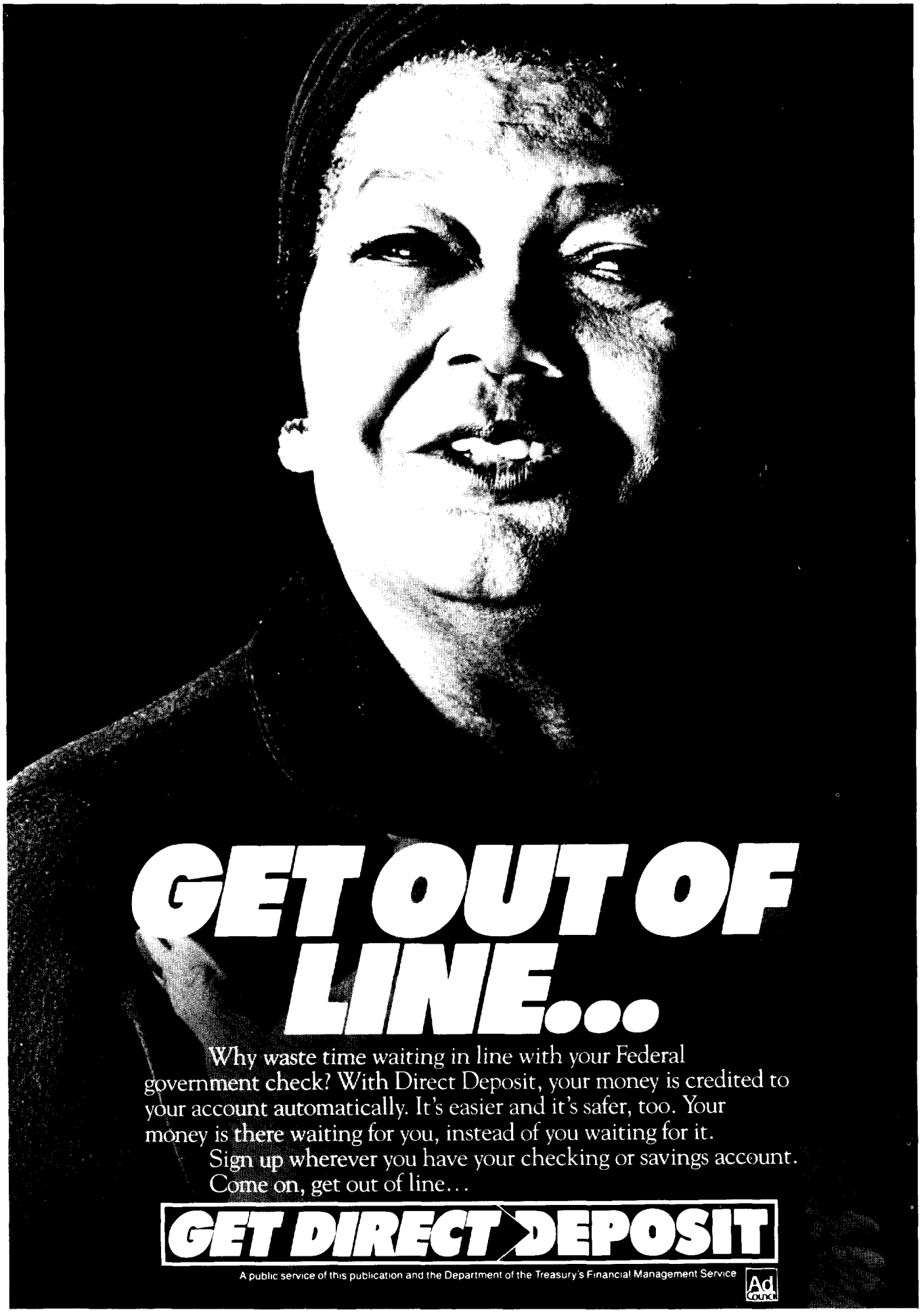

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