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FROM VITAL & HEALTH STATISTICS OF THE NATIONAL CENTER FOR HEALTH STATISTICS
U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE | No. 7 May 25, 1977 | Public Health Service • Health Resources Administration

Total Serum Cholesterol Level of Adults 18-74 Years of Age, United States, 1971-74[a]

The serum cholesterol level in this report were obtained as a part of the Health and Nutrition Examination Survey (HANES). HANES is a program of the National Center for Health Statistics in which measures of nutritional status are collected for a scientifically designed sample representative of the civilian, noninstitutionalized population of the United States in a broad range of ages, 1-74 years.[1]

Field data collection operations for the first HANES survey were started in April 1971 and completed in June 1974. Of the 28,043 persons aged 1-74 years who were selected in the national probability sample to represent the 194 million persons in that age group in the civilian noninstitutionalized population, 20,749, or 74 percent, were examined. When adjustments were made for the differential sampling ratios used for the effect of oversampling among the poor, preschool children, women of childbearing age, and the elderly, this corresponds to an effective response rate of 75 percent. There were 13,645 people ages 18-74 years on whom serum cholesterol level determinations were made. Selected from the national probability sample of 19,572, these individuals represented the 128 million of that age group in the population. This is an unadjusted response rate of 70 percent and an effective adjusted response rate of 70 percent. Detailed estimates of the distribution of serum cholesterol levels will be described and analyzed in a forthcoming report in Series 11[2] of *Vital and Health Statistics*. Selected data and findings from that report are presented in tables 1-5 and figures 1-3 of this *Advance Data*.

Serum cholesterol levels have been identified as one of the important multiple risk factors in the development of coronary heart disease. The results of epidemiologic studies based on adult data from longitudinal studies such as the Framingham Heart Study[3] have demonstrated that persons with elevated serum cholesterol values developed coronary heart disease with greater frequency. Serum cholesterol levels of adults aged 18-74 years are presented and analyzed by age, sex, and race because of medical interest in such data. HANES provided cross-sectional data of serum cholesterol levels obtained on different age cohorts representative of the U.S. population. The age trends represented mean levels for successive cohorts of different age groups. The limitation of cross-sectional data are recognized in considering group age changes because they reflect effects of environmental as well as developmental and heredity influences.

All serum cholesterol determinations for HANES were made in the Lipid Standardization Laboratory of the Center for Disease Control (CDC), Public Health Service, Atlanta, Georgia. The analytical method was based on that of Abell et al.,[4], but was modified for a semiautomated production line. The method, described in detail by Eavenson et al.[5] was made possible by the development of a relatively stable Liebermann color reagent and was designed for automatic pipetting units.

The Lipid Laboratory compared the results obtained with this semiautomated method with those obtained from their standardized version.[4] To examine the bias of the semiautomated

[a]This report prepared by Sidney Abraham, Clifford L. Johnson, and Margaret D. Carrol.

method, data were obtained from pools of sera analyzed by the reference method and by the semiautomated method. In 1972, pools ranging from 134 to 343 mg per 100 ml had an average positive bias of 4.07 percent for the semiautomated method as compared to the standard method; for the 1973-74 period, the corresponding figure was a positive bias of 4.9 percent. The weighted average bias was 4.5 percent. The 1971-1974 data in this report are presented without correction for bias so that they provide population reference standards for determinations made by the semiautomated methodology now in use. However, in the series report, HANES' 1971-1974 serum cholesterol data are corrected for bias when HANES data are compared with Health Examination Survey data of 1960-1962.

PRINCIPAL FINDINGS

For men, the lowest mean serum cholesterol level occurs in the youngest age group measured, 18-24 years. However, the mean level increases steadily with age until the age group 35-44 years. Then it increases by a small increment to a maximum level of 240.2 mg per 100 ml at the age group 55-64 years, declining slightly to a mean level of 236.2 mg per 100 ml at the oldest age group measured, 65-74 years (table 1, figure 1).

For women, the mean serum cholesterol levels do not parallel those of men in the same

Figure 1. MEAN SERUM CHOLESTEROL LEVELS OF ADULTS BY SEX AND AGE: UNITED STATES, 1971-74

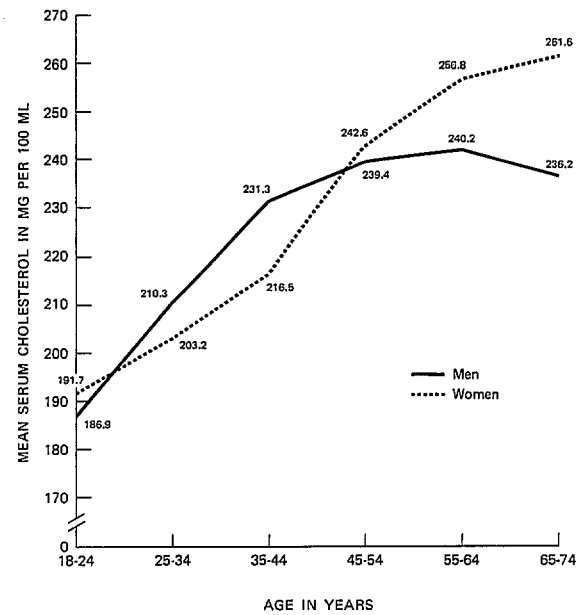

Table 1. Serum cholesterol level of adults 18-74 years by sex and age with mean, standard deviation, and standard error of the mean: United States, 1971-74

Age	Both sexes			Men			Women		
	Mean[1]	Standard deviation	Standard error of the mean	Mean[1]	Standard deviation	Standard error of the mean	Mean[1]	Standard deviation	Standard error of the mean
All ages 18-74 years	223.4	51.5	0.80	221.8	49.9	1.09	224.9	52.8	0.99
18-24 years	189.4	39.0	1.41	186.9	36.7	1.89	191.7	41.0	1.92
25-34 years	206.6	43.2	1.42	210.3	44.0	2.27	203.2	42.2	1.39
35-44 years	223.6	45.3	1.50	231.3	45.9	2.53	216.5	43.5	1.37
45-54 years	241.1	49.7	1.48	239.4	47.0	2.54	242.6	52.0	2.36
55-64 years	248.9	50.3	2.48	240.2	51.2	3.17	256.8	48.2	2.72
65-74 years	250.7	54.2	1.35	236.2	53.8	2.05	261.6	51.9	1.92

[1] Mg per 100 ml.

age groups. The serum cholesterol levels are slightly higher for women than for men in the age group 18-24 years. However, in the older age groups, there is a slight but consistently higher mean serum cholesterol level for men as compared with that for women until the age group 45-54 years. Thereafter the mean levels for men show a plateau effect and a slight decrease, while the mean levels for women continue upward to 256.8 mg per 100 ml at age 55-64 years and to a maximum value of 261.6 mg per 100 ml at the age group 65-74 years (table 1, figure 1).

The standard deviations of the distributions by age and sex are shown in table 1. The variability within each age and sex group increases with age as indicated by the standard deviations. Although the differences are small, men show greater variations around their mean levels at most age groups than women do. The percent distribution of men and women 18-74 years of age falling into each of the 16 groups according to their levels of cholesterol are shown in tables 2 and 3.

Mean serum cholesterol levels for white men are consistently higher than those for Negro men at ages 18-24, 35-44, and 45-54. The differences in mean levels range from 2.3 to 6.8 mg per 100 ml. The same direction is not evident at ages 25-34 and ages 55 years and older, when Negro men have higher mean serum cholesterol levels than those of white men. However, the differences in mean levels are small and range from 1.0 to 4.3 mg per 100 ml (table 4 and figure 2).

The mean serum cholesterol level for white and Negro men generally increases with age. The mean level for white men increases rapidly to the age group 35-44 years. The mean level then continues upward at a slower rate of increase, reaching a peak of 239.9 mg per 100 ml at ages 45-64 years, and declines slightly thereafter. The mean levels for Negro men also increase with age but at a slower rate; they are slightly higher at the older ages and peak at a later age—55-64 years—than those for white men. A slight decline in mean level also occurs in the age group 65-74 years.

Table 4 and figure 3 show that mean serum cholesterol levels for Negro women are consistently higher than those of white women in the age groups under age 65 years. In the oldest age group measured, 65-74 years, the mean levels for white women are slightly higher than those for Negro women, a difference of 2.1 mg per 100 ml. The mean levels for Negro and white women

Table 2. Percent distribution of serum cholesterol levels of men by age: United States, 1971-74

Serum cholesterol level (mg per 100 ml)	All ages 18-74 years	18-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years
	Percent distribution						
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Under 100	0.1	0.1	-	-	0.4	0.1	0.2
100-119	0.4	1.0	0.3	0.1	0.3	0.0	0.3
120-139	2.1	5.6	2.8	0.8	0.3	1.3	1.2
140-159	5.6	16.4	5.3	2.3	3.0	1.1	2.8
160-179	11.5	23.5	15.4	9.1	5.4	4.4	5.9
180-199	15.6	23.1	20.6	12.9	8.3	13.6	12.3
200-219	16.2	13.4	19.9	18.1	16.4	12.8	17.3
220-239	16.0	7.4	13.9	17.2	20.1	23.2	16.0
240-259	12.0	5.5	9.8	14.3	15.7	13.8	14.8
260-279	8.8	2.0	5.6	11.7	11.3	12.7	12.7
280-299	4.6	0.8	3.4	4.8	7.3	6.2	7.1
300-319	3.3	1.0	0.9	3.3	6.5	5.3	4.3
320-339	1.7	0.0	0.8	3.7	1.6	2.2	2.4
340-359	1.1	0.2	0.3	1.1	2.9	1.2	0.8
360-379	0.3	-	0.4	0.0	0.2	0.9	0.9
380 or more	0.6	-	0.6	0.6	0.3	1.2	1.0

NOTE: Percents may not add to 100.0 due to rounding.

Figure 2. MEAN SERUM CHOLESTEROL LEVELS OF MEN BY AGE AND RACE: UNITED STATES, 1971-74

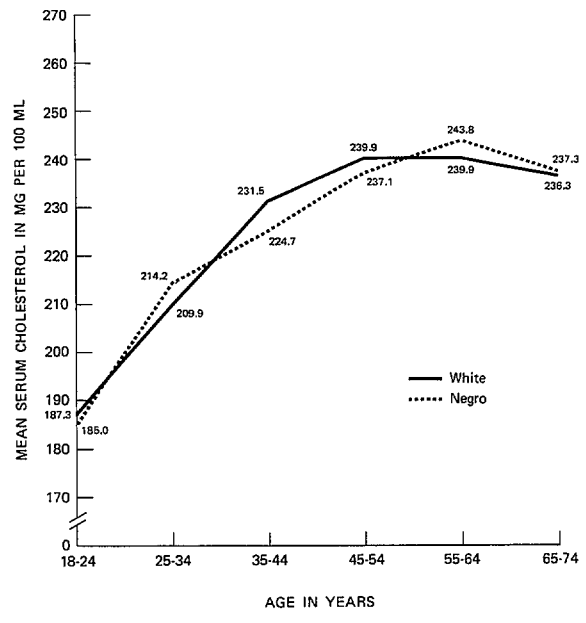

Figure 3. MEAN SERUM CHOLESTEROL LEVELS OF WOMEN BY AGE AND RACE: UNITED STATES, 1971-74

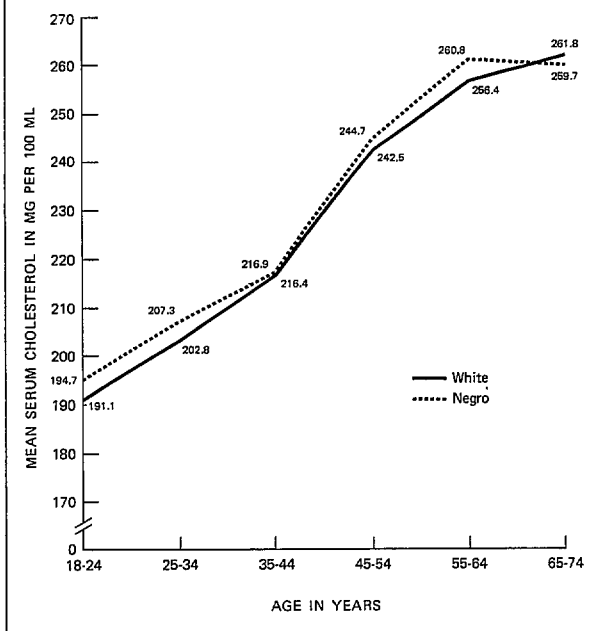

Table 3. Percent distribution of serum cholesterol levels of women by age: United States, 1971-74

Serum cholesterol level (mg per 100 ml)	All ages 18-74 years	18-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years
	Percent distribution						
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Under 100	0.1	0.3	0.3	0.1	-	-	-
100-119	0.4	1.2	0.6	0.3	0.1	0.1	0.4
120-139	2.2	6.1	3.1	1.3	0.6	0.2	0.8
140-159	5.8	13.6	8.1	4.9	2.6	1.0	1.6
160-179	10.6	21.1	16.2	11.0	5.0	2.6	2.0
180-199	15.2	19.6	21.8	19.0	11.7	7.4	5.1
200-219	16.2	14.9	20.6	21.5	15.4	11.8	9.1
220-239	14.6	11.9	12.2	16.4	18.5	14.8	14.3
240-259	11.7	5.7	8.0	11.8	14.4	16.2	17.7
260-279	9.1	3.2	5.4	6.3	12.0	16.8	14.7
280-299	5.6	0.9	1.6	3.2	8.1	10.8	13.6
300-319	3.8	0.9	1.0	2.5	3.9	8.9	9.0
320-339	2.2	0.4	0.4	1.0	3.3	4.4	5.4
340-359	1.0	0.0	0.3	0.3	1.2	2.0	3.0
360-379	0.8	-	0.1	0.1	1.7	1.9	1.8
380 or more	0.7	0.2	0.3	0.3	1.5	1.1	1.5

NOTE: Percents may not add to 100.0 due to rounding.

increase with age to 55-64 years. Then the mean level for Negro women declines slightly while it continues to rise less rapidly for white women although it slightly exceeds the Negro women's level.

Age not only affects the comparison of mean serum cholesterol levels between races but also the comparison levels between sexes. For example, the mean levels of white and Negro men in the youngest age group measured, 18-24 years, are slightly lower than the mean levels for women of both races at the same age (table 4). Although a crossover occurs in the midthirties, the pattern reverses again after age 45, when the mean levels for women are higher and increase more rapidly than those for men, particularly after age 55.

The distribution of serum cholesterol levels was also used to note the proportion of persons in any race-sex-age group that exceeds the level of 260 mg per 100 ml and more. These measurements were used to estimate the prevalence of elevated serum cholesterol levels. Although there is no statistical information regarding the actual level of serum cholesterol separating "high" from "low" risk individuals, the level of 260 mg per 100 ml has been cited in studies to distinguish "high" from "less high" or "low".

Among men, proportions varied from a low of 4.0 percent in age group 18-24 years to a high of 30.1 percent in age group 45-54 years. The level then declines to about 29 percent at ages 55 and older (table 5).

Among women, the lowest proportion also occurs at the youngest age group measured—18-24 years—with the proportion increasing steadily with age until it reaches a maximum of 49.2 percent at the age group 65-74 years.

At the youngest age group measured, 18-24 years, and at the ages of 45 years and older, there are higher proportions of women with serum cholesterol levels of 260 mg per 100 ml and more than there are of men. This pattern is not evident for age groups 25-34 and 35-44 years when the proportions are higher for males than for females. In the age groups 18-24 and 45-54 years, the differences in proportions between the sexes are small—slightly more than 1.5 percent. These differences are much larger in the ages 55 years and older. Elevated serum cholesterol levels increase with age for women but show a slight decrease for men at ages 55 years and over.

There are higher proportions of white and Negro women with serum cholesterol levels of 260 mg per 100 ml and more than there are of

Table 4. Serum cholesterol levels of adults 18-74 years by race, sex, and age with mean, standard deviation, and standard error of the mean: United States, 1971-74

Age	White						Negro					
	Men			Women			Men			Women		
	Mean[1]	Standard deviation	Standard error of the mean	Mean[1]	Standard deviation	Standard error of the mean	Mean[1]	Standard deviation	Standard error of the mean	Mean[1]	Standard deviation	Standard error of the mean
All ages 18-74 years.....	222.2	49.7	1.09	225.1	53.0	1.02	218.9	52.7	3.41	224.0	50.5	1.78
18-24 years..	187.3	37.2	2.07	191.1	41.1	2.11	185.0	32.5	3.75	194.7	38.9	3.33
25-34 years..	209.9	42.4	2.38	202.8	42.4	1.47	214.2	57.0	9.26	207.3	40.7	3.42
35-44 years..	231.5	45.5	2.49	216.4	42.8	1.56	224.7	51.7	8.56	216.9	42.2	3.25
45-54 years..	239.9	47.4	2.61	242.5	52.5	2.49	237.1	42.2	5.61	244.7	46.5	6.49
55-64 years..	239.9	50.6	3.41	256.4	47.8	2.89	243.8	58.8	11.65	260.8	52.6	5.68
65-74 years..	236.3	54.3	2.40	261.8	52.3	2.02	237.3	48.4	3.40	259.7	47.7	3.78

[1]Mg per 100 ml.

men in ages 18-24 and 45 years and older (table 5). This pattern is reversed for the age groups 25-34 and 35-44 years, when the proportions are higher for white and Negro men than for women of both races. In the age group 45-54 years, the differences in proportions between white men and women are 0.6 percent while the differences between Negro men and women are 11.8 percent. The differences are larger in the ages 55 years and older, particularly for white men as compared to white women, 16.8 and 20.5 percent, respectively.

The proportion of white men and women with serum cholesterol levels of 260 mg per 100 ml and more in the youngest age group measured, 18-24 years, are consistently higher than those of their Negro counterparts (table 5). However, the pattern is reversed for the age group 25-44 years, when the proportions of serum cholesterol levels for Negro men and

Table 5. Prevalence rates for serum cholesterol levels of 260 or more among adults 18-74 years by race, sex, and age with standard errors: United States, 1971-74

Sex and age	Rate per 100 persons[1]	Population estimate in thousands	Standard error of rate	Prevalence rate for serum cholesterol levels of 260 or more[1]		Standard error of prevalence rate for serum cholesterol levels of 260 or more[1]	
				White	Negro	White	Negro
Both sexes				Rate per 100 persons			
All ages 18-74 years	21.9	27,974	0.58	22.1	20.4	0.60	1.30
18-24 years	4.8	1,134	0.54	4.9	4.0	0.62	0.82
25-34 years	10.5	2,812	0.84	10.3	12.5	0.84	3.50
35-44 years	19.3	4,353	1.22	19.2	18.4	1.18	3.43
45-54 years	31.0	7,289	1.61	31.2	30.2	1.69	4.58
55-64 years	38.2	7,203	2.32	38.2	40.3	2.44	4.54
65-74 years	40.6	5,182	1.27	40.9	38.7	1.37	3.32
Men							
All ages 18-74 years	20.4	12,358	0.87	20.6	19.0	0.92	1.87
18-24 years	4.0	451	0.78	4.1	2.5	0.88	1.69
25-34 years	12.1	1,538	1.46	11.7	14.9	1.54	5.10
35-44 years	25.3	2,735	2.13	24.9	25.6	2.03	7.00
45-54 years	30.1	3,392	2.22	30.9	24.2	2.25	5.82
55-64 years	29.7	2,636	2.39	29.4	34.0	2.59	10.20
65-74 years	29.2	1,605	1.38	29.2	30.3	1.57	3.38
Women							
All ages 18-74 years	23.2	15,616	0.79	23.5	21.6	0.83	1.58
18-24 years	5.6	683	0.87	5.6	5.3	1.05	1.48
25-34 years	9.1	1,275	0.97	9.0	10.4	0.98	2.87
35-44 years	13.7	1,618	1.19	13.7	14.1	1.22	2.71
45-54 years	31.8	3,897	2.08	31.5	36.0	2.19	6.81
55-64 years	45.9	4,567	3.04	46.2	44.6	3.19	5.67
65-74 years	49.2	3,577	1.81	49.7	44.9	1.90	4.29

[1]Mg per 100 ml.

women are slightly higher than their white counterparts. Consistent findings are not found in the older age groups. In the age group 45-54 years, white men and Negro women have a higher proportion of elevated serum cholesterol levels than white women and Negro men. In contrast, in the age groups 55-64 and 65-74 years, Negro men and white women have a higher elevated serum cholesterol level than white men and Negro women.

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TECHNICAL NOTES

The sampling plan for the 65 pre-selected examination locations in the Health and Nutrition Examination Survey (HANES) followed a highly stratified multi-stage probability design in which a sample of the civilian, noninstitutionalized population of the conterminous United States, 1-74 years of age, was selected. Successive elements dealt with in the process of sampling were the primary sampling unit, census enumeration district, segment (a cluster of households), household, eligible person, and sample person. The sampling design provided for over-sampling among persons living in poverty areas, preschool children, women of childbearing age, and the elderly.

The serum cholesterol determinations are shown as population estimates, that is, the serum cholesterol findings for each individual have been "weighted" by the reciprocal of the probability of selecting the person. Adjustments were made for persons in the sample who were not examined and for post-stratified ratio. Adjustments were also made so that the final sampling estimates of the population size were brought into closer alignment with the U.S. Bureau of the Census independent estimates for the civilian noninstitutionalized population of the United States as of November 1, 1972, by race, sex, and age.

SYMBOLS

Data not available	---
Category not applicable	...
Quantity zero	-
Quantity more than 0 but less than 0.05	0.0
Figure does not meet standards of reliability or precision	*

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