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Tuberculin Skin Test Reaction Among Adults 25-74 Years

United States, 1971-72

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Tuberculin Skin Test Reaction Among Adults 25-74 Years

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The prevalence of positive reaction to tuberculin skin tests, indicating exposure to and continuing hypersensitivity to tubercle bacilli, in the noninstitutionalized U.S. adult population, shown by age, sex, race, geographic region, family income, education, marital status, and a measure of crowding in the household.

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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NATIONAL CENTER FOR HEALTH STATISTICS

DIVISION OF HEALTH EXAMINATION STATISTICS

COOPERATION OF THE BUREAU OF THE CENSUS

In accordance with specifications established by the National Health Survey, the Bureau of the Census, under a contractual agreement, participated in the design and selection of the sample, and carried out the first stage of the field interviewing and certain parts of the statistical processing for the Health Examination Survey.

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TUBERCULIN SKIN TEST REACTION AMONG ADULTS 25-74 YEARS

Arnold Engel, M.D. and Jean Roberts, *Division of Health Examination Statistics*

INTRODUCTION

In this report basic data on the prevalence of positive reaction to tuberculin skin tests indicating exposure to and continuing hypersensitivity to tubercle bacilli are presented by age, sex, race, and various other demographic characteristics for U.S. noninstitutionalized adults 25-74 years of age. The data in this report were obtained on a subsample of the first Health and Nutrition Examination Survey during the years 1971-72.

The Health Examination Survey is one of the major programs of the National Center for Health Statistics authorized under the National Health Survey Act of 1956 by the 84th Congress as a continuing Public Health Service activity to determine the health status of the population.

The data systems programs used to carry out the intent of the National Health Survey [1] include: the Health Examination Survey; the Health Interview Survey which collects health information from samples of people by household interviews focused primarily on the impact of illness and disability within various population groups; the Health Manpower and Facilities surveys which obtain data on hospitals, nursing homes, and other resident institutions; and the Health Resources Utilization surveys which obtain information on persons using and the extent of use of health facilities and manpower.

The Health Examination Survey is the only one of these programs designed to collect needed health statistics information obtainable only through direct examinations of probability samples of the population. From direct examinations, tests, and measurements data are obtained in this program on the prevalence of medically defined illness—known and previously unknown or undiagnosed conditions—and on the distributions of a variety of health related physical, physiological, and psychological measurements from which normative data and appropriate cutting points for what is abnormal can be determined. Medical history, demographic, and socioeconomic data on the sample population under study are also collected so that the examination findings may be related to them.

Since 1960 the Health Examination Survey has been planned and carried out as a series of separate, consecutive programs called "cycles," each of which is limited to some specific segment of the U.S. population and to specific aspects of health. During the first cycle in 1960-62 the prevalence of certain chronic diseases and the distribution of various physical and physiological measures were determined among a defined adult population. [2,3] For that program a national probability sample of 7,710 persons, of whom 6,672 or 86.5 percent were examined, were selected to represent the 111 million civilian noninstitutionalized adults 18-79 years of age in the U.S. population at that time.

The target populations for the second and third cycles in 1963-65 and 1966-70 were, respectively, the Nation's noninstitutionalized children 6-11 years and youths 12-17 years. [4,5] In both the examination was focused primarily on health factors related to growth and development. For the second program, the size of the probability sample selected to represent the nearly 24 million noninstitutionalized U.S. children 6-11

years of age was 7,417 of which 7,119 or 96 percent were examined. In the youths' program, the national probability sample size was 7,518, with 6,768 or 90 percent examined, to represent the 22.7 million 12-17 years of age in the civilian noninstitutionalized population.

The first Health and Nutrition Examination Survey (HANES-I), from which the findings in this report were derived, was designed to measure the nutritional status of the U.S. population age 1-74 years, to obtain some limited information on general health status of the entire age group, and further information on the health status--with particular concentration on cardiovascular, respiratory, and arthritic conditions--and medical care needs of adults 25-74 years of age in the civilian noninstitutionalized population. A detailed description of the specific content and plan of operation including sample design has been published.[6]

As in previous Health Examination Surveys, the U.S. Bureau of the Census cooperated in the sample design and in the initial visits and interviewing at the selected eligible households in the 65 primary sampling units throughout the United States. Additional household visiting, interviewing, history taking, and explaining the examination portion of the program were done by Health Examination Survey representatives from the mobile examination center. The selected sample persons for whom an appointment could be made were brought into the specially constructed mobile examination centers which were moved into a central location in each of the primary sampling units. The survey teams which traveled to the various survey locations throughout the country included professional and paraprofessional medical and dental examiners along with technicians, interviewers, and other staff.

The probability sample design used in the study provided for oversampling, at predetermined rates, among the poor, preschool children, women of childbearing ages, and the elderly so that the nutritional status of these "high-risk" groups could be more accurately estimated. It further provided for a nationally representative subset of 35 of the initially planned primary sampling units throughout the United States so that some preliminary national findings on the nutritional status of the population could be published before the total HANES-I survey was completed and so that national estimates could be obtained from those parts of the examination that were included only in the 35-stand subsample.

Each adult ages 25-74 years selected in the sample for the more detailed examination was given a tuberculin skin test as part of the examination component relating to respiratory conditions. However, this test, which was administered by the survey staff nurse during the examination, had to be read by the nurse or another specially trained staff member between 48 and 72 hours later preferably at the examining center in order to save staff personnel time. Because of the burden imposed on the examinee by the necessity of a second visit, this test was discontinued after 35 stands. While not on as large a sample base as originally planned, these data provide the first available national estimates of the prevalence of tuberculin positive skin test reactions among the civilian noninstitutionalized adults 25-74 years of age in the United States.

For the 35 locations at which the tuberculin skin tests were given in HANES-I during the period between April 1971 and October 1972, a national probability sample of 2,798 adults was selected to represent the 103 million in the target population age 25-74 years. The 1,892 adults who came in for examination represent 68.7 percent of the sample adults selected when adjustments are made for the differential sampling rates for the age-sex-income defined population subgroups. (The unadjusted overall response rate for this adult subsample was 67.6 percent.)

Surveys of the National Center for Health Statistics, including all earlier programs of the Health Examination Surveys, have achieved higher levels of response than that reached for the 35-stand subsample in this first HANES. The 68.7 percent response rate, while higher than many smaller scale population health examination surveys, fails to meet fully the requirements of the original probability design. However, following a policy of remuneration of participants adopted after the completion of 20 PSU's, there has been a significant increase in participation.[7]

National estimates in this report are based on weighted observations, i.e., the data obtained for each examined adult are inflated to the level of the total target population. The estimates have

been calculated as though the examined adults in each of the age, sex, and income classes are a random subsample of the sample adults in the same class (appendix I). While there is evidence from the earlier examination surveys and medical history data from HANES that this is a reasonable approximation, it is clear that some estimates are subject to considerable risk of bias when more than one-quarter of the sample persons in a particular age-sex-income class were not examined.

While all 1,892 adult examinees 25-74 years of age in this detailed HANES subsample were to be given the tuberculin skin test, it was administered to 1,580 or 83.5 percent of those examined and readings on the degree of reaction were obtained for 1,494 or 79.0 percent of the examinees. Because of the small sample from which these tuberculin skin test results are available, the national prevalence estimates cannot be shown in as much relevant demographic, socioeconomic, or other detail as desired since the sampling variability is greater and hence the estimates less precise than those national estimates usually published in these findings reports from the Health Examination Survey data.

TESTING PROCEDURE

At each of the 35 preselected locations throughout the country, arrangements were made for sample persons to come or be brought into the specially designed mobile center for examination in the morning, afternoon, or evening.

In the tuberculin skin testing part of the examination the dual procedure of both a standard for the mammalian-type purified protein derivative (PPD-S) tuberculin antigen (prepared from Mycobacterium tuberculosis) and the only standardized purified protein derivative antigen available prepared from a Battey type of atypical (nontuberculous) mycobacteria (PPD-B) were used. The simultaneous skin testing with the PPD-S tuberculin antigen and PPD-B antigen permitted differentiation between reactivity caused by infection with M. tuberculosis and the other mycobacteria.

The survey staff nurse, after thorough cleansing of the upper one-third of both volar forearms with alcohol and holding the forearm skin taut, injected intradermally 5 tuberculin units (TU) of PPD-S contained in 0.1 cc solution approximately 2 inches below the antecubital form on the volar surface of the left arm of each adult examinee. Similarly an injection of 5 units (U) of PPD-B in 0.1 cc solution was given in the right arm. Both antigens used in the survey examinations were obtained from the Tuberculosis Program of the Center for Disease Control (CDC), Public Health Service. Dr. Lydia Edwards and others of the CDC staff also advised on the dosage and methods used in this part of the examination.

The tuberculin skin test was read 48-72 hours after injection. The extent of induration was the sole criterion for determining reactivity to the two antigens; erythema was ignored. The indurated area was measured precisely to the nearest millimeter at its widest transverse diameter after thorough palpation and close visual inspection.

The survey staff nurses giving the injections and reading the reactions to the tests were trained for approximately 1 week by the experienced staff of the Tuberculin Program of CDC. Nurses administered all tuberculin skin tests in the examination and read 92.2 percent of them. Of the remainder 5.3 percent were read by other examining personnel who had also been carefully trained to do this and 2.3 percent by others, almost all (2.1 percent) of whom were other physicians not specifically trained in the survey method.

A number of investigators have drawn attention to differences in tuberculin skin test results due to variability in methods or observers.[8-10] These variations may arise from differences in the amount of test material injected, the site of the injection, whether the test material leaks out, and the precision used by the reader in interpreting the reaction. In HANES-I these identifiable sources of variability were controlled as much as possible through training in the use of the standard methods but no actual program of replicate readings was attempted. However, comparison of the percent of adults found to be tuberculin positive by the four nurses who did most of the readings (about 80 percent) show remarkably little variation among them (table A).

Table A. Proportion of adult examinees found tuberculin positive by 4 nurse observers in the Health and Nutrition Examination Survey, 1971-72

Nurse observers	Number of examinees observed	Percent of examinees tuberculin positive
1----------	399	22.3
2----------	291	19.6
3----------	208	23.8
4----------	299	21.8

Each of the nurses was assigned to examination locations in different parts of the country. Hence some of the differences in these rates among the nurse observers may reflect area differences in tuberculin sensitivity.

Of those tested and read, 99.1 percent were read within 2-3 days after administration. The remaining 0.9 percent were read on the 4th day after administration. Tests were read in the home for 10.4 percent, at work for 2.7 percent, at the mobile examination center for 83.8 percent, and at some other location for 3.1 percent.

In all, tuberculin skin tests were administered and read for 78.5 percent of the examinees. There were 6.6 percent not given the test because their examination was done a day or two before the mobile examining unit was scheduled to move to the next location and survey personnel would not have been available to read the reaction. In addition 1.0 percent refused the test, giving as their reason a history of tuberculosis or INH prophylaxis, 0.7 percent because of a history of a previous positive test, and 0.7 percent because of a history of a recent negative test. The remaining 12.5 percent included 7.4 percent who were not administered the test because the examinee was unable or refused to return and 5.1 percent to whom the test was given but who did not return for a reading.

Classification of Results

The following classification of the tuberculin skin test reactions or history were used in this report:

Tuberculin positive

1. All examinees with reactions to PPD-S equal to or greater than 10 mm. in diameter.
2. All examinees with reaction to PPD-S of 5-9 mm. in diameter and with the reading of PPD-S at least 2 mm. greater than the PPD-B reading. This part of the classification is based on the findings from a followup study of 625,000 naval recruits who showed a risk of developing tuberculosis similar to those in examinees groups 1 and 2.[11]
3. All examinees not given the tuberculin skin test because of a history of a positive reaction, tuberculosis, or INH prophylaxis. It was assumed that persons in this group would have had a positive reaction if the test had been given them.

Tuberculin negative

1. All those whose PPD-S reading was less than 5 mm. or with PPD-S of 5-9 mm. but with the PPD-S less than the PPD-B reading plus 2 mm.

Unknown

1. Those not given the test because they were examined in the last day or two at a particular location.
2. All others to whom the tests were not administered or were administered but not read.

More than one-fifth of the examinees were classified as tuberculin positive on the basis of test results or history. This included 65 percent who had a strong reaction to PPD-S of 10 mm. or more in diameter, 25 percent who had a less marked skin reaction to the tuberculin antigen, and the remaining 10 percent who gave a history of tuberculosis or previous positive test reaction (table B). For the remaining four-fifths of the examinees classified as tuberculin negative, 96 percent reacted more strongly to the PPD-B than to the tuberculin or had a PPD-S less than 5 mm., 3 percent showed a PPD-S reaction 5-9 mm. and an equal reaction to the tuberculin and the Battey, and 1 percent gave a history of a recent negative test reaction.

Table B. Percent distributions of specific test results or history for adults 25-74 years, classified as tuberculin positive and tuberculin negative, by sex: United States, 1971-72

Test result or history	25-74 years		
	Both sexes	Men	Women
	Percent distribution		
Total tuberculin positive	100.0	100.0	100.0
PPD-S 10 mm. or more	65.1	71.5	58.1
PPD-S 5-9 mm. with PPD-S 2 mm. or more greater than PPD-B	25.1	18.5	32.4
Tuberculosis history	5.6	5.0	6.3
Previous positive reaction	4.2	5.0	3.2
Total tuberculin negative	100.0	100.0	100.0
PPD-S 5-9 mm. with PPD-S and PPD-B differing by less than 2 mm.	2.7	3.7	1.9
PPD-S 5-9 mm. with PPD-B at least 2 mm. less than PPD-S; PPD-S less than 5 mm.	96.2	95.8	96.5
Previous negative reaction	1.1	0.5	1.6

Those 6.6 percent of the examinees classified as unknown with respect to their reaction to the tuberculin antigen who were not given the test because their examination was scheduled in the last day or two at a particular location are unlikely to have biased the findings from this study. Among the remainder of those classified as unknown with respect to tuberculin reaction or history (12.0 percent of all examinees) some small potential sources of bias in either direction may exist although the bias here is more likely to be positive. The proportion returning for reading was slightly greater among those living in large urban areas, where the prevalence of tuberculosis and hence the proportion with positive reactions to the tuberculin antigen tends to be higher than among those living in smaller urban or rural areas who lived further from the examining center. Also contributing to this bias would be the expected greater likelihood of positive than negative reactors to return for a reading. The effect on the likelihood of the tested examinee to return for a reading among those who had been tested before would be varied depending upon their concern and previous experience. However, the distribution of income and educational levels of those classified as unknown with respect to their reaction to tuberculin do not differ significantly from that among those with known reactions.

All further analyses of these data will be limited unless further specifically qualified to the total group of tuberculin positive reactors (those with reactions to PPD-S of 10 mm. or more, those with PPD-S of 5-9 mm. and PPD-S less PPD-B of +2 mm. or more, and those who were not tested but who had a history of tuberculosis or previous positive tuberculin reaction). It is assumed that the prevalence of the tuberculin positive among those individuals designated as unknown would be roughly similar to that for those whose test results were available in this study across all demographic and socioeconomic variables considered (appendix II).

FINDINGS

The prevalence of positive reaction to tuberculin skin tests among the civilian noninstitutionalized adults age 25-74 years in the United States

is 21.5 percent, as estimated from findings of the national probability sample examined in the Health and Nutrition Examination Survey of 1971-72. If those with sensitivity to tuberculin (PPD-S) of less than 10 mm. are excluded, the prevalence of this degree of tuberculin positive reaction among this age group is 16.1 percent (table 1).

Men are more likely than women to be tuberculin positive. The prevalence for all tuberculin positive is 24.2 percent among men and 19.1 percent among women. Omitting the reactions to PPD-S of less than 10 mm., the prevalence for this degree of reaction is 19.7 percent among men and 12.9 percent among women.

In both men and women the prevalence of positive reaction rises steadily from 12.5 percent and 10.6 percent, respectively, in the youngest age group 25-34 to 30.1 percent and 27.3 percent, respectively, in the 45-54 age group (figure 1). In the age group 55-64 the prevalence of positive tests declines slightly for both sexes? It continues to decline in women through the last age group (65-74) but there is a sharp rise among the oldest group for men. The rise appears to be statistically significant but due to sampling variation may not reflect so large a rise in prevalence in the actual population which it represents.

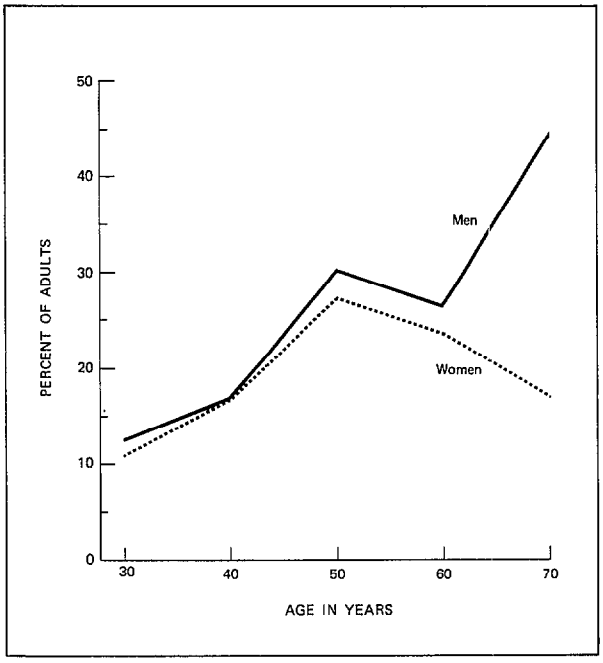

Figure 1. Prevalence of tuberculin positive skin tests among adults, by age and sex: United States, 1971-72.

There is in general a paucity of comparable data on age trends in tuberculin reaction in the adult population. However, a community study in Muscogee County, Georgia and Russel County, Alabama in 1950 using 5 TU of PPD showed in general an age trend quite similar to that of the HANES findings.[12] In the Muscogee County study and three other community-wide studies in Palmier County, North Carolina; Falls County, Minnesota; and Plainsville, Montana the prevalence of TB positive reaction was higher for males than females.[13]

The age distribution of TB positive reaction is undoubtedly the resultant of a number of factors. High rates of TB infection have been reported in older adult groups of the population in various early tuberculin skin test and autopsy studies. In one of these studies, autopsies of more than 1,000 New York City residents who died suddenly and unexpectedly during the years 1944-47 revealed evidence of previous TB infection in 88 percent of those 60 years and older,[14] and 80 percent of those between 40 and 50 years of age. In a 1934 study of University of Maryland Medical School freshman 65.4 percent were positive to 1 TU but by 1957 only 10.6 percent were positive to 1 TU. Opie in 1927 found 70.4 percent of Philadelphia school children positive to 10 TU.[15] During the years 1949-64, a very large continuing study of naval recruits demonstrated a decrease in percentage of positive reactions of about ¼ of 1 percent per year.[13] Lower prevalence rates found in younger individuals are undoubtedly the result of the much lower risk of exposure to and hence decreased probability of infection with tuberculosis in recent years. Testing programs for 2,334,960 first grade children in 1968-69 revealed the very low rate of only 0.37 percent tuberculin positive.[12]

Two other factors may serve to reduce the prevalence rate in the oldest age groups. A follow-up study of a cohort of 1,324 children in Ontario, tested at two points in time 36 years apart demonstrated a decrease in prevalence of a positive reaction to 5 TU in the same children from 52 percent to 42 percent. It appears likely that new infection and reinfection may be needed to maintain the tuberculin hypersensitive reaction.[16]

Another factor may be a diminished reactivity of the skin in old age. Woodruff found in new admissions to a tuberculosis hospital a reaction rate to 1 TU of old tuberculin (OT) in elderly patients only 77 percent of that in patients of all ages.[17]

Because the sampling variability of age-sex specific values for each demographic subgroup is large in this study, a summary comparison was considered preferable to the presentation of prevalence rates specific by age and sex in the following sections of this report. For this reason, the actual prevalence rate for each group is compared with an expected rate. The expected value of a particular group is obtained by weighting age and sex specific rates for the total United States by the number in the corresponding age-sex classes for that group. This will eliminate from the expected rate the effect of differences due solely to those from age-sex distributions in the various groups of the population. A positive difference between actual and expected rates, for example, indicates that the prevalence rate for the group is higher than expected though such differences may arise by chance (or through sampling variability). Alternatively the data can be presented as a ratio of actual to expected rates. If the rate is greater than 1.0, the actual rate is higher than expected. If the rate is less than 1.0 the actual rate is less than expected.

Demographic

Race.—Prevalence rates for tuberculin positive reaction are greater among Negro than white adults for both men and women, although the difference is only statistically significant for men (table 2 and figure 2). This finding is consistent with those from the testing of naval recruits during the years 1958-69. During those years 3.8 percent of white and 12.4 percent of Negro men had positive tuberculin reactions measuring 10 or more millimeters in diameter.[18] Data from the Muscogee County Study previously cited[12] also demonstrates a considerably higher prevalence of tuberculin positive in the Negro population of this county.

Area.—Regional differences in the prevalence of tuberculin positive reaction are not particularly striking. Prevalence rates are lower among women in the South than those in the other regions. While the prevalence is higher among both men and women in the Northeast than elsewhere the differences are not large enough to be considered statistically significant (table 3 and figure 3).

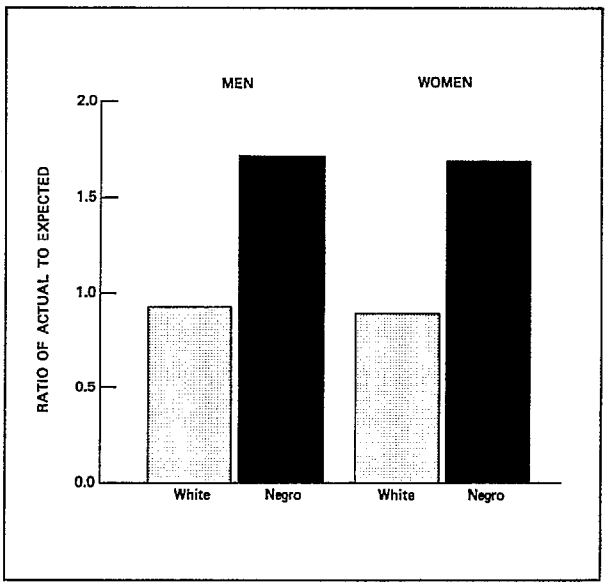

Figure 2. Ratio of actual to expected prevalence of positive skin tests among adults 25-74 years, by race and sex: United States, 1971-72.

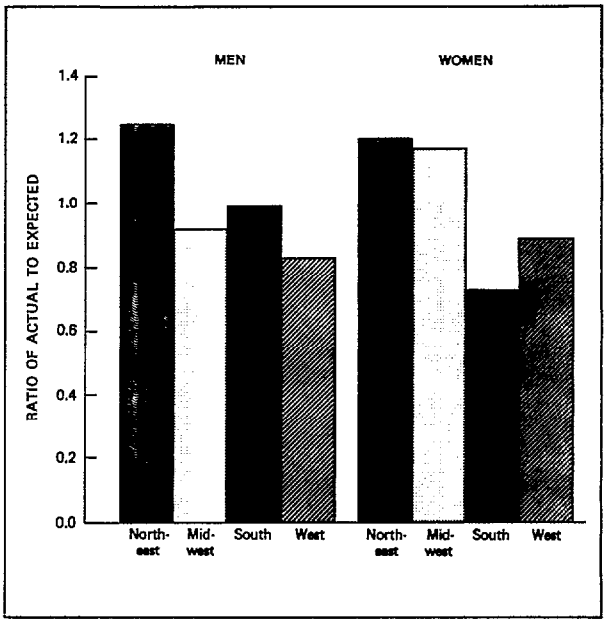

Figure 3. Ratio of actual to expected prevalence of positive skin tests among adults 25-74 years, by geographic region and sex: United States, 1971-72.

There appeared to be some tendency towards higher prevalence of tuberculin positive reaction in central city areas than elsewhere among both men and women but only the total prevalence for all adults in this type of location is sufficiently higher to be statistically significant (table 4). Adults living in urbanized areas with populations of 3 million or more and of ¼-1 million have a somewhat higher than expected prevalence of tuberculin positive; the converse is true of adults living in rural areas, but neither of these relationships is statistically significant (table 5). A similar pattern of prevalence was found in the U.S. Naval Recruit Study[12] which showed a prevalence of 4.2 percent in metropolitan areas, 2.8 percent in farm areas, and 3.6 percent in other areas. In some areas in the Naval Recruit Study such as Minneapolis-St. Paul rates were similar for the various counties included in the area. For other areas such as Boston, New York, Philadelphia, and San Francisco rates were higher in the densely populated counties. This of course may reflect the differences in the racial and socioeconomic composition of the population among the different cities in the U.S.

The present national study also shows an extremely low prevalence rate of tuberculin positive among women living in farm compared to those living in nonfarm residences (table 6). This group might be expected to have less exposure to active tuberculosis than other groups in the population.

Income.—In order to delineate the tuberculin positive prevalence by income more fully, the summary approach was not used. A careful examination of individual age groups (table 7 and figure 4) reveals a markedly lower prevalence among those individuals with annual family in-

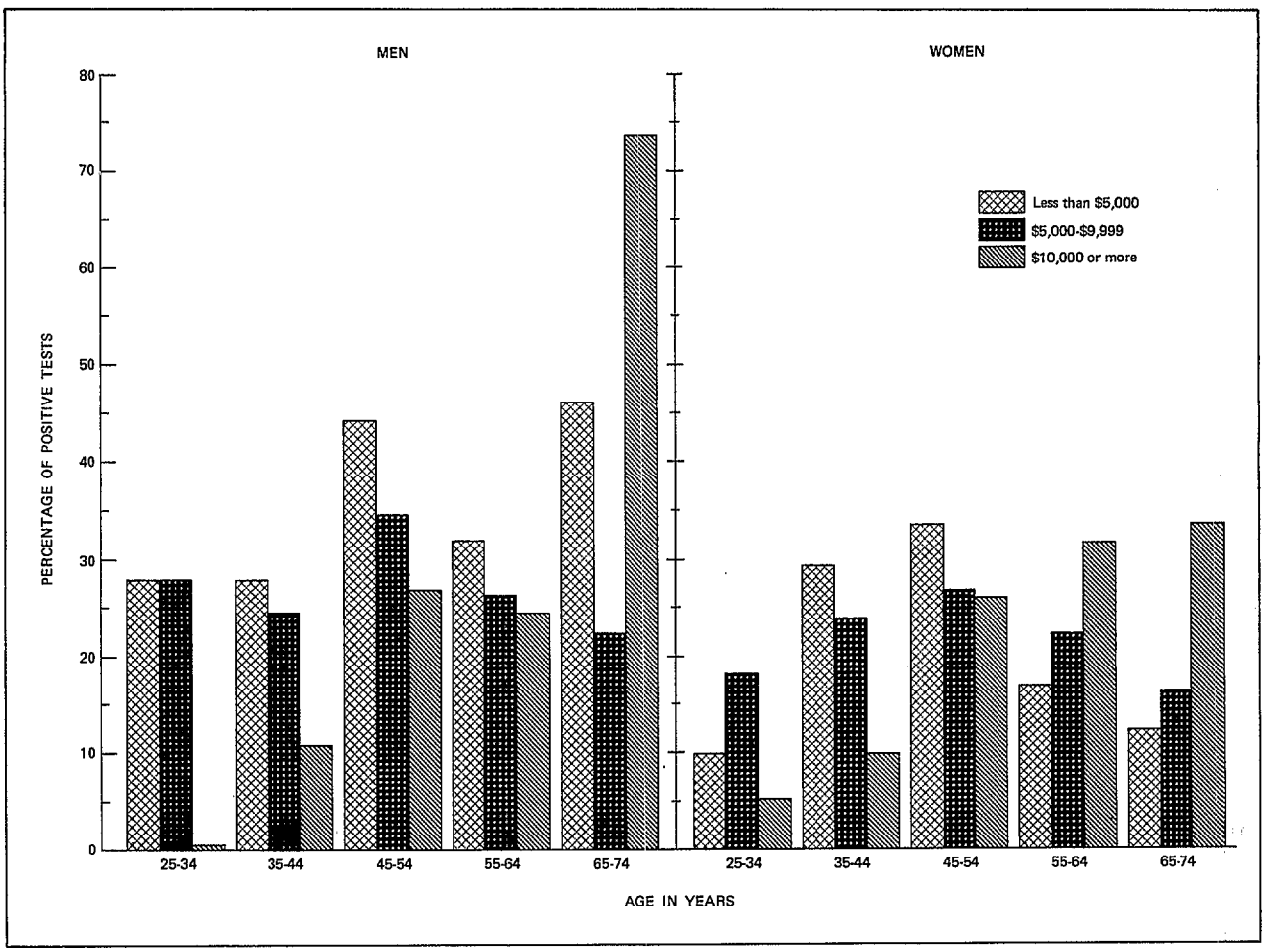

Figure 4. Prevalence of tuberculin positive skin tests among adults, by annual family income, age, and sex: United States, 1971-72.

come of $10,000 and more in the younger age group under 35 years. This relative low prevalence among those in the high income level families in the younger groups becomes much less marked with increase in age and indeed in the two oldest groups in women and the oldest group in men this relation to income appears to reverse in direction. This may reflect conditions in the recent past where family income has had a strong influence on the opportunity of becoming tuberculin positive and in the more remote past where income may not have had as much as effect on the chances of becoming tuberculin positive. Changes in residence and income over a life time are among the many factors that make an interpretation of these data difficult. It should be noted that in one careful study of household contacts to index cases [19] susceptibility to infection in households containing an index case of tuberculosis was found not to be significantly influenced by sex, age, or socioeconomic factors. For example, 71.4 percent of the white and 70.2 percent of the Negro household members became infected when exposed to a sputum positive index case, while only 37.0 percent of the white and 37.1 percent of the Negro became infected when exposed to a sputum negative case. Of course the chances of exposure and the degree of exposure to active cases of tuberculosis would be expected to vary greatly in different groups of the population of the U.S. at present. Such factors as the marked decrease in infectiveness following institution of adequate chemotherapy should also be considered.[12]

In the present study the association of tuberculin positive reaction with education is similar to that shown with income (table 8). There is a lower prevalence of tuberculin positive among men with the highest level of education than others. A slightly lower than expected prevalence rate for this highest education group is also found among women. The differences are not large enough to be statistically significant.

There does not appear to be any significant differences in these prevalence rates in regard to usual activity for either men or women (table 9). Nor is there any particular pattern of differences in prevalence rates among those working in different industries (table 10). None of the differences in prevalence for occupational groups are statistically significant though in general the pattern of differences found is what might be expected on the basis of income and education. For example, lower rates are shown for professional and technical groups than others (table 11). The data are also somewhat similar to mortality data based on a U.S. 1960 Census sample, especially in regard to reduced rates for professional workers and increased rates for laborers.[13] Mortality rates are influenced of course by factors such as susceptibility to developing clinical disease following infection and the intervention of medical treatment.

Marital Status

There appears to be some tendency toward higher than expected prevalence of tuberculin positive in divorced or separated men and women (table 12). However, the elevation is not large enough to be significant considering the relatively small numbers in these two groups. It is interesting to note that in the tuberculosis cases reported in Denmark from 1960-68, the prevalence rates among divorced men and women were considerably higher than among married men and women.[20]

Size of Residence

There is a definite trend toward decreasing prevalence rates of positive tuberculin reaction among adults as the number of rooms in their residences increases (table 13 and figure 5). The trend is monotonic from one to five rooms with some considerable fluctuation following further increase in the number of rooms in the examinee's residence. More specific data on the degree of crowding or space available per household occupant were not computed.

Crowding has long been considered to be one factor involved in the transmittal of tuberculosis infection operating probably through decreased atmospheric dilution of the infectious agent.

In a study of intrafamilial transmission of tuberculosis, i.e., household infection by an index case residing in that household, crowding correlated .22 with acquisition of infection.[21] Of course, in common with other factors considered, the degree of crowding present at the time of this

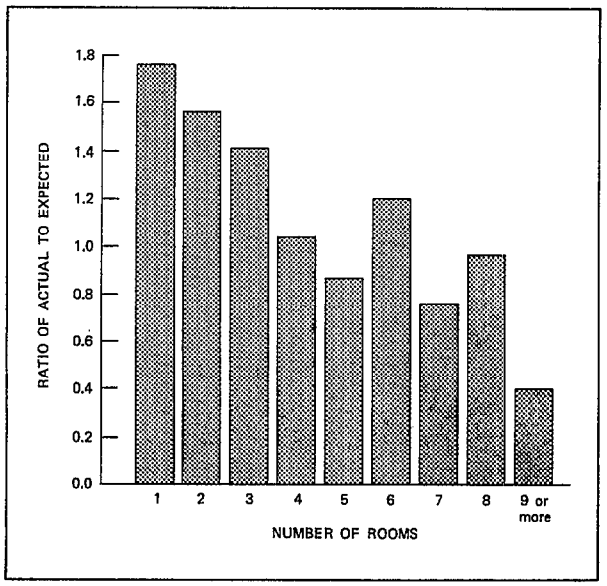

Figure 5. Prevalence of tuberculin positive skin tests among adults 25-74 years, by number of rooms in residence: United States, 1971-72.

examination may not represent the degree of crowding in an individual's history at the time in the past during which he might have been at greatest risk of being infected with tuberculosis. Since the extent of crowding within households is also positively correlated with family income, some of the association of the degree of positive tuberculin reaction with crowding shown here may be due to the previously noted association with family income.

DISCUSSION

Tuberculin hypersensitivity is a specifically acquired capacity of lymphoid cells to interact with tubercule bacilliary antigens. The delayed or cellular type of hypersensitivity is a reaction to the protein antigens and perhaps to other constituents of the tubercule bacilli.[22] Purified protein derivitive of M. tuberculosis as prepared by Seibert (PPD-S) has been analyzed and found to be a proteinaceous preparation containing 1.2 percent nucleic acid and 5.9 percent polysaccharide.[23] Purified preparations of tuberculins are more likely to identify tuberculosis than their source material, Old Tuberculin, which has been aptly called a witch's brew.[12] However, even standardized and purified tuberculosis such as PPD-S (United States) and PPD-RT23 (World Health Organization) may in practice give results which differ from each other.[24]

Hypersensitivity to tuberculosis, once acquired, is persistently reactive throughout life in most people. This presumably occurs because the individual retains a focus of dormant bacilli and is occasionally exposed to freshly acquired tubercle bacilli.[22] The degree of sensitivity may not remain the same from 1 year to the next, but may vary gradually in either direction or magnitude.[25] A number of conditions such as influenza, infectious mononucleosis, scarlatina, sarcoidosis, amyloidosis, Hodgkins disease, leukemia, measles, prolonged steroid therapy, and terminal tuberculosis may either temporarily or permanently remove an individual's established tuberculin sensitivity.[22] Tuberculin sensitivity may also be acquired through BCG vaccination. However, in this country relatively few persons would have been sensitized in this way. Aside from its use in field trials, BCG vaccination in the United States has been limited to special groups—nurses, medical students, laboratory workers, and others presumed to be at considerable risk of developing tuberculosis because of their environment. BCG has not been used extensively even among those special-risk groups.[26]

The purpose of a dual test as used in the HANES survey is to distinguish between sensitivity to the bacillus M. tuberculosis from sensitivity to other generically related bacilli.[27] The control employed was a purified protein derivative of an atypical bacillus of the Battey strain (PPD-B). This strain is antigentically related to M. tuberculosis and gives cross-reactions to it that will be less strong than to M. tuberculosis among individuals who have acquired sensitivity to the latter organism. The validity of this dual test has been determined in a followup study of 625,000 U.S. naval recruits with the following results obtained: (1) PPD-S 12 mm. or greater—tuberculin positive rate of 330 per 100,000; (2) PPD-S 6-11 mm. and greater in diameter than PPD-Battey by 2 or more mm.—tuberculin positive rate of 298 per 100,000; (3) PPD-S 6-11 mm. and either equal in diameter or ± 1 mm. to PPD-Battey—tuberculin positive rate of 95 per

100,000; (4) PPD-S 6-11 mm. and smaller than PPD-Battey by at least 2 mm.—tuberculin positive rate of 17 per 100,000.[11]

Exposure to an individual who has tuberculosis in a household is not a guarantee that others in the same household will become infected with TB. For example, only 51 percent of children 5-19 living in households of sputum positive cases in rural Tennessee in the 1930's were infected by the time the source case was diagnosed.[28] The likelihood of contracting an infection from an active case in the household depends on such factors as the severity of the disease, crowding, intimacy of exposure, and the mode of family living.[21] Factors affecting an individual's resistance to disease will also determine whether an infection develops into a clinical condition. For example, in the study among naval recruits tuberculosis morbidity was found to increase with height and to be reduced by weight even though physique was not associated with any difference in the infection rate as determined by tuberculin testing.[12]

Improvement of host resistance accompanying rising standard of living has been credited with some of the reduction in TB morbidity which occurred prior to the more rapid decrease after chemotherapy introduction in 1947. Widespread malnutrition among the population of occupied Holland in the last year of World War II was accompanied by a substantial increase in tuberculosis.[24]

Mortality from tuberculosis in the United States showed a dramatic decrease during the 20th century. In 1900 the mortality rate was 202 per 100,000 population. By 1968 the rate had fallen to 3.3 per 100,000.[29] However, as in other countries, it is likely that the overall decline in infection for all ages in the U.S. population does not parallel that of the TB mortality or morbidity but is much lower.[30]

The reservoir of infected individuals is of interest because after successful recovery from a primary infection the body is unable to completely rid itself of invading organisms leaving an unknown but significant proportion of those individuals at risk of reactivation of the TB infection throughout the rest of their lives.[12] One study of bacteriologically confirmed cases found evidence of tuberculous lesions among 72 percent on available preexisting X-rays. These individuals were experiencing their first clinical episode of disease. The lesions encountered were apical abnormalities.

Only 5 percent of the individuals studied over 50 years of age were able to give a history of close contact with an active case of TB in the preceding 3 years.[31] By 1970, 55 percent of the new cases in the United States occurred among adults over the age of 45. Hence it was estimated in 1971 that at that time the predominant source of new TB cases in the U.S. was endogenous breakdown of already infected individuals. Some of the factors that have been implicated in or associated with reactivation are old age, alcoholism, steroid therapy, diabetes, and silicosis.[31]

With the declining incidence of the disease in the United States and the correspondingly low level of transmission of infection, new cases are increasingly restricted to older persons.[32] Further evidence of this change in the morbidity rate is available from a study in Minnesota showing an increase in the proportion of new TB cases among those 45 years and older from 16 percent in 1920 to 66 percent in 1968 in that State. This was accompanied by a rise in the proportion of TB deaths in Minnesota among adults over 45. This age group accounted for 23 percent of the TB deaths in that State in 1920 and 96 percent in 1968. In general, the estimates for the tuberculin positive U.S. adults from HANES reveal the same differentials in prevalence in regard to sex, race, income, and other demographic and socioeconomic indicators as in many of the epidemiological studies reported in the literature. From the HANES data it would appear that socioeconomic factors, as represented by income, show at present a much stronger relationship with the prevalence of TB infection than they did in the 1st third of the 20th century. The HANES data also reveals that a considerable proportion (21.5 percent) of the adult population of the U.S. is infected with tuberculosis (tuberculin positive) and is therefore at risk of reactivation.

This prevalence estimate of 21.5 percent of the tuberculin positive reactors among the adult U.S. population age 25-74 years is, of course, subject to sampling variability since it was based on the findings among a small national probability sample, as described. The 95-percent confidence

limits for this estimate are between 17.9 and 25.1 percent. In other words, the actual prevalence rate for the tuberculin positive in the U.S. adult population may be as high as 25.1 percent or as low as 17.9 percent but is not likely to be higher or lower than these values.

Increasingly, the goals of public health have shifted from only controlling a disease towards its eventual eradication. The year 1976 marked the apparent final eradication of smallpox. Tuberculosis, which killed Keats and Thoreau and marked the end of innumerable operatic prima donnas, is no longer the plague it used to be. As tuberculosis has diminished in prevalence public concern has shifted to other diseases. However, tuberculosis eradication is not a simple matter. These HANES data would indicate that there are still very large infected reservoirs of the disease in the population and no completely effective vaccine is available to protect the uninfected.

The tuberculin testing component used in the HANES survey 1971-72 in spite of its shortcomings with respect to sample size and possible nonresponse bias would appear to provide a prototype of a monitoring mechanism for evaluating the effectiveness of the national tuberculosis control in this country. Of course it cannot do more than act as a supplement to State and local tuberculosis control programs. These serve to pin point areas with high TB morbidity such as Central Harlem in New York City. Future national tuberculin surveys would need to include the pediatric as well as adult age groups. The sample size should also be greatly increased.

In conclusion, while the prevalence of tuberculosis is greatly diminished from what it was 40 years ago it is still a major health problem with a sizeable reservoir of infected individuals in the population. Disease in those individuals may reactivate at any time and can serve as a source of new infection. Continued progress in TB control depends on continuous efforts that will have to be maintained for many years to come.

SUMMARY

This report contains national estimates of the prevalence of tuberculin positive reaction among the civilian noninstitutionalized adults 25-74 years of age in the United States, based on the findings from the tuberculin testing component in the Health and Nutrition Examination Survey of 1971-1972. These prevalence rates are analyzed by age, sex, race, geographic region, and relevant socioeconomic factors.

Major findings from this study include:

- In the United States an estimated 21.5 percent of noninstitutionalized adults 25-74 years are tuberculin positive. Men are more likely than women to be tuberculin positive, the prevalence rates being 24.2 percent and 19.1 percent, respectively.
- Prevalence of positive tuberculin reaction in both sexes increases with age from from 25 to 54 years but tends to decline somewhat after 55 years in women. For men, the rate increases again at 65-74 years.
- The highest prevalence rates are among Negro men. The next highest are those for Negro women and they are followed by those for white men and white women in that order.
- Lower prevalence of tuberculin positive reaction was found among white women in the South and women living on farms than others. Adults living in central city areas had higher prevalence rates than those living elsewhere.
- Marked income differentials are evident with the lowest tuberculin positive prevalence among young adults under 35 years with annual family income of $10,000 or more. In older adults, this income differential becomes progressively less with increasing age until by 55 years for women and 65 years for men the pattern reverses and the highest prevalence is found among the highest income group.
- A significantly lower prevalence of tuberculin positive reaction was found in men with some college education than in those with lesser education.
- A trend toward decreased prevalence of positive tuberculin reaction among adults as the number of rooms in their residences increased.

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LIST OF DETAILED TABLES

Table 1. Prevalence rates and standard errors for tuberculin positive adults 25-74 years, by age and sex: United States, 1971-72

Age and sex	Tuberculin positive		Tuberculin positive excluding reaction to PPD-S of less than 10 mm. diameter	
	Rate per 100	Standard error	Rate per 100	Standard error
Both sexes 25-74 years	21.5	1.78	16.1	1.33
25-34 years	11.4	2.83	7.5	1.86
34-44 years	17.0	3.55	13.9	2.90
45-54 years	28.7	3.71	22.9	2.96
55-64 years	24.9	3.65	18.0	2.64
65-74 years	28.9	2.46	19.7	1.68
Men 25-74 years	24.2	2.37	19.7	1.93
25-34 years	12.5	4.25	10.5	3.57
35-44 years	16.8	3.29	14.7	2.88
45-54 years	30.1	5.83	24.4	4.73
55-64 years	26.4	5.16	22.8	4.44
65-74 years	44.3	4.82	31.3	3.41
Women 25-74 years	19.1	1.95	12.9	1.32
25-34 years	10.6	3.86	5.2	1.89
35-44 years	16.9	5.27	12.9	4.02
45-54 years	27.3	4.53	21.4	3.55
55-64 years	23.7	3.94	14.0	2.33
65-74 years	17.1	5.57	10.7	3.49

Table 2. Actual and expected prevalence rates and standard errors for tuberculin positive adults 25-74 years, by race and sex: United States, 1971-72

Sex, rate, and standard error	White	Negro
Both sexes		
Actual	19.6	*35.0
Expected	21.5	*20.6
Actual/Expected[1]	0.91	*1.70
Standard error	1.62	*5.50
Men		
Actual	22.5	*41.7
Expected	24.2	*24.4
Actual/Expected[1]	0.93	*1.71
Standard error	2.32	*6.89
Women		
Actual	17.1	*30.6
Expected	19.2	*18.1
Actual/Expected[1]	0.89	*1.69
Standard error	2.03	*6.60

[1]Actual/Expected means actual divided by expected.

Table 3. Actual and expected prevalence rates and standard errors for tuberculin positive adults 25-74 years, by sex and geographic region: United States, 1971-72

Sex, rate, and standard error	Northeast	Midwest	South	West
Both sexes				
Actual	26.9	21.6	18.6	18.2
Expected	22.0	21.1	21.5	21.2
Actual/Expected[1]	1.22	1.02	0.87	0.86
Standard error	4.81	3.51	4.00	2.53
Men				
Actual	30.9	21.8	24.7	19.6
Expected	24.7	23.8	25.0	23.5
Actual/Expected[1]	1.25	0.92	0.99	0.83
Standard error	4.86	4.91	6.62	2.49
Women				
Actual	23.9	21.5	13.8	16.9
Expected	20.0	18.4	18.8	18.9
Actual/Expected[1]	1.20	1.17	0.73	0.89
Standard error	6.34	2.86	2.38	3.32

[1]Actual/Expected means actual divided by expected.

Table 4. Actual and expected prevalence rates and standard errors for tuberculin positive adults 25-74 years, by sex and location of place of residence: United States, 1971-72

Sex, rate, and standard error	SMSA in central city	SMSA not in central city	Location not in SMSA
Both sexes			
Actual	27.8	18.7	18.9
Expected	21.3	21.2	21.8
Actual/Expected[1]	1.31	0.88	0.87
Standard error	3.12	1.89	3.08
Men			
Actual	30.8	22.4	21.1
Expected	24.2	23.6	25.0
Actual/Expected[1]	1.27	0.95	0.84
Standard error	4.16	2.51	4.71
Women			
Actual	25.5	15.4	16.9
Expected	19.1	19.2	19.0
Actual/Expected[1]	1.34	0.80	0.89
Standard error	4.04	2.25	2.65

[1]Actual/Expected means actual divided by expected.

Table 5. Prevalence rates and standard errors for tuberculin positive adults 25-74 years, by sex and population size of place of residence: United States, 1971-72

Sex, rate, and standard error	Population size of place of residence							
	Urbanized areas				Outside urbanized areas			Rural areas
	3,000,000 or more	1-3 million	250,000-999,999	Less than 250,000	25,000 or more	10,000-24,999	2,500-9,999	
Both sexes								
Actual	28.0	20.0	*28.0	18.9	*24.2	*30.0	21.0	16.2
Expected	20.8	21.5	*22.0	21.8	*21.7	*20.6	22.8	21.4
Actual/Expected[1]	1.35	0.93	*1.27	0.87	*1.12	*1.46	0.92	0.76
Standard error	4.90	2.05	*10.70	2.04	*19.54	*10.40	5.15	3.86
Men								
Actual	32.3	17.9	*34.5	22.4	*37.4	*29.6	*22.5	19.1
Expected	23.0	23.9	*25.1	25.0	*24.7	*23.1	*26.9	24.1
Actual/Expected[1]	1.40	0.75	*1.37	0.90	*1.51	*1.28	*0.84	0.79
Standard error	7.04	2.26	*13.99	1.64	*34.06	*11.29	*7.49	5.91
Women								
Actual	24.6	22.2	*24.0	16.0	*15.5	*30.3	*19.3	13.7
Expected	19.1	18.8	*20.0	19.1	*19.8	*18.3	*18.3	19.0
Actual/Expected[1]	1.29	1.18	*1.20	0.84	*0.88	*1.66	*1.05	0.72
Standard error	5.85	3.81	*8.78	3.21	*13.14	*12.13	*6.79	2.83

[1]Actual/Expected means actual divided by expected.

Table 6. Actual and expected rates and standard errors for tuberculin positive adults 25-74 years, by sex and farm-nonfarm residence: United States, 1971-72

Sex and residence	Actual	Expected	Actual/Expected[1]	Standard error
Both sexes				
Farm	11.4	24.0	0.48	3.33
Nonfarm	22.0	21.3	1.03	1.91
Men				
Farm	*25.2	*29.2	*0.86	*8.31
Nonfarm	24.2	24.0	1.01	2.45
Women				
Farm	*1.1	*20.3	*0.05	*1.56
Nonfarm	20.0	19.0	1.05	2.15

[1]Actual/Expected means actual divided by expected.

Table 7. Prevalence rates and standard errors for tuberculin positive adults 25-74 years, by age, sex, and family income: United States, 1971-72

Age and sex	Annual family income					
	Less than $5,000	$5,000-$9,999	$10,000 or more	Less than $5,000	$5,000-$9,999	$10,000 or more
	Rate per 100			Standard error		
Both sexes 25-74 years	25.3	24.5	17.4	4.20	3.57	2.11
25-34 years	*15.6	22.3	*3.0	*10.62	6.62	*1.65
35-44 years	*28.8	24.3	*10.3	*9.42	6.34	*3.31
45-54 years	36.2	30.5	26.5	9.12	6.89	5.20
55-64 years	20.7	24.5	27.9	4.82	5.47	5.38
65-74 years	26.4	18.8	54.2	3.36	5.38	8.90
Men 25-74 years	37.4	27.8	18.2	4.15	5.01	2.44
25-34 years	*28.0	*28.0	*0.4	*16.12	*11.17	*0.37
35-44 years	*28.0	*24.6	*10.8	*12.73	*11.24	*4.33
45-54 years	*44.2	*34.6	26.9	*12.41	*10.23	6.21
55-64 years	*32.0	*26.3	24.5	*11.62	*8.25	7.48
65-74 years	46.1	*22.3	73.7	7.65	*9.79	11.15
Women 25-74 years	19.2	21.4	16.7	4.53	3.68	2.19
25-34 years	*9.8	*18.2	*5.2	*10.42	*7.20	*3.26
35-44 years	*29.4	*23.9	*9.8	*11.87	*9.82	*4.84
45-54 years	*33.6	*26.8	26.0	*10.52	*8.85	6.90
55-64 years	16.8	*22.2	*31.7	5.37	*6.70	*9.72
65-74 years	12.2	*16.3	*33.5	3.70	*9.40	*15.45

Table 8. Actual and expected rates and standard errors for tuberculin positive adults 25-74 years, by sex and education: United States, 1971-72

Sex and education	Actual	Expected	Actual/Expected[1]	Standard error
Both sexes				
Less than 5 years	*40.8	*25.6	*1.59	*11.98
5-8 years	30.3	24.7	1.23	4.79
9-12 years	20.9	20.9	1.00	2.56
13 years or more	14.5	19.8	0.73	2.71
Men				
Less than 5 years	*33.3	*33.4	*1.00	*14.35
5-8 years	36.3	28.1	1.29	6.87
9-12 years	27.4	24.1	1.14	3.67
13 years or more	13.5	21.4	0.63	2.25
Women				
Less than 5 years	*46.8	*19.4	*2.41	*18.14
5-8 years	23.7	20.9	1.13	4.28
9-12 years	17.3	19.1	0.91	2.70
13 years or more	16.0	17.4	0.92	4.37

[1]Actual/Expected means actual divided by expected.

Table 9. Prevalence rates and standard errors for tuberculin positive adults 25-74 years, by sex and usual activity: United States, 1971-72

Sex, rate, and standard error	Working	Keeping house	Other
Both sexes			
Actual	20.4	19.3	32.8
Expected	21.1	18.7	30.6
Actual/Expected[1]	0.97	1.03	1.07
Standard error	2.68	1.79	5.53
Men			
Actual	21.8	-	33.8
Expected	22.2	-	32.4
Actual/Expected[1]	0.98	-	1.04
Standard error	2.53	-	5.55
Women			
Actual	18.3	19.3	*27.1
Expected	19.4	18.7	*21.3
Actual/Expected[1]	0.94	1.03	*1.27
Standard error	3.80	1.79	*11.63

[1]Actual/Expected means actual divided by expected.

Table 10. Actual and expected rates and standard errors for tuberculin positive adults 25-74 years, by sex and industry: United States, 1971-72

	Industry	Both sexes			
		Actual	Expected	Actual/ Expected[1]	Standard error
1	Agriculture, forestries, and fisheries----------	*23.4	*25.5	*0.92	*7.15
2	Mining and construction----------	*31.1	*24.0	*1.30	*10.77
3	Manufacturing----------	21.2	20.8	1.01	4.39
4	Transportation, communication, utilities----------	*17.3	*19.4	*0.89	*8.74
5	Wholesale and retail trade----------	17.1	20.5	0.83	3.48
6	Finance, insurance, real estate-------	*26.9	*23.5	*1.14	*10.34
7	Services----------	19.0	21.4	0.89	2.10
8	Public administration----------	*21.9	*21.9	*1.00	*7.29

[1]Actual/Expected means actual divided by expected.

Table 10. Actual and expected rates and standard errors for tuberculin positive adults 25-74 years, by sex and industry: United States, 1971-72—Con.

Men				Women				
Actual	Expected	Actual/Expected[1]	Standard error	Actual	Expected	Actual/Expected[1]	Standard error	
22.2	27.3	0.81	6.88	*28.2	*18.2	*1.55	*30.78	1
*26.8	*23.7	*1.13	*10.74	*68.2	*24.8	*2.75	*41.19	2
22.5	21.1	1.07	4.23	*17.8	*19.9	*0.89	*9.14	3
*20.2	*18.6	*1.09	*10.36	*8.1	*22.0	*0.37	*7.59	4
*18.8	*22.4	*0.84	*5.01	*15.3	*18.6	*0.82	*6.92	5
52.9	28.8	1.84	14.40	*0.6	*18.1	*0.03	*1.06	6
18.2	23.7	0.77	3.70	19.5	19.6	0.99	1.90	7
*27.1	*25.1	*1.08	*10.25	*13.5	*16.6	*0.81	*5.93	8

Table 11. Actual and expected rates and standard errors for tuberculin positive adults 25-74 years, by sex and occupation: United States, 1971-72

	Occupation	Both sexes			
		Actual	Expected	Actual/Expected[1]	Standard error
1	Professional and technical----------	*12.7	*20.3	*0.63	*4.44
2	Managers and administrators----------	20.5	21.5	0.95	5.71
3	Sales workers----------	*17.2	*21.7	*0.79	*8.43
4	Clerical----------	18.2	19.5	0.93	2.67
5	Craftsmen----------	21.5	22.4	0.96	5.85
6	Operatives, except transport---------	18.3	21.5	0.85	4.93
7	Transport, equipment operatives------	*31.5	*19.8	*1.59	*15.02
8	Laborers, except farm----------	*42.7	*25.6	*1.67	*13.20
9	Service workers----------	24.4	19.7	1.24	3.75
10	Private household workers----------	*31.4	*22.6	*1.39	*11.19
11	Farm----------	*32.1	*23.5	*1.37	*14.00

[1]Actual/Expected means actual divided by expected.

Table 11. Actual and expected rates and standard errors for tuberculin positive adults 25-74 years, by sex and occupation: United States, 1971-72—Con.

Men				Women				
Actual	Expected	Actual/ Expected[1]	Standard error	Actual	Expected	Actual/ Expected[1]	Standard error	
*12.4	*21.2	*0.59	*4.80	*13.3	*18.6	*0.72	*6.32	1
21.8	22.4	0.97	5.75	*16.1	*18.5	*0.87	*10.65	2
*24.2	*23.2	*1.04	*10.68	*5.0	*19.2	*0.26	*7.46	3
*35.3	*23.8	*1.48	*18.80	14.3	18.5	0.77	3.92	4
22.8	22.6	1.01	5.50	-	-	-	-	5
*13.6	*22.5	*0.60	*5.21	*24.5	*20.2	*1.21	*10.86	6
*33.2	*19.3	*1.72	*15.08	*17.8	*23.4	*0.76	*30.69	7
*40.7	*26.0	*1.57	*13.66	*61.4	*21.1	*2.91	*47.58	8
*39.1	*22.9	*1.71	*11.46	*17.7	*18.2	*0.97	*5.57	9
-	-	-	-	*31.4	*22.6	*1.39	*11.19	10
*31.9	*24.7	*1.29	*20.00	*32.5	*18.4	*1.77	*25.00	11

Table 12. Actual and expected rates and standard errors for tuberculin positive adults 25-74 years, by sex and marital status: United States, 1971-72

Sex, rate, and standard error	Marital status				
	Married	Widowed	Never married	Divorced	Separated
Both sexes					
Actual	21.3	17.6	*17.5	33.4	*27.6
Expected	21.6	21.9	*20.3	21.4	*20.4
Actual/Expected[1]	0.99	0.80	*0.86	1.56	*1.35
Standard error	1.68	4.64	*6.90	7.91	*12.96
Men					
Actual	23.4	37.8	*19.8	*44.0	*44.6
Expected	24.0	33.4	*22.3	*32.7	*24.4
Actual/Expected[1]	0.98	1.13	*0.89	*1.35	*1.83
Standard error	2.26	16.91	*10.36	*18.36	*18.13
Women					
Actual	19.0	15.3	*16.0	*30.3	*20.5
Expected	19.0	20.6	*18.8	*18.0	*18.6
Actual/Expected[1]	1.00	0.74	*0.85	*1.68	*1.10
Standard error	1.95	4.21	*8.68	*8.53	*7.30

[1]Actual/Expected means actual divided by expected.

Table 13. Actual and expected rates and standard errors for tuberculin positive adults 25-74 years, by number of rooms in place of residence: United States, 1971-72

Rate and standard error	Number of rooms								
	1	2	3	4	5	6	7	8	9 or more
Actual----------	*53.3	*37.9	30.8	21.9	18.6	25.5	17.4	19.3	*9.1
Expected----------	*30.2	*24.3	21.8	21.1	21.5	21.2	22.8	19.9	*22.5
Actual/Expected[1]----	*1.76	*1.56	1.41	1.04	0.87	1.20	0.76	0.97	*0.40
Standard error------	*20.84	*13.55	4.65	3.83	2.84	4.03	2.48	5.31	*4.43

[1]Actual/Expected means actual divided by expected.

APPENDIXES

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APPENDIX I

STATISTICAL NOTES

The Survey Design

The sampling plan for the first 65 stands of the Health and Nutrition Examination Survey (HANES) followed a stratified multistage probability design in which a sample of the civilian noninstitutionalized population of the coterminous United States, 1-74 years of age, was selected. Excluded from the selection were persons residing in Alaska and Hawaii and those within the coterminous United States confined to institutions or residing on reservation lands of American Indians. Successive elements dealt with in the process of sampling were the primary sampling unit (PSU), census enumeration district (ED), segment (a cluster of households), household, eligible persons, and finally sample persons.

The starting points in the first stage of this design were the 1960 decennial census lists of addresses and the nearly 1,900 primary sampling units (PSU's) into which the entire United States was divided. Each PSU is either a standard metropolitan statistical area (SMSA), a single county or two or three contiguous counties. The PSU's were grouped into 357 strata for use in the Health Interview Survey and subsequently collasped into 40 super strata for use in Cycle II and III of the Health Examination Survey and HANES.

Fifteen of the 40 super strata contained a single large metropolitan area of more than 2,000,000 population. These 15 large metropolitan areas were chosen into the sample with certainty. The 25 noncertainty strata were classified into four broad geographic regions of approximately equal population and cross-classified into four broad population density groups in each region. Then a modified Goodman-Kish controlled selection technique was used to select two PSU's from each of the 25 noncertainty super strata with the probability of selection of a PSU proportionate to its 1960 population so that proportionate representation of specified State groups and rate of population change classes was maintained in the sample. In this manner a total first stage sample of 65 PSU's was selected. These 65 sample PSU's or stands are the areas within which a sample of persons would be selected for examination over a 3-year survey period.

In order to produce national estimates of the nutritional status of the U.S. population at an earlier date, a probability subsample of 35 stands of the 65 stands was selected. This 35 stand subsample also made it possible to produce national estimates of certain other aspects of health status in the population that were critically needed at an earlier date and examination components that for logistic reasons could not be continued for the remainder of the 65 stands. Included among the 35 stands are 10 of the 15 large certainty metropolitan areas and one stand from each of the 25 noncertainty super strata. The reduction from 15 to 10 large metropolitan areas was accomplished by randomly selecting one stand from multiple-stand standard metropolitan statistical areas, e.g., selecting the southern half of the Chicago SMSA to represent the entire SMSA. (This selection procedure was based on operational considerations and, although unbiased is recognized as not being statistically optimal.) It is this subsample of 35 stands upon which the findings contained in this report are based.

Although the 1970 Census data were used as the frame for selecting the sample within PSU's when they became available, the calendar of operations required that 1960 Census data be used for the 35-stand sample of HANES. Census enumeration districts (ED's) in each PSU were divided into segments of an expected six housing units each. In urban ED's the segments were clusters of six addresses from the 1960 Census listing books. For ED's not having usable addresses, area sampling was employed and consequently some variation in the segment size occurred. To make the sample representative of the current population of the United States, the address or list segments were supplemented by a sample of housing units that had been constructed since 1960.

Within each PSU a systematic sample of segments was selected. The enumeration districts which fell into the sample were coded into one of two economic classes. The first class, identified as the "poverty stratum," was composed of "Current Poverty Areas"

that had been identified by the U.S. Bureau of the Census in 1970 (pre 1970 Census), plus other ED's in the PSU with a mean income of less than $3,000 in 1959 (based on 1960 Census). The second economic class, the "nonpoverty stratum," includes all ED's not designated as belonging to the "poverty stratum."

All sample segments classified as being in the "poverty stratum" were retained in the sample. For those sample segments in "nonpoverty stratum" ED's, the selected segments were divided into eight random subgroups and one of the subgroups was chosen to remain in the HANES sample. This procedure permits a separate analysis with adequate reliability of those classified as being below the poverty level and those classified as being above the poverty level.

After identification of the sample segments, a list of all current addresses within the segment boundaries was made, and the households were interviewed to determine the age and sex of each household member as well as other demographic and socioeconomic information required for the survey.

To select the persons in sample segments to be examined in HANES, all household members aged 1-74 in each segment were listed on a sample selection worksheet with each household in the segment listed serially. The number of household members in each of the six age-sex groups shown below were listed on the worksheet under the appropriate age-sex group column. The sample selection worksheets were then put in segment number order and a systematic random sample of persons in each age-sex group was selected to be examined using the following sampling rates.

Ages	*Rate*
1-5 years	½
6-19 years	¼
20-44 years, men	¼
20-44 years, women	½
45-64 years	¼
65-74 years	1

The persons selected in the 35 stand sample of HANES comprise a representative sample of the target population and included 14,147 sample persons 1-74 years of age of whom 10,126 or 71.6 percent were examined. When adjustments are made for differential sampling for high risk groups, the response rate becomes 72.8 percent.

The one-fifth subsample of those in the total sample aged 25-74 years was designated to receive a more detailed examination and to obtain further data on health status and unmet health care needs. It was chosen systematically after a random start using the following sampling rates:

Age	*Rate applied to nutrition sample for detailed subsample*	*Resultant effective sampling rate for detailed subsample*
25-44 years, men	2/5	1/10
25-44 years, women	1/5	1/10
45-64 years	3/5	3/20
65-74 years	1/4	1/4

The adults 25-74 years of age in this 35-stand detailed sample of HANES are also a representative sample of that target population and included 2,798 sample adults 25-74 years of age of whom 1,892 or 67.6 percent were examined. When adjustments are made for differential sampling in the older groups, the effective response rate is 68.7 percent.

All data presented in this report are based on "weighted" observations. That is, data recorded for each sample person are inflated to characterize the subuniverse from which that sample person was drawn. The weight for each examined person is a product of the reciprocal of the probability of selecting the person, an adjustment for nonresponse cases (i.e., persons not examined), and a poststratified ratio adjustment which increases precision by bringing survey results into closer alignment with known U.S. population figures.

A more detailed description of the survey design and selection technique can be found in the Plan and Operation of a Health and Nutrition Examination Survey, U.S. 1971-1973, *Vital and Health Statistics*, Series 1. No. 10a.

Nonresponse

In any health examination survey, after the sample is identified and the sample persons are requested to participate in the examination, the survey meets one of its more severe problems. Usually a sizable number of sample persons will not participate in the examination. Whether or not an individual participates is determined by many factors, some of them uncontrollable, and therefore, may be reasonably treated as an outcome of a random event with a particular probability of occurrence. If these probabilities of participation were known and greater than zero for all persons, then the examined persons would constitute a probability sample from which unbiased estimates of the target population could be derived. In this situation, the effect of nonparticipation would only be to reduce the sample size, thereby increasing the sampling errors of examination findings. However, in practice a potential for bias due to nonresponse exists since the exact probabilities are never known. A further potential for bias exists if: (1) a sizable proportion of sample persons have a zero probability of participation, that is, they would never agree

to participate in an examination survey of the same procedures and inducements, and also (2) these persons differ from other sample persons with respect to characteristics under examination. It is for these reasons that intensive efforts are made in HANES to develop and implement procedures and inducements that would reduce the number of nonrespondents and thereby reduce the potential of bias due to nonresponse. These procedures and inducements are discussed in the Plan and Operation of the Health and Nutrition Examination Survey, U.S. 1971-1973, *Vital and Health Statistics*, Series 1, No. 10a.

Despite these intensive efforts 27.2 percent of the sample persons 1-74 years and 31.3 percent of those 25-74 years from the first 35 stands were not examined. Consequently, the potential for a sizable bias does exist in the estimates in this publication. From what we know about the nonrespondents and the nature of nonresponse we believe that the likelihood of sizable bias is small. For instance, only a small proportion of persons gave reasons for nonparticipation which would lead to the belief that they would never agree to participate in examination surveys and that they may differ from examined persons with respect to the characteristic under examination. Only 15 percent of the nonrespondents gave as their reasons for nonparticipation personal illness, physically unable, pregnant, anti-doctor, or fear of finding something wrong. Typical among the reasons given by the other nonrespondents were: unable because of work, school, or household duties; suspicious or skeptical of the program; just not interested in participating; and private medical care sufficient or just visited doctor.

An analysis of medical history data obtained for most nonexaminees as well as examinees also supports the belief that the likelihood of sizable bias due to nonresponse is small. No large differences were found between the examined group and nonexamined group for the statistics compared. For example, 11 percent of persons examined reported having an illness or condition which interferes with their eating as compared to 9 percent of persons not examined but who had completed a medical history. The percent of persons examined reporting ever being told by a doctor that they had arthritis was 20 percent; the percent for high blood pressure was 18 percent and for diabetes was 4 percent. The corresponding percents for nonexamined persons were: arthritis, 17 percent; high blood pressure, 21 percent; and diabetes 4 percent.

As was mentioned earlier, the data in this report are based on weighted observations, and one of the components of the weight assigned to an examined person was an adjustment for nonresponse. Since the probabilities of participation are not known for sample persons in HANES, a procedure was adopted which multiplies the reciprocal of the probability of selection of sample persons by a factor which brings estimates based on examined persons only up to a level which would have been achieved if all sample persons had been examined. This nonresponse adjustment factor is the ratio of the sum of sampling weights for all sample persons within a relatively homogeneous class defined by age, sex, and poverty status to the sum of sampling weights for all responding sample persons within the same homogeneous class. To the degree that homogeneous groups can be defined which are also homogeneous with respect to the characteristics under study, the procedure can be effective in reducing the potential bias from nonresponse.

For the 35 stand sample of HANES, persons were grouped into 20 age-sex-poverty status groups within each stand, yielding seven hundred separate cells with an average membership of about 20 sample persons each. These adjustment factors are distributed among examined persons as shown in table I.

Table I. Percent distribution of nonresponse adjustment factors, HANES, Stands 01-35, 1971-1972

Size of factor	Percent distribution
Total----------	100.0
1.00-1.24----------	38.4
1.25-1.49----------	31.6
1.50-1.74----------	12.9
1.75-1.99----------	8.4
2.00-2.49----------	6.1
2.50-2.99----------	1.2
3.00-3.03----------	1.4

Missing Data

Examination surveys are subject to the 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. The tuberculin test was administered to 1,580 or 83.5 percent of those adults examined and readings on the degree of reaction were obtained for 1,494 or 79.0 percent of the examinees. An additional 2.4 percent were not tested but gave as a reason for refusal a history of tuberculosis, receiving INH prophylaxis, or recent tuberculin tests with known reactions. No estimates were imputed for the 18.6 percent without useable tuberculin skin test results or histories. The 6.6 percent not tested because they were examined in the last day or two at a location are unlikely to have biased the findings. Among the remaining 12.0 percent some potential biasing effects may exist but in either di-

rection. The proportion returning for reading was slightly greater among those living in large urban areas where the prevalence of tuberculosis and hence chance of exposure is greater than elsewhere.

Possibly also contributing to a positive bias is the greater likelihood of positive than negative reactors to return for a reading. However, it is likely that the prevalence and characteristics of positive tuberculin reaction among those 18.6 percent whose test results were not available would not be markedly different than those with known reactions.

Expected Values

In the detailed tables both the actual and expected prevalence rates are shown for adults in the various demographic groups. The expected values are obtained by assuming that the national age-specific rates apply within the appropriate age-sex subgroups for which the value is to be derived.

For example, if in an area (e.g., the Northeast) estimates from the Health Examination Survey show n_i men in the i^{th} age group (i = 25 - 34, 35 - 44 — 65 - 74; $\sum n_i = n$) and the estimates of prevalence rates for all U.S. men in the i^{th} age group to be x_i, then the expected prevalence rate for men in that area is:

$$\frac{1}{n}\sum_i n_i X_i$$

The specific area may have higher values for younger men and lower values for older men than in the other areas. In that case the expected rates may obliterate one or both of these differentials. These types of limitations need to be kept in mind in interpreting these data. The standard error of the difference between an actual and an expected rate may be approximated by the standard error of the actual value.

Small Numbers

In some tables magnitudes are shown for cells for which the sample size is so small that the sampling error may be several times as great as the statistic itself. Obviously in such instances the numbers, if shown, have been included to convey an impression of the overall story of the table.

Sampling and Measurement Error

In the present report, reference has been made to efforts to minimize bias and variability of measurement techniques. The potential of residual bias due to the high nonresponse rate has also been discussed.

The probability design of the survey makes possible the calculation of sampling errors. Traditionally the role of the sampling error has been the determination of how imprecise the survey results may be because they come from a sample rather than from the measurement of all elements in the universe.

The estimation of sampling errors for a study of the type of the Health and Nutrition Examination Survey is difficult for at least three reasons: (1) measurement error and "pure" sampling error are confounded in the data—it is not easy to find a procedure which will either completely include both or treat one or the other separately; (2) the survey design and estimation procedure are complex, and, accordingly, require computationally involved techniques for the calculation of variances; and (3) hundreds of statistics are presented in the tables in this report, many for subclasses of the population for which there are a small number of sample cases. Estimates of sampling error are obtained from the sample data and are themselves subject to sampling error when the number of cases in a cell is small or, even occassionally, when the number of cases is substantial.

Estimates of the standard errors for selected statistics used in this report are presented in the detailed tables. These estimates have been prepared by a replication technique which yields overall variability through observation of variability among random subsamples of the total sample. Again, readers are reminded that these estimated sampling errors do not reflect any residual bias which might still be present after the attempted correction for nonresponse. The standard error is primarily a measure of sampling variability, that is, the variations that might occur by chance because only a sample of the population is surveyed. As calculated for this report, the standard error also reflects part of the variation which arises in the measurement process. It does not include estimates of any biases which might lie in the data. The chances are about 68 out of 100 that an estimate from the sample would differ from a complete census by less than the standard error. The chances are about 95 out of 100 that the difference would be less than twice the standard error and about 99 out of 100 that it would be less than 2½ times as large.

APPENDIX II

DEMOGRAPHIC AND SOCIOECONOMIC TERMS

Age.—The age recorded for each examinee was the age at last birthday at the time of examination. The age criterion for inclusion in the sample used in this survey were defined as age at time of Census interview. In this sample there were 8 examinees who were 74 years of age at the time of interview but 75 years of age at examination. In the adjustment and weighting procedures used to produce national estimates, these persons were included in the 74 year old group.

Race.—Race was recorded as "white," "Negro," or "other." "Other" includes Japanese, Chinese, American Indian, Korean, Eskimo and all races other than white and Negro. Mexicans were included with "white" unless definitely known to be American Indian or of other nonwhite race. Negroes and persons of mixed Negro and other parentage were recorded as "Negro." When a person of mixed racial background is uncertain about his race, the race of his father was recorded.

Geographic region.—The forty-eight continguous States and the District of Columbia (not Alaska and Hawaii) were stratified into four broad geographic regions of about the same population size. With a few exceptions the compositions of the regions are as follows:

Region	*States Included*
Northeast	Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania
Midwest	Ohio, Michigan, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri
South	Delaware, Maryland, Virginia, West Virginia, Kentucky, Arkansas, Tennessee, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, District of Columbia
West	Washington, Oregon, Idaho, Montana, Wyoming, Colorado, Utah, Nevada, California, Arizona, New Mexico, Texas, Oklahoma, Kansas, Nebraska, South Dakota, North Dakota

In a few instances the actual boundaries of the regions do not follow State lines. Some strata in the Midwest and South Regions include PSU's actually located in the West Region. Similarly, some strata in the West Region contain PSU's located in the Midwest and South Regions.

Population density.—The United States population was divided into five population groups of approximately the same size. These groups were defined differently for the four geographic regions as is shown below. For the very large SMSA's, except those in the South Region, the criterion for inclusion was population size; these SMSA's were chosen for the sample with certainty. In the South Region, the "largest SMSA's" were defined in the same way as "other large SMSA's," but were put in a different stratum for sampling purposes.

Region	Class Composition
Northeast	
Largest SMSA's	The SMSA's population was greater than 2.4 million.
Other large SMSA's	Seventy percent or more of the SMSA's population was urban.
Other SMSA's	Less than 70 percent of the SMSA's population was urban.
Not in SMSA, urban	Forty percent or more of the population was urban.
Not in SMSA, rural	Less than 40 percent of the population was urban.
Midwest	
Largest SMSA's	The SMSA's population was greater than 3 million.
Other large SMSA's	Ninety percent or more of the SMSA's population was urban.
Other SMSA's	Less than 90 percent of the SMSA's population was urban.

Not in SMSA, urban	Thirty-four percent or more of the population was urban.
Not in SMSA, rural	Less than 34 percent of the population was urban.
South	
Largest SMSA's	Ninety percent or more of the SMSA's population was urban.
Other large SMSA's	Ninety percent or more of the SMSA's population was urban.
Other SMSA's	Less than 90 percent of the SMSA's population was urban.
Not in SMSA, urban	Thirty percent or more of the population was urban.
Not in SMSA, rural	Less than 30 percent of the population was urban.
West	
Largest SMSA's	The SMSA's population was greater than 2.5 million.
Other large SMSA's	Seventy-two percent or more of the SMSA's population was urban.
Other SMSA's	Less than 72 percent of the SMSA's population was urban.
Not in SMSA, urban	Thirty-six percent or more more of the population was urban.
Not in SMSA, rural	Less than 36 percent of the population was urban.

Urban-rural.—The classification of urban-rural areas is that used in the 1960 Census. According to the 1960 definition, those areas considered urban are: (a) places of 2,500 inhabitants or more incorporated as cities, boroughs, villages, and towns (except towns in New England, New York, and Wisconsin); (b) the densely settled urban fringe, whether incorporated or unincorporated, of urbanized areas; (c) towns in New England and townships in New Jersey and Pennsylvania which contain no incorporated municipalities as subdivisions and have either 2,500 inhabitants or more, or a population of 2,500 to 25,000 and a density of 1,500 persons per square mile; (d) counties in States other than the New England States, New Jersey, and Pennsylvania that have no incorporated municipalities within their boundaries and have a density of 1,500 persons or more per square mile; and (e) unincorporated places of 2,500 inhabitants or more which are not included in any urban fringe. The remaining population is classified as rural.

By means of the first digit of the identification code on the household questionnaire, the urban and rural population is divided into the following categories according to population: (1) urban, 3,000,000 or more; (2) urban, 1,000,000-2,999,999; (3) urban, 250,000-999,999; (4) urban, under 250,000; (5) urban not in urbanized area, 25,000 or more; (6) urban not in urbanized areas, 10,000-24,999; (7) urban not in urbanized area, 2,500-9,999; and (8) rural.

SMSA-Not in SMSA.—By means of the second digit of the identification code on the household questionnaire, the population is classified as living "in central city" of a standard metropolitan statistical area (SMSA), "not in central city" of an SMSA, or "not in SMSA." The definitions and titles of SMSA's are established by the U.S. Office of Management and Budget with the advice of the Federal Committee on Standard Metropolitan Statistical Areas. An SMSA consists of a county or group of contiguous counties (except in New England) which contains at least one central city of 50,000 people or more, or "twin cities" with a combined population of at least 50,000 people. In addition, other contiguous counties are included in an SMSA if, according to certain criteria, they are socially and economically integrated with the central city. Definitions of SMSA's which identify the composition and structure of each are given in U.S. Office of Management and Budget, *Standard Metropolitan Statistical Areas,* 1967 Edition. Persons "in central city" of an SMSA are therefore defined as those whose residency is in the city or cities of the standard metropolitan statistical area title. Persons who reside in an SMSA but not in the city given in the SMSA title are considered "not in central city." Note: It is possible for rural-farm and rural-nonfarm residents (as defined above) to be coded as "in SMSA."

Family income.—The income recorded is the total income received during the 12 months prior to the interview by the head of the household and all other household members related to the head. This income is the gross cash income (excluding pay in kind) except in the case of a family with its own farm or business. In that instance net income is recorded. Also included is the income of a member of the Armed Forces who is living at home with his family (even though he is not considered a household member). If he is not living at home, allotments and other money received by the family from him are included in the family income figure.

Education.—The only grades counted are those that have been attended in a regular school where persons are given formal education—either graded public or private schools, day or night, full-time or part-time attendance. A "regular" school is one which 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 are not counted in determining

the highest grade of school completed. If a person attended school in a foreign country, an ungraded school, under a tutor, or under other special circumstances, the nearest equivalent of his highest grade attended.

Industry.—The industry in which a person reports he is working is classified by the major activity of the establishment in which he works. The only exceptions to this are those few establishments classified according to the major activity of the parent organization such as research laboratories, warehouses, repair shops, and storage garages when these kinds of establishments exist primarily to serve their own parent organizations rather than the public or other organizations. The industry groupings shown below are the same as those used by the U.S. Bureau of the Census for the 1970 Census. Codes for these industries are listed in the U.S. Bureau of the Census publication, *1970 Census of Population Alphabetical Index of Industries and Occupations.* U.S. Government Printing Office, Washington, D.C., 1971.

Industry Groups

Agriculture, forestry, and fisheries
Mining
Construction
Manufacturing
Transportation, communication, and other public utilities
Wholesale and retail trade
Finance, insurance, and real estate
Business and repair services
Personal services
Entertainment and recreation services
Professional and related services
Public administration
Industry not reported

The industry "public administration" is limited to the postal service, and Federal, State, and local public administrations. This category includes only uniquely governmental functions and excludes those activities which may also be carried out by private enterprise. For example, teachers in public educational facilities and nurses engaged in medical services of governmental agencies are included in the "professional and related services" group.

Occupation.—A person's principal job or business as reported during the household interview is considered to be his occupation. If the person worked at a job or business during the 2 weeks preceding the interview, the question about his occupation (or what kind of work he was doing) applies to his job during that period. If the person works at or has more than one job, the questions refer to the job at which he spends the most time. If equal time is spent at each job, the questions refer to the one the person considers the most important or the one which he has had longer. A person who has not begun work at a new job, is looking for work, or is on layoff from a job is questioned about his last full-time civilian job or business.

The occupation groupings shown below are the same as those used by the U.S. Bureau of the Census for the 1970 Census. Codes for these occupations are listed in the U.S. Bureau of the Census publication, *1970 Census of Population Alphabetical Index of Industries and Occupations,* U.S. Government Printing Office, Washington, D.C., 1971.

Occupation Groups

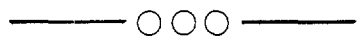
Professional, technical, and kindred workers
Managers and administrators, except farm
Sales workers
Clerical and kindred workers
Craftsmen and kindred workers
Operatives, except transport
Transport equipment operatives
Laborers, except farm
Farmers and farm managers
Farm laborers and farm foremen
Service workers, except private household
Private household workers
Occupation not reported

Usual activity.—This item on the household questionnaire is defined as that activity ("working," "keeping house," or "something else") in which the person has been engaged for most of the time between the date of interview and the same date 3 months earlier. "Working" includes paid work as an employee for someone else for wages, salary, commission, or "pay in kind" (meals, living quarters, or supplies provided in the place of cash wages). Also included is work in the person's own business, professional practice, or farm, and work without pay in a business or farm run by a relative. Work done around a person's own house or volunteer, unpaid work for a church or charity is not included in the "working" category. "Something else" included people in all activities besides "working" and "keeping house."

Marital status.—The five categories of marital status on the household questionnaire are "married," "widowed," "never married," "divorced," and "separated." A respondent is not asked about the marital status of a person under 17 years old unless there is reason to believe the person is not single. A person whose marriage has been annulled is considered "never married." Persons having common law marriages are considered "married." "Separated" refers only to married persons who have a legal separation or who have parted because of marital discord. Thus persons separated because of the circumstances of their employment, service in the Armed Forces, or

similar reasons are classified as "married," not "separated."

Number of rooms in living quarters.—Included in the count are whole rooms used for living purposes such as living rooms, dining rooms, bedrooms, kitchens, finished attic or basement rooms, recreation rooms, permanently closed porches suitable for year-round use, lodgers' rooms, and rooms used for offices by persons living in the housing units. Not considered as rooms are bathrooms, halls, foyers or vestibules, balconies, closets, alcoves, strip or pullman kitchens, laundry or furnace rooms, unfinished attics or basements, other unfinished space used for storage, open porches, trailers used only for bedrooms, and offices used only by persons not living in the housing units.



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