

**Rheumatoid Arthritis
in Adults
United States - 1960 - 1962**

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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.

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IN THIS REPORT are presented findings on the prevalence of rheumatoid arthritis (RA) obtained from Cycle I of the Health Examination Survey. Cycle I consisted of examinations of a nationwide probability sample of persons 18-79 years of age selected from the U.S. civilian, noninstitutional population.

This report describes the steps taken in diagnosing RA, presents the data collected, and compares the information obtained in this survey with that obtained in other surveys. The relationship of the prevalence of RA to the demographic variables of age, race, sex, family income, education, family size, place description, marital status, usual activity, occupation, and industry are examined.

Some 3.6 million adults had RA. RA was more prevalent in women than in men. The likelihood of having RA was about the same for both white and Negro adults. The prevalence of RA varied by certain other demographic factors. Among the differentials noted was a lower than expected RA prevalence for persons with more education and a lower than expected prevalence for men in the professions and in technical and managerial fields.

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RHEUMATOID ARTHRITIS IN ADULTS

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Rheumatoid arthritis is a chronic inflammatory disease of connective tissue manifested by varying degrees of joint and constitutional symptoms. Permanent joint deformities, disability, and chronic invalidism are not infrequent consequences of this disease. It is hoped that the data furnished by the Health Examination Survey may prove useful to practitioners and to investigators working with this puzzling disease of unknown etiology.

The National Health Survey uses three methods for obtaining information about the health of the U.S. population. The first is a household interview in which persons are asked to give information relating to their health or to the health of other household members. The second is the collection of data from available records, such as hospital forms. The third is direct examination. The Health Examination Survey (HES) was organized to use the third procedure, drawing samples of the population of the United States and, by medical examination and with various tests and measurements, undertaking to characterize the population under study.

The first goal of the Health Examination Survey was to examine a nationwide probability sample of the civilian, noninstitutionalized population aged 18-79 years to obtain information on the prevalence of cardiovascular diseases and certain other chronic diseases, dental health, and the distribution of a number of anthropometric and sensory characteristics. Altogether 6,672 of a sample of 7,710 persons were examined in the first survey, which began in October 1959 and ended in

December 1962. Medical and other HES staff members gave these sample persons a standard examination, lasting about 2 hours, in specially designed mobile clinics.

This report discusses the prevalence of rheumatoid arthritis by age, race, and sex and according to certain other demographic factors. It also compares the findings of this survey with that of other surveys. The HES findings in regard to osteoarthritis have been published separately.¹ The rheumatoid arthritis report is one of a series describing and evaluating the plan, conduct, and findings of the first cycle of the Health Examination Survey. A description of the general plan and of the sample population and response have been published,^{2,3} providing a general background for all the reports of findings. In this report the entire examination of the joints is outlined and those parts of the examination relating to the diagnosis of rheumatoid arthritis are discussed.

EXAMINATION AND CRITERIA

Diagnostic Criteria and Classification of Rheumatoid Arthritis

The diagnostic criteria used in the survey were essentially those of the American Rheumatism Association (ARA)⁴ for active rheumatoid arthritis classified according to the number of criteria fulfilled. Diagnostic criteria with the weight assigned to criteria according to the

present somewhat arbitrary system were as follows:

Symptoms

1. Morning stiffness—1 point.
2. Pain on motion or tenderness in at least one joint (observed by physician)—1 point.

Clinical Signs (Observed by Physician)

3. A total allotment of 1-3 points was allocated to joint swelling according to the following classification:
 - a. Swelling (soft tissue thickening or fluid, not bony growth alone) in at least one joint—1 point.
 - b. Swelling as above in at least one other joint—2 points.
 - c. Swelling as above with simultaneous symmetrical involvement on both sides of the body (terminal phalangeal joints do not qualify)—3 points.
4. Subcutaneous nodules over bony prominences on extensor surfaces or in juxta-articular regions—1 point.

Radiological Signs

5. X-ray changes; the minimum requirement in the Survey was an erosion of the bone in the involved joint—1 point.

Serology

6. The demonstration of rheumatoid factor by any method which in two laboratories has been positive in not over 5 percent of normal controls—1 point.

Cases were classified as follows:

- 3 or 4 points—Probable case of rheumatoid arthritis.
- 5 or 6 points—Definite case of rheumatoid arthritis.
- 7 or 8 points—Classical case of rheumatoid arthritis.

The rates for rheumatoid arthritis as determined by the Health Examination Survey refer only to those cases diagnosed by the single examination administered by the survey. Due to the remittent nature of the disease there may be cases that might not be labeled as rheumatoid arthritis in a single examination but might be so classified in a subsequent examination.⁵

The Joint Examination

The medical history.—After a brief interview by a receptionist the examinee was given a medical history form to complete. Included among the questions were some pertaining to rheumatoid symptoms or diseases. The questions dealt with morning stiffness, joint pain, swelling and tenderness, and the presence or absence of a previous history of arthritis. Of all these questions, only the one on morning stiffness was included in the determination of the diagnoses of rheumatoid arthritis.

The physical examination.—This was a standardized physical examination for which the method of examination had been specifically outlined to the examining physician, who was a fellow or resident in internal medicine. Joints included in this examination were the hip, knee, ankle, feet, cervical and lumbar spine, elbow, wrist, shoulder, metacarpophalangeal, proximal interphalangeal, distal interphalangeal, sternoclavicular, and sacroiliac. Among the manifestations of joint involvement to be looked for were pain on motion, limitation of motion, tenderness on compression of joints, swelling, deformity, subcutaneous nodules, and atrophy. The form used in the physical examination of the joint is shown in Appendix II. The diagnostic criteria obtained from the physical examination were pain on motion, tenderness, joint swelling, and subcutaneous nodules. Since the subjects were only examined once, no information is available concerning the duration of any of the findings. Unfortunately information obtained from the patient on symptom duration was too unreliable for use.

Serology.—Serum for the bentonite flocculation test was refrigerated and shipped to the National Institute of Arthritis and Metabolic Diseases (NIAMD) for analysis for rheumatoid

Table A. Percent of men and women with specified findings and relative prevalence by sex: United States, 1960-62

Diagnostic finding	Men	Women	$\frac{\text{Women}}{\text{Men}}$
	Percent		Relative prevalence
Symmetrical joint swelling-----	0.9	3.1	3.3
Subcutaneous nodules-----	*	*	*
Tenderness-----	9.4	17.5	1.9
Pain on motion-----	1.9	3.4	1.8
Swelling, one joint-----	1.7	1.8	1.1
Positive bentonite flocculation test-----	3.4	3.5	1.0
Swelling, two joints-----	0.3	0.3	0.8
Positive X-ray-----	1.0	0.6	0.7
Morning stiffness-----	22.1	32.2	1.5
Severe and frequent-----	4.3	8.4	2.0
Mild and frequent-----	3.5	4.9	1.4
Severe and infrequent-----	1.3	2.4	1.9
Mild and infrequent-----	13.1	16.5	1.3

factor. In the test bentonite, a naturally occurring clay in powder form was suspended in distilled water. Particles of optimum size for the test were obtained by differential centrifugation. The particles were coated with gamma globulin and dyed with methylene blue. Rheumatoid factor, if present in an examinee's serum, flocculated coated particles. Findings were considered positive when at least 50 percent of the bentonite particles were clumped into compact masses by a serum diluted 1:32 or more.⁶

Radiological examination.—X-rays were taken of the hands and feet of each examinee by the survey technicians. A 10 by 12 inch film was taken of both hands with a bone standard placed between them. Similarly a 10 by 12 inch film was taken of the feet with a bone standard placed between them. The X-rays were read independently by three expert specialists in arthritis from the NIAMD. None of the readers had any knowledge of the age, sex, or clinical state of any individual. A series of reference X-ray plates (Appendix III) were prepared from

clinical cases at the NIAMD utilizing standards set forth by Kellgren and Lawrence.⁷ The films were read for the presence of osteoporosis, cartilage destruction, bone destruction, and ankylosis. A 5-point score was used with a score of 2-4 being indicative of rheumatoid arthritis. A high degree of agreement was found among the readers. Rating disagreements were resolved in conference by the three readers. A description of the process of resolving disagreements in ratings is given in the National Center for Health Statistics report on osteoarthritis.¹

DISTRIBUTION OF DIAGNOSTIC CRITERIA

Table A gives the percent distribution of each diagnostic finding in the population according to sex. The diagnostic findings tenderness and pain on motion are listed separately, and a separate tabulation of morning stiffness broken down into four degrees of severity is also included.

The data for morning stiffness were obtained from the self-administered history (for exact form see Appendix I). The four possible combinations of answers to the question were as follows:

Symptoms occurred and Bothered the examinee

Every few days	Quite a bit	(Severe and frequent)
Every few days	Just a little	(Mild and frequent)
Less often	Quite a bit	(Severe and infrequent)
Less often	Just a little	(Mild and infrequent)

Symmetrical swelling, joint tenderness, pain on motion, and severe morning stiffness were much more common in women than men. Swelling in one joint, positive bentonite flocculation test, swelling in two joints, and a positive X-ray were about as common or more common in men than women. It should also be noted that the more marked the morning stiffness the greater the ex-

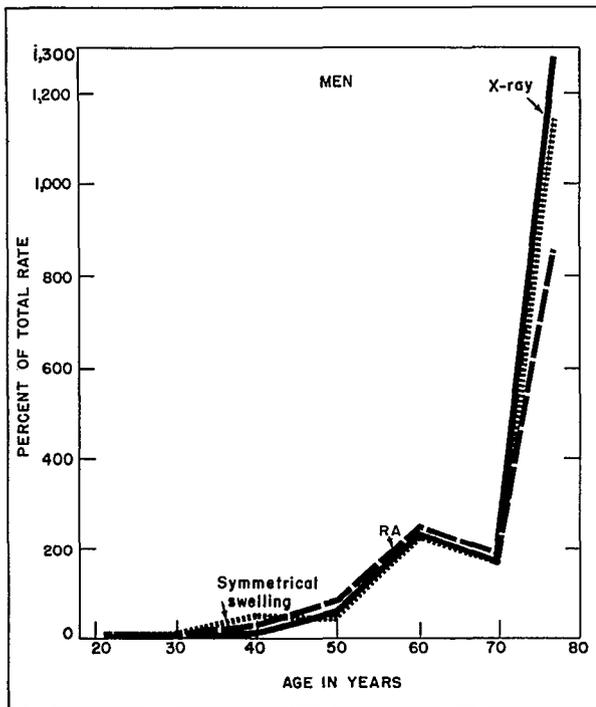


Figure 1. Prevalence of positive X-ray, symmetrical swelling, and rheumatoid arthritis in men, divided by the total prevalence for all ages multiplied by 100, by age.

(100 percent equals average prevalence for all ages)

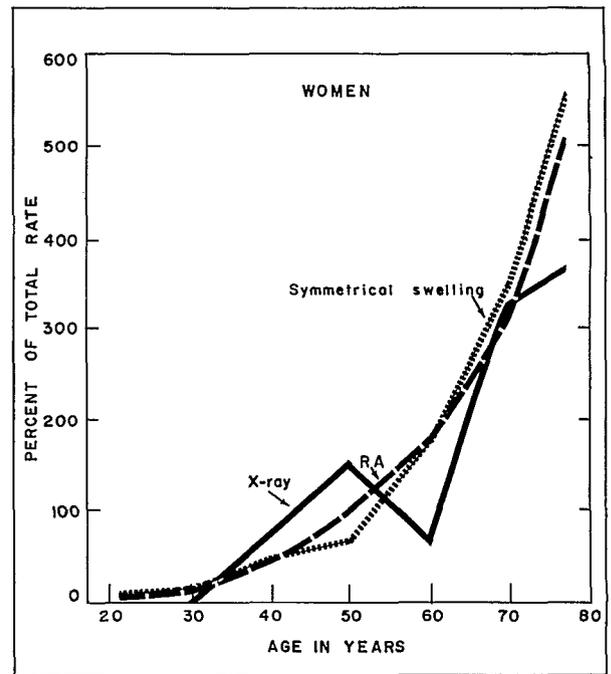


Figure 2. Prevalence of positive X-ray, symmetrical swelling, and rheumatoid arthritis in women, divided by the total prevalence for all ages multiplied by 100, by age.

(100 percent equals average prevalence for all ages)

cess in women. The general pattern of the distribution of diagnostic findings by sex appears to show a greater relative prevalence in women for those findings accompanying an acute episode of joint disease.

The distribution by age of the diagnostic findings in the male and female populations are outlined in figures 1-8. Each finding is plotted using its own mean rate for all age groups as a standard. Data are presented as the percentage that each age group rate forms of the total rate for all age groups. For example, if the rate at age 60 for a particular finding was twice the total mean rate the graph would be marked at the 200 percent level. The actual rates for the diagnostic findings by age are given in table 1. On each graph a similar curve for rheumatoid arthritis is included for reference.

In general all the diagnostic findings show a gradient with increasing age. The curves follow more or less closely the curve for rheumatoid arthritis, depending to a large extent on the

Table B. Percent with positive bentonite flocculation tests according to Health Examination Survey, 1960-62

Rheumatoid arthritis status	Point value	Percent positive BFT
No rheumatoid arthritis-	0-2	2.6
Probable rheumatoid arthritis-----	3	23.0
	4	3.5
Definite rheumatoid arthritis-----	5	12.2
	6	60.0
Classical rheumatoid arthritis-----	7	100.0
	8	100.0

Of considerable interest is the distribution of positive bentonite flocculation tests (BFT) in the Health Examination Survey. Table B gives the percent of positive bentonite flocculation tests present in the nonrheumatoid examinees and in

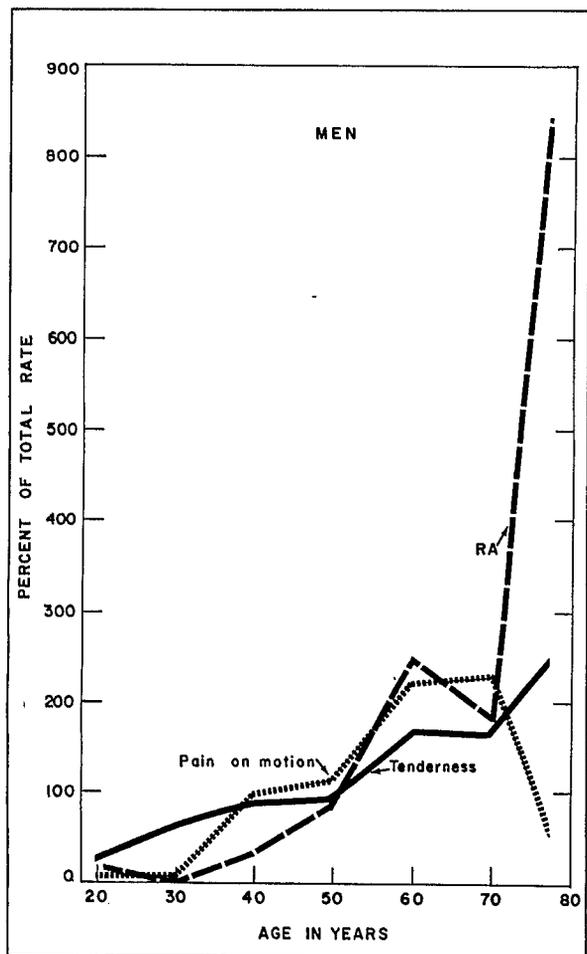


Figure 3. Prevalence of tenderness, pain on motion, and rheumatoid arthritis in men, divided by the total prevalence for all ages multiplied by 100, by age.

(100 percent equals average prevalence for all ages)

relative specificity of the diagnostic finding to the diagnosis of rheumatoid arthritis. It is interesting to note that mild, infrequent morning stiffness shows no age gradient and so lacks any correlation with the rheumatoid arthritis curve. This lack of correspondence reflects the very low true positive rate for mild, infrequent morning stiffness. It is also interesting to note that all the diagnostic findings either decrease or level off in males for the age group 65-74. This parallels the small decrease in the rheumatoid arthritis rates for males in this age group.

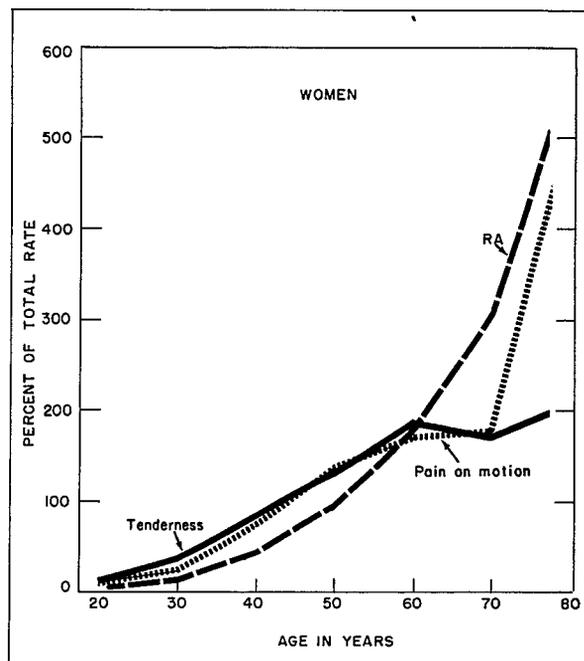


Figure 4. Prevalence of tenderness, pain on motion, and rheumatoid arthritis in women, divided by the total prevalence for all ages multiplied by 100, by age.

(100 percent equals average prevalence for all ages)

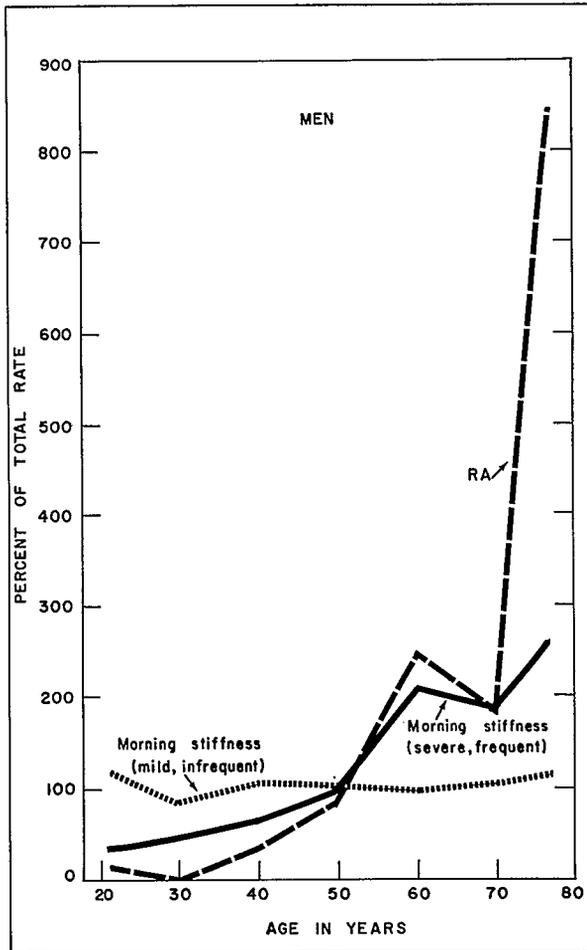


Figure 5. Prevalence of morning stiffness (severe, frequent), morning stiffness (mild, infrequent), and rheumatoid arthritis in men, divided by the total prevalence for all ages multiplied by 100, by age.
(100 percent equals average prevalence for all ages)

the rheumatoid examinees according to the ARA point count. It can be seen that a positive BFT is present in low frequencies in probable rheumatoid arthritis and in definite rheumatoid arthritis which has a point value of 5. Thus, only if the ARA point count is 6 or more is the percent with positive BFT very high. Some of the cases with a positive BFT found in the probable group with a point value of 3 are probably the result of a chance combination of individuals with other positive diagnostic findings of point value 2 coupled with a

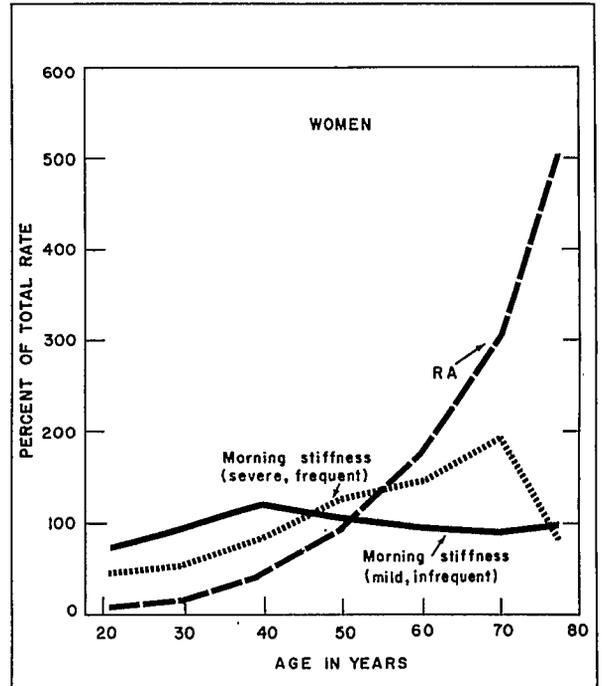


Figure 6. Prevalence of morning stiffness (severe, frequent), morning stiffness (mild, infrequent), and rheumatoid arthritis in women, divided by the total prevalence for all ages multiplied by 100, by age.
(100 percent equals average prevalence for all ages)

positive BFT due to factors other than rheumatoid arthritis. The overall prevalence of a positive BFT can therefore be expected to be more in a clinical group than in a population survey since the clinical group contains a much higher proportion of definite and classical cases of rheumatoid arthritis.

Findings by Age and Sex

On the basis of the survey findings it is estimated that of the 111.1 million adults in the United States aged 18-79 in 1960-62, 3.6 million had rheumatoid arthritis. This represents 3.2 percent of the adults in this age range. As classified by ARA criteria, 30 percent of these cases were definite or classical arthritis and 70 percent were probable cases of arthritis (table 2).

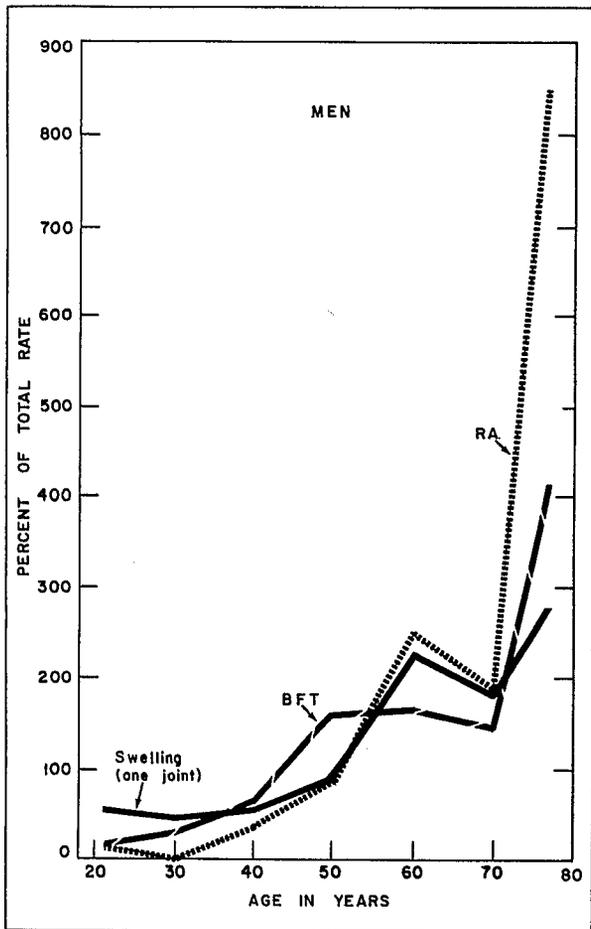


Figure 7. Prevalence of positive bentonite flocculation test, swelling in one joint, and rheumatoid arthritis in men, divided by the total prevalence for all ages multiplied by 100, by age. (100 percent equals average prevalence for all ages)

Rates for rheumatoid arthritis that are referred to in the remainder of this report are the sum of the rates for all cases designated as classical, definite, or probable by ARA classification.

In the Health Examination Survey the prevalence rate for females was 4.6 percent and that for males was 1.7 percent, giving a sex ratio of 2.7/1.

In females the prevalence of rheumatoid arthritis rose sharply with age, with the gradient becoming steeper in each older age group. In the age group 18-24 nearly 0.3 percent had rheuma-

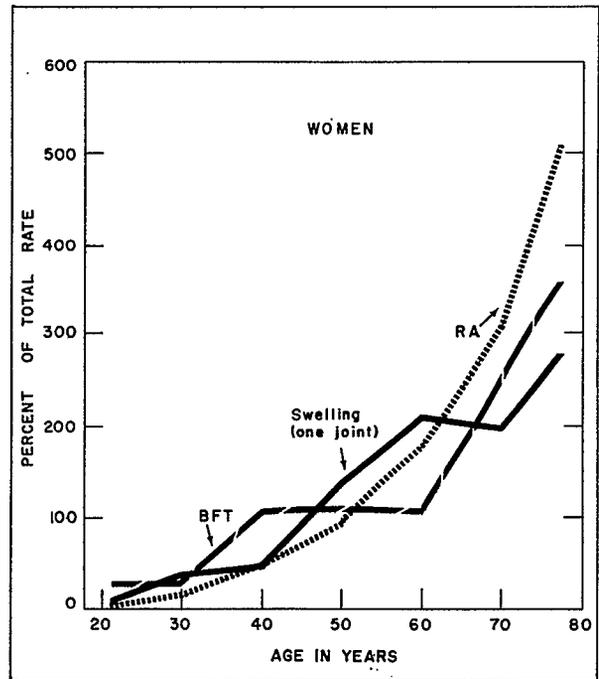


Figure 8. Prevalence of positive bentonite flocculation test, swelling in one joint, and rheumatoid arthritis in women, divided by the total prevalence for all ages multiplied by 100, by age. (100 percent equals average prevalence for all ages)

toid arthritis. By age 75-79 years 23.5 percent of the women had rheumatoid arthritis (tables 2 and 3).

In males the prevalence of rheumatoid arthritis also rose sharply with age. In the age group 18-24 only 0.2 percent had rheumatoid arthritis. By age 75-79 years 14.1 percent of the men had rheumatoid arthritis. In contrast to females, however, there was one age group (65-74 years) among males in which there was an actual decrease in prevalence when compared with the preceding age group. Although this decrease is not statistically significant, data from other studies (see page 8) and individual analysis of the diagnostic criteria (see page 6) support the likelihood of at least a leveling off of the rheumatoid arthritis rates for this age group.

Comparison of the HES findings in regard to distribution of rheumatoid arthritis by age and sex with those found in other surveys is of some interest. One of these was a survey made of the

population of the town of Tecumseh, Mich., in which 90 percent of all inhabitants over the age of 6 were examined.⁸ From this source, only data on persons aged 18-79 years—a total of 4,796 examinees—will be used for comparative purposes.⁹ The second was a survey of a sample of the population over the age of 15 in the towns of Leigh and Wensleydale, England, in which a total of 2,234 people were examined.¹⁰ The third was a large-scale survey of a sample of the population of 68 municipalities in the Netherlands. A total of 141,845 persons were first screened by a questionnaire, and the ones with rheumatic symptoms were examined.¹¹ The age group surveyed was from 15-64 years old. In all three surveys ARA criteria were employed in making the diagnoses of rheumatoid arthritis. However, the survey in the Netherlands counted only probable cases "with four criteria at hand" instead of the three criteria used in the other two surveys and in the Health Examination Survey. Even with the use of ARA criteria, observer differences may account for a major part of the differences in prevalence rates between different surveys. Sex and age differentials, however, are much less likely to be affected by observer differences or by variation in methods of examination.

The female/male sex ratio in the other surveys was as follows; Tecumseh, 3.8/1; Netherlands, 2.5/1; Leigh and Wensleydale, 2.4/1. The corresponding HES ratio was 2.7/1.

The trends by age reported by the three surveys were in general similar to those reported for the United States. In figures 9 and 10, rates from all four surveys are plotted as percentage of the total rate for male and female, respectively, at different age levels. For example, if the rate at ages 65-74 years was twice the total rate for all age groups combined, the rate for 65-74 would be plotted at 200 percent on the graph. Since the data for the Netherlands only went up to age 64, the total rate was less than it would have been had ages over 64 been included. This resulted in slightly increased percentages in the early age groups in the Netherlands as compared with the other groups.

For the males, three out of four surveys showed a decrease in prevalence starting just before the age of 60. This decrease took place about a decade earlier in the Tecumseh study

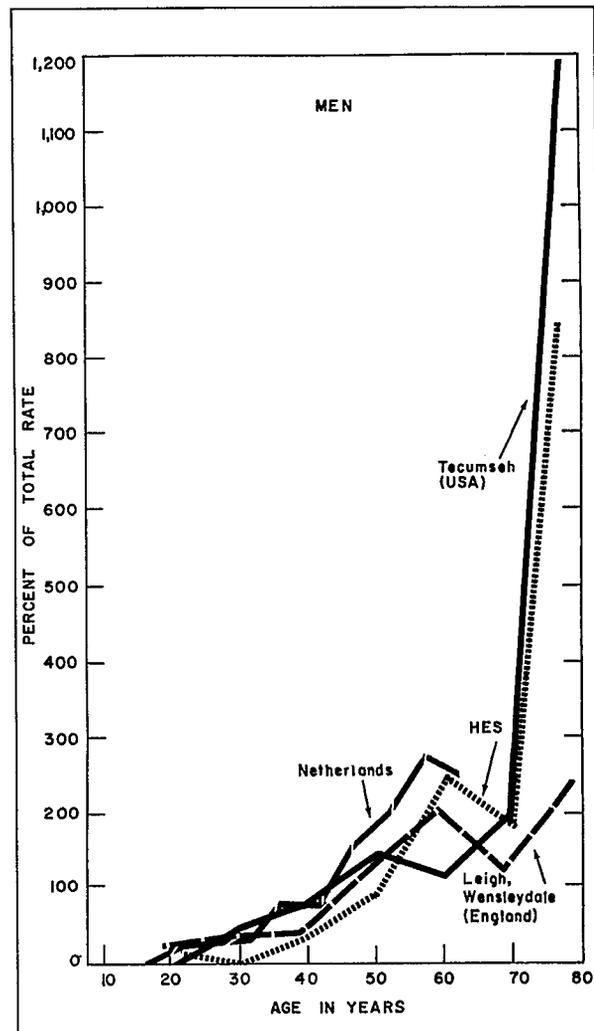


Figure 9. Prevalence of rheumatoid arthritis in men as reported in four surveys, divided by the total prevalence for all ages multiplied by 100, by age. (100 percent equals average prevalence for all ages)

than in the others. As noted previously, the prevalence of all diagnostic findings either decreased or leveled off for men in the age group 65-74. Therefore in males it is probable that there was no increase in prevalence of rheumatoid arthritis for the 65-74 age group. All three surveys with relevant data showed an increase in prevalence in the oldest age group. It must be noted, however, that the numbers of people examined in the oldest age group of each of these

three surveys (HES, Tecumseh, Leigh and Wensleydale) were not large.

In females the trend by age was quite similar in all study groups until about the age of 60. Then the prevalence either leveled off (Leigh and Wensleydale), decreased slightly and then increased slightly (Tecumseh), or increased steadily (HES). In the HES data it can be calculated that the rate for females aged 75-79 was significantly higher than that for ages 55-64. Since only a small number of people were examined in all three surveys in these older age groups, it is quite possible that differences in prevalences found in these groups among the three surveys were due to chance variation.

Demographic Variables

In the discussion that follows, the population is classified in a variety of ways—for instance, by race, by family income, by education—and the

prevalence of rheumatoid arthritis in different groups is compared. If the population is classified by family income, for example, the prevalence of rheumatoid arthritis in different income groups is examined to determine whether prevalence rates vary from one income group to another. In making these comparisons, allowances must be made for the differences from one group to another in the distribution of people by age and sex. Because the sampling variability of age-sex specific values for any group is usually large, a summary comparison by sex was thought preferable to the presentation of prevalence rates specific by age and sex. 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 age-sex distribution for that group. The obvious meaning can be attached to differences between actual and expected rates with the understanding that differences may arise by chance. A positive difference, for example, indicates that the prevalence rate for the group is higher than expected. Alternatively the data can be presented as a ratio of actual to expected rates. If the ratio is greater than 1.0 the actual rate is higher than expected. If the ratio is less than 1.0 the actual rate is less than expected. In general, where there is no statistically significant difference between the actual and expected values for a group, differences for individual age-specific groups exhibit only random fluctuations.

Race.—So far as can be judged from the data, the prevalence of rheumatoid arthritis was the same in white and Negro adults (table 4). The rates for nonwhite males other than Negroes were suggestively higher. In our sample the bulk of this group was composed of American Indians in Arizona. No reliable estimates can be made from this small sample as to the prevalence of rheumatoid arthritis in American Indians as a whole or in the other nonwhite non-Negro group. Of some interest are prevalence data for rheumatoid arthritis from a survey by Dr. Burch of 2,005 subjects in two Indian tribes, the Blackfoot and the Pima. In this survey the combined female/male

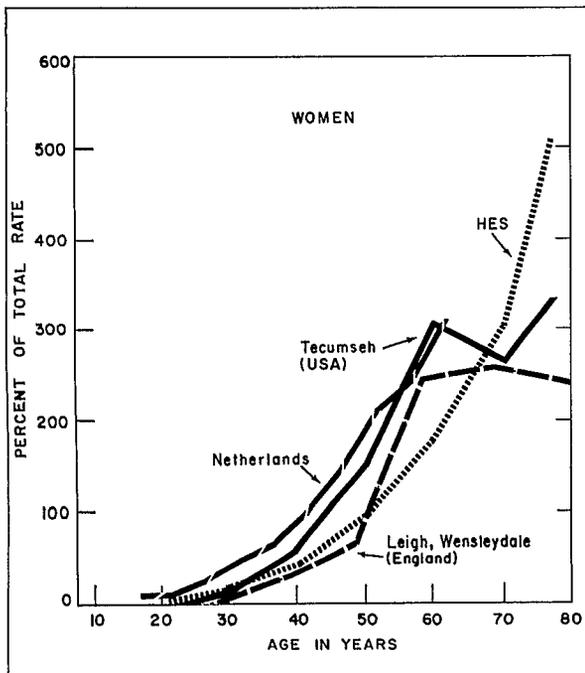


Figure 10. Prevalence of rheumatoid arthritis in women as reported in four surveys, divided by the total prevalence for all ages multiplied by 100, by age. (100 percent equals average prevalence for all ages)

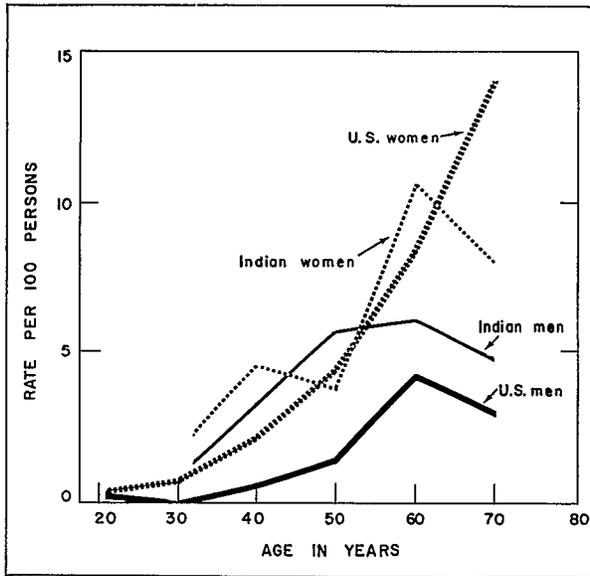


Figure 11. Prevalence of rheumatoid arthritis in Pima and Blackfoot Indians as compared with U.S. men and women, by age.

sex ratio was only 1.3/1 (fig. 11). At present there is no explanation available to account for the relatively high rheumatoid arthritis prevalence in males of this group.¹²

Residence.—There appears to be somewhat less rheumatoid arthritis in "other very large metropolitan areas" (population 500,000-3,000,000) and somewhat more in "other urban areas." These differences are statistically significant in females and are in the same direction but not significant in males (table 6). There were no other significant differences in rates whether classified by geographic region (table 5) or by place description (table 7). These various, somewhat confusing groupings are discussed in Appendix V, where all the demographic terms used in this report are defined.

The only other data available for comparison are provided by a survey of 68 municipalities in the Netherlands.¹¹ In it the lowest rates were found for both sexes in the largest towns (Amsterdam, Rotterdam, Hague, and Utrecht).

One must of necessity take into account the problem of observer differences when one evaluates place differences in rates. This is of especial importance in such diseases as rheuma-

toid arthritis, where the diagnosis is based largely on criteria directly observed by the physician. Significant differences in prevalence can conceivably be produced in different areas due to some consistent pattern of observers' differences. This possibility has been greatly minimized in the Health Examination Survey by the use of a large number of physicians (62) for conducting the examinations.

Another complicating factor in the survey was that the itinerary for HES was designed to avoid the South in summer and the North in winter. Thus if there are significant seasonal fluctuations in the prevalence of rheumatoid arthritis, the pattern of scheduling used in the survey fluctuations may have acted to cancel out regional differences.

Education and family income.—In men there was a distinct trend toward decreasing prevalence of rheumatoid arthritis with a higher level of education (table 8 and fig. 12). Men who had less than a fifth grade education had the highest rates, and men at the highest educational level had the lowest rates. For females no such trend existed, and the only significant finding was an elevation of the rheumatoid arthritis rate in those women with less than a fifth grade education.

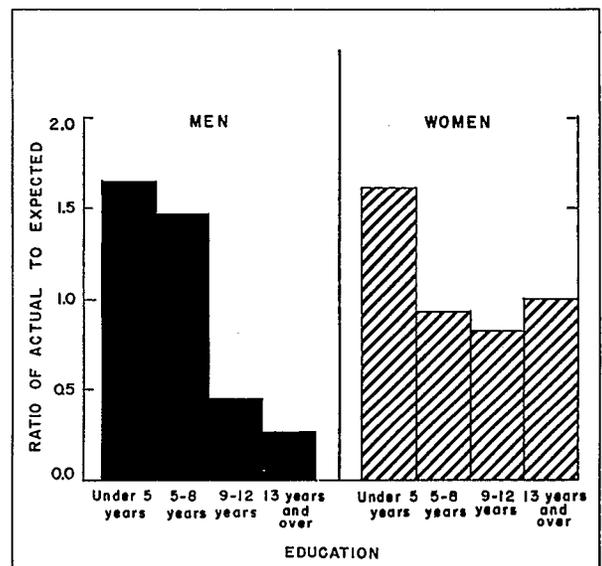


Figure 12. Ratio of actual to expected rate of rheumatoid arthritis in adults, by education.

For all the diagnostic findings in men, with the exception of the bentonite flocculation tests, an overall trend existed toward decreasing prevalence with increasing education (tables 9 and 10). A similar but less marked trend was also present for women. A positive BFT at dilutions of 1:512 or more (which are felt to be somewhat more highly diagnostic of rheumatoid arthritis than lower dilutions)¹³ had a low prevalence for the higher educational groups. It should also be noted that severe frequent morning stiffness showed a definite trend toward decreased prevalence with higher educational levels but mild, infrequent morning stiffness showed none. In general when both sexes are combined, diagnostic findings of greater diagnostic effectiveness for rheumatoid arthritis showed a more pronounced trend with education.

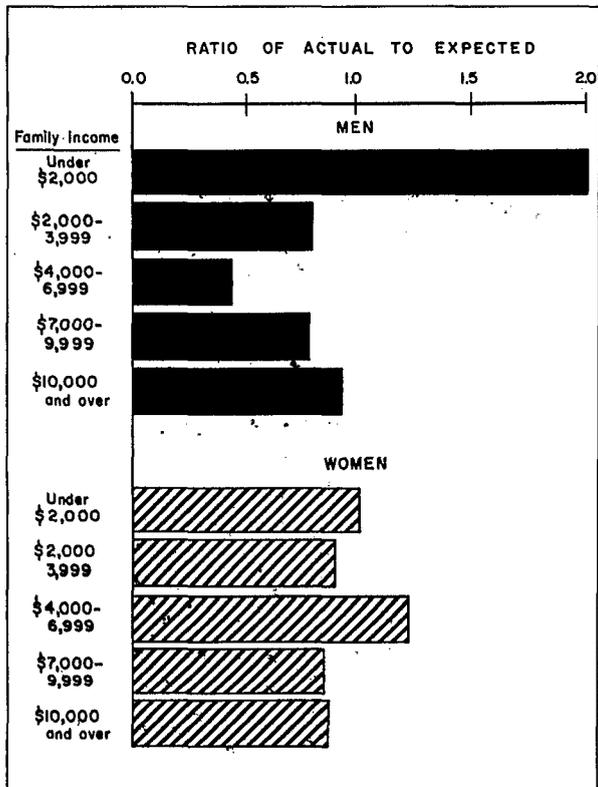


Figure 13. Ratio of actual to expected rate of rheumatoid arthritis in adults, by family income.

There appeared to be somewhat higher rates than expected for males with less than \$2,000 family income and somewhat lower rates than expected for those with \$4,000-\$6,999 family income. The distribution of rates in females was close to that expected, with exactly the expected rate for the income group under \$2,000 and even a slight increase (insignificant) in rate for the \$4,000-\$6,999 income group, which was the lowest for males (table 11 and fig. 13).

Findings for HES by education and income differed somewhat from the findings of King and Cobb in their survey of the Arsenal Health District in Pittsburgh.¹⁴ Although they reported an increased rate for females with a fifth grade education or lower, they found no difference in rates by education in males. As in the HES study the distribution of rates by income in females was close to that expected. For males there was a trend for lower rates with higher income. However, the data were not strictly comparable with those of HES, since only three income groups were reported in King and Cobb's study.

Of some interest is Cobb's finding of relatively higher rates when the educational level was low and the income high or when the educational level was high and the income was low. The HES data, when similarly cross-classified for education and income, show no such elevation in rates for either high education and low income or low education and high income. Using the same sort of indirect age adjustment as Cobb, the rates for the HES study were as follows:

Education	Income	
	Under \$4,000	\$4,000 and over
	Rate per 100 adults	
Under 5 years-----	5.8	4.9
5-8 years-----	3.8	3.2
9 years and over-----	2.1	2.6

Some of the differences in findings in the two surveys may have resulted from the use of an

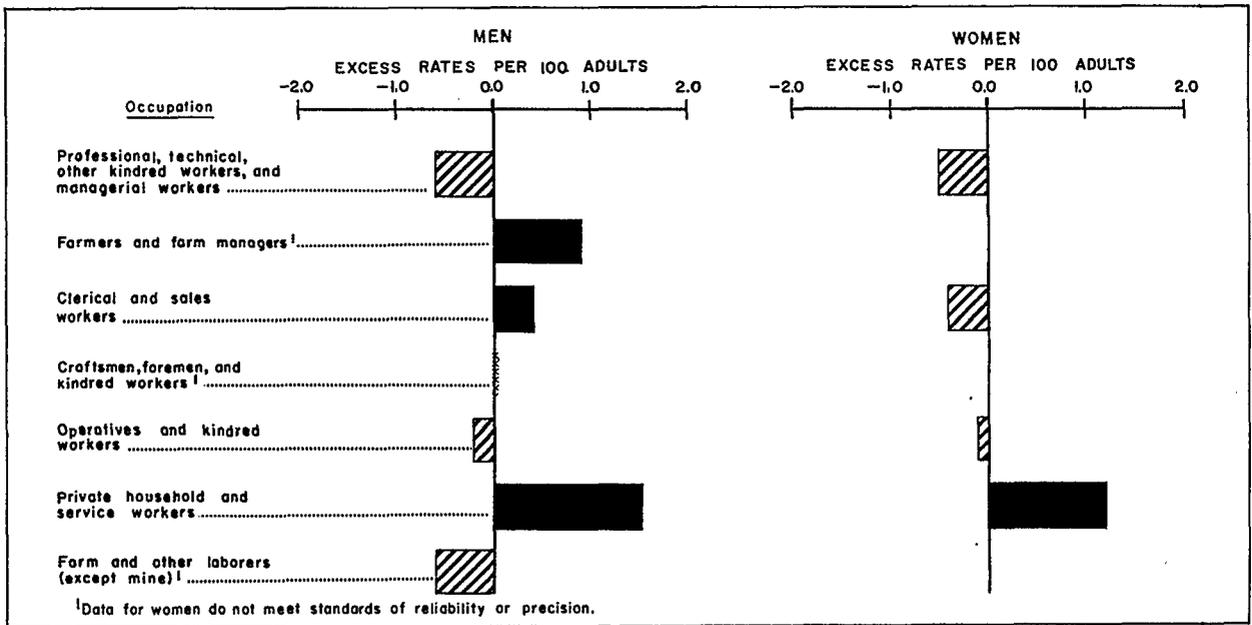


Figure 14. Excess of actual over expected prevalence of rheumatoid arthritis, by occupation and sex.

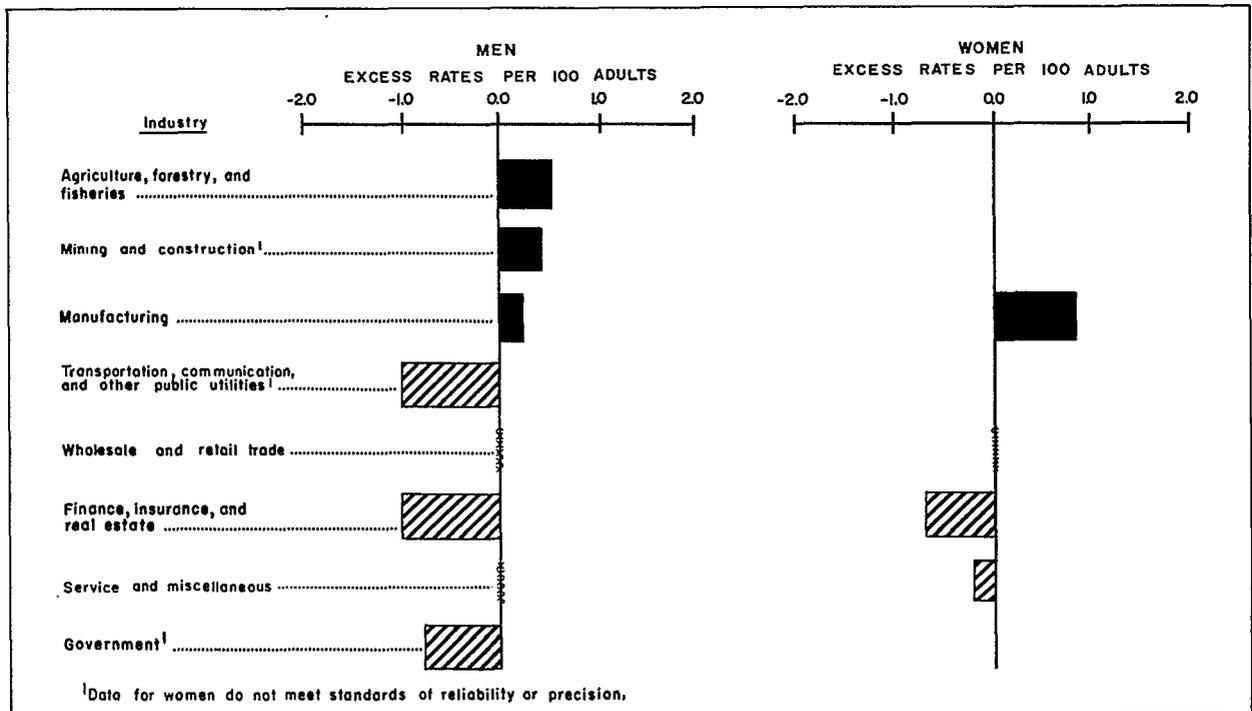


Figure 15. Excess of actual over expected prevalence of rheumatoid arthritis, by industry and sex.

"index of rheumatoid arthritis" by Cobb for the study of associations of the disease and environmental factors of interest. Cobb reported that his index had a sensitivity of 0.65 and a specificity of 0.95 for the diagnosis of rheumatoid arthritis. His Rheumatoid Arthritis Index is defined as a "yes" answer to all three of the following questions:

1. Have you ever had arthritis or rheumatism?
2. Have you ever had swelling in any joints?
3. Do you wake up with stiffness or aching in your joints and muscles?

As noted previously the HES technique was based on the use of the ARA diagnostic criteria, which may have produced somewhat different results from Cobb's diagnostic method.

Occupation, industry, and usual activity status.—Men engaged in managerial and technical occupations and in the professions had a lower than expected prevalence of rheumatoid arthritis (table 12 and fig. 14). Although there were no significant differences in particular industries taken individually, there was a strong suggestion of lower prevalence for men in industries with, in general, a lower proportion of persons working at jobs involving more than minimal physical activity. Thus there were no cases of rheumatoid arthritis found in men employed in government, finance, insurance, real estate, transportation, communication, and other public utilities (table 13 and fig. 15).

In regard to occupational data it is necessary to consider the importance of health status and in particular arthritis as a factor involved in change of occupational or retirement. Thus lower rates in working people may result from the removal of people with a disability from the labor force. On the other hand an individual with some degree of disability may be shifted to a "light job" and remain employed in the same industry. The rates for both men and women employees were suggestive of a low prevalence; however, these rates had too large a sampling variability for the differences among them to be deemed significant (table 14).

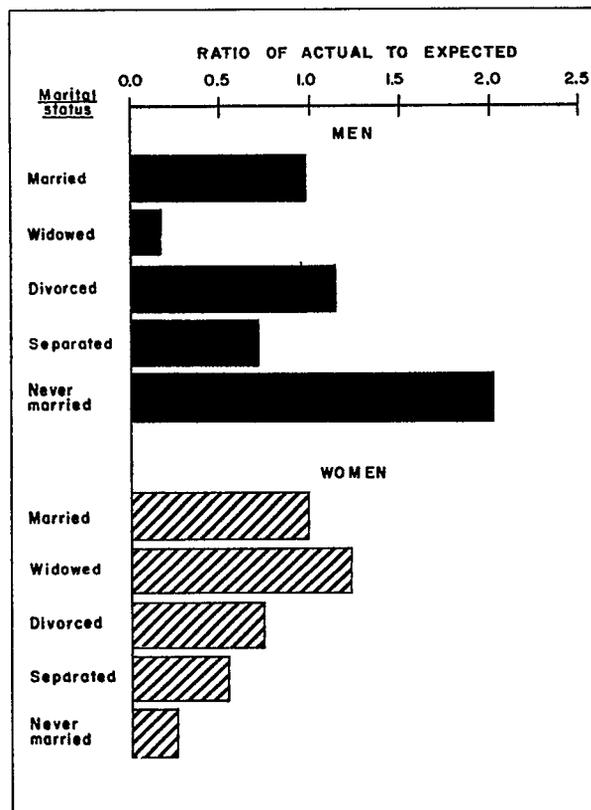


Figure 16. Ratio of actual to expected rate of rheumatoid arthritis, by marital status.

The only other data available for comparison on occupation and industry are provided by de Graaff's study in the Netherlands. In his study, male workers in agriculture had the highest rates, while professionals had the lowest rates. There were no significant differences in rates among employed females.¹¹

Marital status and number of children.—Widowed men and unmarried females had significantly less rheumatoid arthritis than expected (table 15 and fig. 16). After the age of 45 there appeared to be a significantly lower rate for women without children than for those with children (table 16). Contrary to Cobb's findings¹⁴ the rate for women with four or more children was generally not higher and was never significantly higher than for those with one to three children.

DISCUSSION

In the report on HES rheumatoid arthritis findings, data were presented indicating that rheumatoid arthritis prevalence rates by age and sex differentials are comparable to those reported for several other populations. The HES findings also indicate no significant differences in rates according to race or region of the United States.

In males there appeared to be significant variations in rates with regard to the demographic variables of education and, more equivocally, income, occupation, and industry. One possible factor acting to produce these variations may have been the relative frequency of minor trauma to joints associated with occupation and socioeconomic status. Although not definitely established, it is the belief of some observers that injury to a joint not infrequently appears to precipitate the onset of an inflammatory arthritis which later spreads to involve other joints and finally presents the features of rheumatoid arthritis.¹⁵

Conclusions drawn from this survey or any population survey using ARA criteria for diagnoses must be qualified by the extent that these criteria do in fact provide a valid diagnosis of rheumatoid arthritis. This is especially important for the category "probable rheumatoid arthritis,"¹⁶ in which fall 70 percent of all cases in the HES study. Moreover, it is probable that further study of rheumatoid arthritis will show that this diagnosis includes a variety of diseases which are of different etiology but which cannot be distinguished in the light of our present knowledge.

The HES findings in regard to the specific ARA criteria tend to show that they are not in fact of equal value in making a diagnosis of rheumatoid arthritis in a general population. Hence there would appear to be merit to the sug-

gestions of other investigators that efforts be made to establish appropriate weights for each one of the diagnostic criteria.¹⁷

Some final caveats are in order. The sample size used for the Health Examination Survey leads to numerous statistics with high sampling variability. Thus, many of the demographic differentials indicated in this report should be regarded as suggestive rather than proved. Most demographic labels are crude indexes, only the first steps to an investigation. Furthermore, the variables on which the data have been classified are more or less correlated (education, for instance, is highly correlated with occupation). If the sample had been larger, more detailed cross-classification would have been appropriate.

SUMMARY

Some 3.6 million adults aged 18-79 years had rheumatoid arthritis. Rheumatoid arthritis is rare among young adults in the United States but becomes increasingly common at older ages. It is more prevalent in women than in men. Negro and white persons are about equally likely to have the disease.

Men with more education have lower rates than men with less education. In occupational terms, men in the professions and in technical and managerial fields have relatively low rheumatoid arthritis rates.

There are no well-defined differences in prevalence evident by place of residence except for a somewhat lower rate for metropolitan areas with populations of 500,000 to 3,000,000 and a somewhat increased rate for urban areas not associated with standard metropolitan statistical areas.

Rheumatoid arthritis is less prevalent in widowed men and unmarried females than in persons of other marital status.

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Table 1. Prevalence of diagnostic findings for rheumatoid arthritis in adults, by sex and age: United States, 1960-62

Sex and age	Morning stiffness (severe, frequent)	Morning stiffness (mild, infrequent)	Tenderness	Pain on motion	Positive X-ray	Positive BFT	Swelling, one joint	Symmetrical swelling
<u>Men</u>	Percent of specified population group							
Total, 18-79 years-	4.25	13.12	9.36	1.92	0.97	3.41	1.70	0.93
18-24 years-----	1.46	15.24	3.07	0.15	-	0.52	0.88	-
25-34 years-----	1.95	10.89	5.95	0.16	-	1.01	0.74	-
35-44 years-----	2.78	13.78	8.30	1.90	0.17	2.23	0.91	0.47
45-54 years-----	4.17	13.14	8.64	2.15	0.54	5.41	1.53	0.38
55-64 years-----	8.78	12.71	15.85	4.22	2.36	5.54	3.79	2.27
65-74 years-----	7.68	13.36	15.66	4.38	1.61	4.89	3.01	1.52
75-79 years-----	11.14	14.64	22.81	1.12	12.39	13.94	4.68	10.58
<u>Women</u>								
Total, 18-79 years-	8.43	16.46	17.50	3.38	0.64	3.48	1.79	3.06
18-24 years-----	3.98	12.10	3.02	0.55	-	0.89	0.14	0.27
25-34 years-----	4.31	16.25	6.43	0.77	-	0.94	0.69	0.33
35-44 years-----	6.98	19.81	14.29	2.52	0.46	3.56	0.78	1.43
45-54 years-----	10.58	17.35	23.58	4.66	0.94	3.75	2.48	2.05
55-64 years-----	12.40	16.06	32.45	5.74	0.43	3.72	3.76	5.29
65-74 years-----	16.29	15.14	29.85	5.89	2.07	8.67	3.58	10.59
75-79 years-----	7.19	16.51	34.43	14.36	2.34	12.33	4.93	17.13

Table 2. Prevalence of classical, definite, and probable rheumatoid arthritis in adults, by sex and age: United States, 1960-62

Sex and age	Total	Classical	Definite	Probable
<u>Both sexes</u>		Rate per 100 adults		
Total, 18-79 years-----	3.2	0.2	0.8	2.3
<u>Men</u>				
Total, 18-79 years-----	1.7	0.2	0.3	1.1
18-24 years-----	0.2	-	-	0.2
25-34 years-----	-	-	-	-
35-44 years-----	0.5	-	-	0.5
45-54 years-----	1.5	-	0.2	1.3
55-64 years-----	4.2	0.4	1.6	2.2
65-74 years-----	3.1	-	0.2	2.9
75-79 years-----	14.1	6.7	1.5	5.9
<u>Women</u>				
Total, 18-79 years-----	4.6	0.2	1.2	3.3
18-24 years-----	0.3	-	-	0.3
25-34 years-----	0.6	-	0.1	0.6
35-44 years-----	2.1	0.2	0.7	1.1
45-54 years-----	4.4	0.2	0.8	3.4
55-64 years-----	8.3	0.3	2.1	5.9
65-74 years-----	14.1	0.5	4.1	9.5
75-79 years-----	23.5	-	6.2	17.2

NOTE: Age-specific rates are subject to high sampling variability but are included to suggest trends and differentials.

Table 3. Prevalence of rheumatoid arthritis in adults, by sex and age: United States, 1960-62

Age	Both sexes	Men	Women
	Number of adults in thousands		
Total, 18-79 years-----	3,591	895	2,696
18-24 years-----	39	16	23
25-34 years-----	71	-	71
35-44 years-----	314	61	253
45-54 years-----	613	149	464
55-64 years-----	988	315	673
65-74 years-----	1,026	152	874
75-79 years-----	540	202	338
	Rate per 100 adults		
Total, 18-79 years-----	3.2	1.7	4.6
18-24 years-----	0.3	0.2	0.3
25-34 years-----	0.3	-	0.6
35-44 years-----	1.3	0.5	2.1
45-54 years-----	3.0	1.5	4.4
55-64 years-----	6.3	4.2	8.3
65-74 years-----	9.2	3.1	14.1
75-79 years-----	18.8	14.1	23.5

Table 4. Actual and expected prevalence rates of rheumatoid arthritis in adults, by sex and race: United States, 1960-62

Race	Men				Women			
	Actual	Expected	Difference	$\frac{\text{Actual}}{\text{Expected}}$	Actual	Expected	Difference	$\frac{\text{Actual}}{\text{Expected}}$
	Rate per 100 adults							
White-----	1.7	1.7	0.0	0.97	4.6	4.7	-0.1	0.98
Negro-----	1.5	1.6	-0.1	0.94	4.7	4.0	0.7	1.17
Other-----	4.2	0.8	3.4	5.00	5.3	3.2	2.1	1.65

Table 5. Actual and expected prevalence rates of rheumatoid arthritis in adults, by sex and geographic region: United States, 1960-62

Region	Men				Women			
	Actual	Expected	Difference	$\frac{\text{Actual}}{\text{Expected}}$	Actual	Expected	Difference	$\frac{\text{Actual}}{\text{Expected}}$
	Rate per 100 adults							
Northeast---	1.4	1.6	-0.2	0.87	4.7	4.7	0.0	0.99
South-----	1.6	1.6	-	1.00	4.8	4.3	0.5	1.11
West-----	2.1	1.9	0.2	1.11	4.4	4.8	-0.4	0.92

Table 6. Actual and expected prevalence rates of rheumatoid arthritis in adults, by sex and population-size groups: United States, 1960-62

Population-size group	Men				Women			
	Actual	Expected	Difference	$\frac{\text{Actual}}{\text{Expected}}$	Actual	Expected	Difference	$\frac{\text{Actual}}{\text{Expected}}$
	Rate per 100 adults							
Giant metropolitan areas-----	1.7	1.7	-	1.00	4.4	4.7	-0.3	-0.92
Other very large metropolitan areas-----	1.2	1.7	-0.5	0.70	2.6	4.5	-1.9	0.58
Other standard metropolitan statistical areas-----	1.3	1.6	-0.3	0.80	4.6	4.5	0.1	1.01
Other urban areas-----	2.5	1.6	0.9	1.53	8.2	4.2	4.0	1.96
Rural areas-----	1.7	1.8	-0.1	0.97	3.4	5.1	-1.7	0.67

Table 7. Actual and expected prevalence rates of rheumatoid arthritis, by sex and place description: United States, 1960-62

Place description	Men				Women			
	Actual	Expected	Difference	$\frac{\text{Actual}}{\text{Expected}}$	Actual	Expected	Difference	$\frac{\text{Actual}}{\text{Expected}}$
	Rate per 100 adults							
SMSA-in central city-----	1.2	1.9	-0.7	0.63	4.4	4.9	-0.5	0.89
SMSA-outside central city-----	1.6	1.5	0.1	1.13	3.9	4.3	-0.4	0.92
Urban, not SMSA-----	2.0	1.5	0.5	1.37	6.9	4.3	2.6	1.61
Rural farm-----	2.4	2.1	0.3	1.15	5.9	4.6	1.3	1.28
Rural nonfarm-----	2.1	1.8	0.3	1.17	3.9	5.0	-1.1	0.78

Table 8. Actual and expected prevalence rates of rheumatoid arthritis, by sex and education: United States, 1960-62

Education	Men				Women			
	Actual	Ex-pected	Differ-ence	<u>Actual</u> Ex-pected	Actual	Ex-pected	Differ-ence	<u>Actual</u> Ex-pected
	Rate per 100 adults							
Under 5 years-----	5.5	3.3	2.2	1.65	13.3	8.2	5.1	1.61
5-8 years-----	3.9	2.7	1.2	1.46	6.3	6.7	-0.4	0.94
9-12 years-----	0.5	1.1	-0.6	0.45	2.7	3.3	-0.6	0.83
13 years and over-----	0.3	1.1	-0.8	0.26	3.8	3.7	0.1	1.02

Table 9. Ratio of actual to expected rates of positive diagnostic findings in adults, by sex and education: United States, 1960-62

Sex and education	Morning stiffness (severe, frequent)	Tender-ness	Pain on motion	Swelling, one joint	Swelling, two joints	Symmet-rical swelling	Posi-tive X-ray	BFT 1:32 or more	BFT 1:512 or more	Morning stiffness (mild, infrequent)
	Ratio of actual to expected rates									
<u>Both sexes</u>										
Under 5 years--	1.52	1.16	1.25	1.52	2.02	1.59	1.36	0.85	1.28	1.00
5-8 years-----	1.17	1.08	1.25	0.97	1.14	1.09	1.21	1.22	1.79	0.83
9-12 years-----	0.90	1.01	1.00	1.01	0.35	0.79	0.84	0.75	0.39	1.07
13 years and over-----	0.62	0.70	0.45	0.61	0.54	0.82	0.37	1.26	0.20	1.02
<u>Men</u>										
Under 5 years--	1.95	1.24	1.11	1.17	2.24	1.91	0.84	0.69	1.51	0.92
5-8 years-----	1.26	1.16	1.12	0.96	1.02	1.44	1.41	1.10	1.63	0.86
9-12 years-----	0.77	0.94	1.20	1.10	0.39	0.29	0.78	0.80	0.13	1.15
13 years and over-----	0.36	0.68	0.43	0.60	0.00	0.25	0.35	1.34	0.33	0.88
<u>Women</u>										
Under 5 years--	1.30	1.12	1.32	1.80	1.68	1.49	2.38	1.00	0.77	1.07
5-8 years-----	1.11	1.04	1.32	0.99	1.34	0.97	0.84	1.34	2.16	0.81
9-12 years-----	0.94	1.04	0.91	0.94	0.33	0.89	0.94	0.72	0.66	1.03
13 years and over-----	0.75	0.70	0.46	0.61	1.23	0.97	0.37	1.17	0.00	1.15

Table 10. Percent of adults having positive diagnostic findings, by sex and education: United States, 1960-62

Sex and education	Morning stiffness (severe, frequent)	Tenderness	Pain on motion	Swelling, one joint	Swelling, two joints	Symmetrical swelling	Positive X-ray	BFT 1:32 or more	BFT 1:512 or more	Morning stiffness (mild, infrequent)
Percent of adults										
<u>Both sexes</u>										
Under 5 years--	13.1	21.4	4.9	3.9	1.0	6.2	2.2	4.4	1.5	14.8
5-8 years-----	9.1	18.3	4.4	2.3	0.5	3.3	1.6	5.5	1.8	12.4
9-12 years-----	5.1	11.8	2.2	1.4	0.1	1.1	0.4	2.1	0.2	16.1
13+ years-----	3.4	8.2	1.0	0.9	0.1	1.2	0.2	3.5	0.1	14.9
<u>Men</u>										
Under 5 years--	12.1	15.7	3.1	2.9	1.3	3.7	1.8	3.6	2.6	12.1
5-8 years-----	7.0	13.4	2.9	2.1	0.5	2.2	2.3	5.0	2.3	11.3
9-12 years-----	2.6	7.4	1.8	1.5	0.1	0.2	0.4	2.2	0.1	15.1
13+ years-----	1.3	5.6	0.7	0.8	0.0	0.1	0.2	3.5	0.2	11.4
<u>Women</u>										
Under 5 years--	14.1	26.6	6.6	4.9	0.7	8.5	2.6	5.2	0.5	17.4
5-8 years-----	11.3	23.1	5.9	2.4	0.5	4.4	0.7	6.0	1.2	13.5
9-12 years-----	7.0	15.3	2.5	1.3	0.1	1.9	0.4	2.1	0.3	17.0
13+ years-----	5.8	11.1	1.3	1.0	0.3	2.3	0.2	3.5	0.0	18.8

Table 11. Actual and expected prevalence rates of rheumatoid arthritis in adults, by sex and family income: United States, 1960-62

Family income	Men				Women			
	Actual	Expected	Difference	<u>Actual</u> Expected	Actual	Expected	Difference	<u>Actual</u> Expected
Rate per 100 adults								
Under \$2,000-----	6.6	3.3	3.3	2.01	7.2	7.2	0.0	1.00
\$2,000-\$3,999-----	1.5	2.0	-0.5	0.78	4.3	4.8	-0.5	0.90
\$4,000-\$6,999-----	0.6	1.2	-0.6	0.44	4.1	3.4	0.7	1.22
\$7,000-\$9,999-----	0.9	1.1	-0.2	0.77	3.1	3.6	-0.5	0.85
\$10,000 and over-----	1.4	1.5	-0.1	0.92	3.6	4.1	-0.5	0.87
Unknown-----	0.7	1.7	-1.0	0.39	6.0	5.7	0.3	1.06

Table 12. Actual and expected prevalence rates of rheumatoid arthritis in adults, by sex and occupation: United States, 1960-62

Sex and occupation	Actual	Expected	Difference	$\frac{\text{Actual}}{\text{Expected}}$
<u>Men</u>				
	Rate per 100 adults			
Professional, technical, and managerial-----	0.5	1.1	-0.6	0.47
Farmers and farm managers-----	2.7	1.8	0.9	1.50
Clerical and sales workers-----	1.4	1.0	0.4	1.38
Craftsmen, foremen, and kindred workers-----	1.1	1.1	-	1.00
Operatives and kindred workers-----	0.6	0.8	-0.2	0.72
Private household and service workers-----	2.8	1.3	1.5	2.25
Farm and other laborers (except mine)-----	0.5	1.1	-0.6	0.50
<u>Women</u>				
Professional, technical, and managerial-----	2.5	3.0	-0.5	0.82
Clerical and sales workers-----	2.0	2.4	-0.4	0.81
Operatives and kindred workers-----	3.1	3.2	-0.1	0.95
Private household and service workers-----	5.1	3.9	1.2	1.31

Table 13. Actual and expected prevalence rates of rheumatoid arthritis in adults, by sex and industry: United States, 1960-62

Sex and industry	Actual	Expected	Difference	<u>Actual</u> Expected
<u>Men</u>				
Rate per 100 adults				
Agriculture, forestries, and fisheries-----	2.0	1.5	0.5	1.29
Mining and construction-----	1.5	1.1	0.4	1.40
Manufacturing-----	1.2	1.0	0.2	1.20
Transportation, communication, and other public utilities-----	0.0	1.0	-1.0	0.00
Wholesale and retail trade-----	1.0	1.0	0.0	1.06
Finance, insurance, and real estate-----	0.0	1.0	-1.0	0.00
Service and miscellaneous-----	1.2	1.2	0.0	1.06
Government-----	0.0	0.8	-0.8	0.00
<u>Women</u>				
Agriculture, forestries, and fisheries-----	3.0	3.0	0.0	1.00
Manufacturing-----	3.7	2.9	0.8	1.28
Wholesale and retail trade-----	2.9	2.9	-	1.00
Finance, insurance, and real estate-----	2.1	2.8	-0.7	0.75
Service and miscellaneous-----	3.3	3.5	-0.2	0.94

Table 14. Actual and expected prevalence rates of rheumatoid arthritis in adults, by sex and usual activity status: United States, 1960-62

Sex and usual activity status	Actual	Expected	Difference	<u>Actual</u> Expected
<u>Men</u>				
Rate per 100 adults				
Usually working-----	1.0	1.2	-0.2	0.77
Retired-----	6.8	5.9	0.9	1.16
Other-----	2.9	1.3	1.6	2.20
<u>Women</u>				
Usually working-----	2.8	3.6	-0.8	0.76
Keeping house-----	5.5	5.1	0.4	1.07
Other-----	3.1	2.1	1.0	1.46

Table 15. Actual and expected prevalence rates of rheumatoid arthritis in adults, by sex and marital status: United States, 1960-62

Marital status	Men				Women			
	Actual	Expected	Difference	$\frac{\text{Actual}}{\text{Expected}}$	Actual	Expected	Difference	$\frac{\text{Actual}}{\text{Expected}}$
	Rate per 100 adults							
Married-----	1.7	1.7	0.0	0.99	3.8	3.9	-0.1	0.99
Widowed-----	0.9	5.4	-4.5	0.17	13.9	11.4	2.5	1.22
Divorced-----	2.5	2.2	0.3	1.14	3.5	4.7	-1.2	0.73
Separated-----	1.1	1.6	-0.5	0.71	1.6	3.0	-1.4	0.54
Never married---	1.7	0.8	0.9	2.02	0.6	2.1	-1.5	0.26

Table 16. Prevalence rates of rheumatoid arthritis in women, by number of children and age: United States, 1960-62

Age	Number of children		
	0	1-3	4 or more
	Rate per 100 women		
18-24 years-----	-	0.4	-
25-34 years-----	0.9	0.5	1.1
35-44 years-----	2.9	2.3	1.8
45-54 years-----	2.4	4.7	5.6
55-64 years-----	4.0	9.3	11.4
65-74 years-----	11.5	15.5	15.8
75-79 years-----	14.3	28.1	25.0

APPENDIX I

ITEMS ON THE MEDICAL HISTORY RELATING TO ARTHRITIS

27. a. Have you ever had morning stiffness, or weakness when you get up? YES NO ?

If YES b. How often? Every few days Less often

c. Does it bother you quite a bit just a little

28. a. How about swelling of the joints? Have you noticed anything like that? YES NO ?

If YES b. How often? Every few days Less often

c. Does it bother you quite a bit just a little

29. a. How about pain in the joints? Have you noticed anything like that? YES NO ?

If YES b. How often? Every few days Less often

c. Does it bother you quite a bit just a little

30. a. How about tenderness of the joints? Have you noticed anything like that? YES NO ?

If YES b. How often? Every few days Less often

c. Does it bother you quite a bit just a little

61. a. Have you ever had any reason to think you may have rheumatism or arthritis? YES NO ?

If YES or ? b. Did a doctor tell you it was rheumatism or arthritis? YES NO

c. How long ago did you first start having it?

1 year 1-5 years over 5 years

d. Have you had it in the past 12 months? YES NO ?

e. Do you take any pills or medicine for it? YES NO ?

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64. Has a doctor ever said you had gout? YES NO

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APPENDIX II

FORM USED IN RECORDING FINDINGS ON THE PHYSICAL EXAMINATION OF THE JOINTS

SUMMARY OF JOINT INVOLVEMENT						
Joints	MANIFESTATIONS					
	Tender	Swelling	Deformity	Limitation	Other ¹	Code
51. Shoulder						
52. Elbow						
53. Wrist						
54. Metacarpo- phalangeal						
55. Proximal- inter- phalangeal						
56. Distal- inter- phalangeal						
57. Hip						
58. Knee						
59. Ankle						
60. Feet						
61. Cervical spine						
62. Lumbar spine						
63. Other*						

Record positive findings as R for right, L for left, RL for both, except for spine (Items 61 and 62) which should be check marked.

Fingers (Items 54, 55, and 56): Record total number of joints involved on right or left.

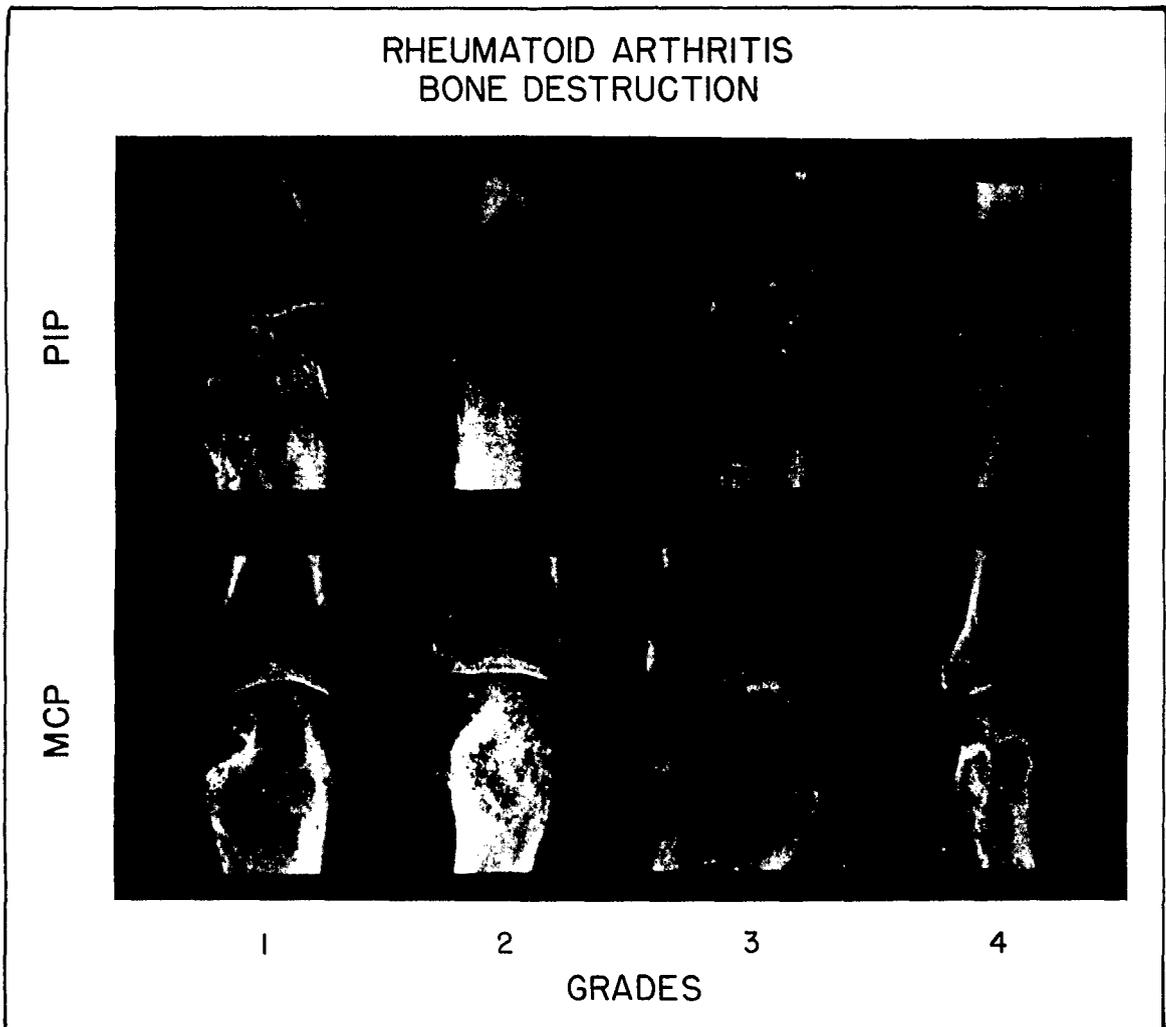
¹"Other" manifestations include Heberden's nodes, subcutaneous nodules, ulnar deviation, pain on motion, heat, atrophy, and funnel fist.

*"Other" joints include temporomandibular, sternoclavicular, sacroiliac, and specific joints of the feet.

APPENDIX III

REFERENCE X-RAY PLATES

The following X-rays show gradings of rheumatoid arthritis bone destruction in the metacarpophalangeal (MCP), proximal interphalangeal (PIP), and metatarsophalangeal (MTP) joints of the hands and feet. The radiograph series is from the Clinical Center, National Institutes of Health.



RHEUMATOID ARTHRITIS BONE DESTRUCTION

THUMB

PIP

GREAT TOE



MTP-I

MTP



1

2

3

4

GRADES

APPENDIX IV

EFFECTIVENESS OF DIAGNOSTIC CRITERIA

Some estimates of the effectiveness of the diagnostic criteria are given in figure I and table I. Figure I shows the true positive rates for the various diagnostic findings. A "true positive" is defined in this survey as any individual who is included in the classical, definite, or positive rheumatoid arthritis group. Table I gives the prevalence rate in percentages of each diagnostic finding in both the rheumatoid and nonrheumatoid

populations. The prevalence rates in the rheumatoid population represent the sensitivity of the diagnostic findings. Specificities and true positive rates for the diagnostic findings are also given in the table. Since extra weight had already been assigned to symmetrical swelling and swelling in two joints, no true positive rate or specificity was calculated for either of these findings. Sensitivity is the chance of finding a true case, and

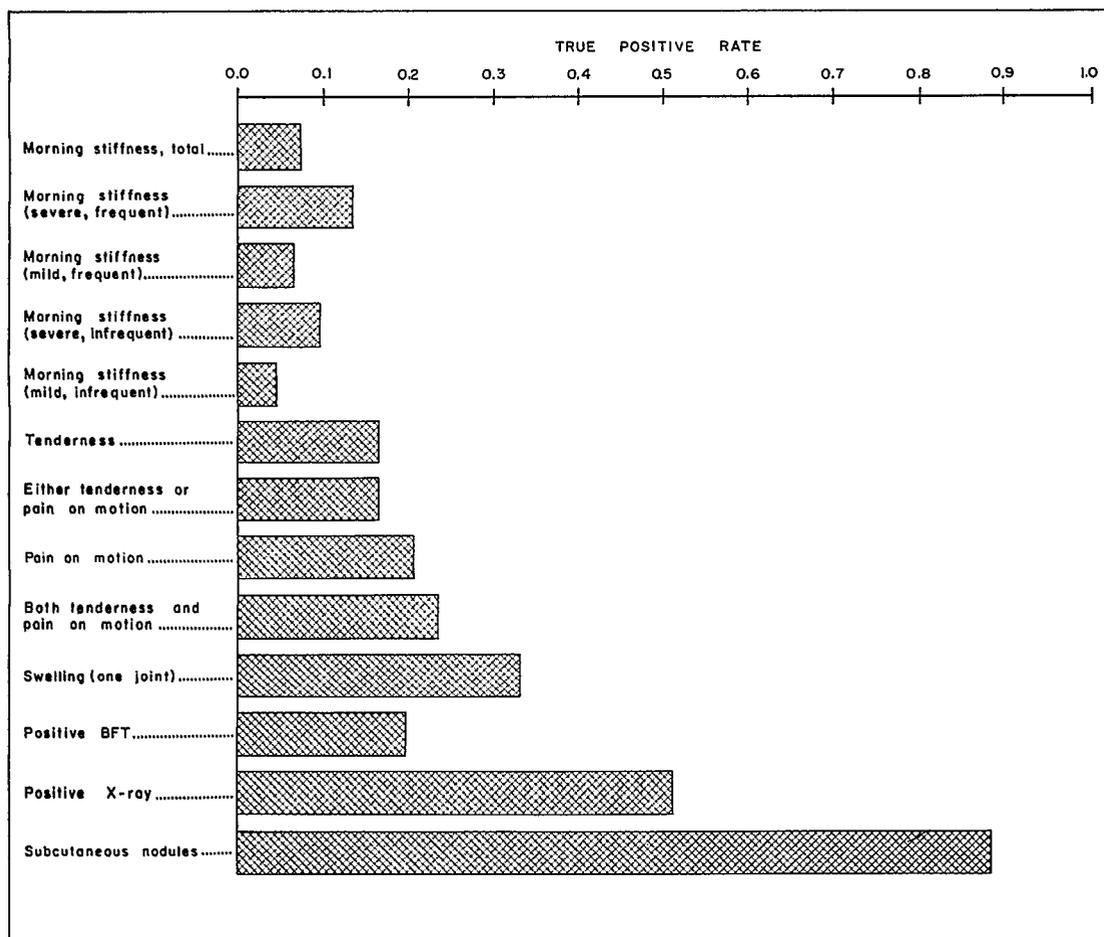


Figure I. True positive rates, by diagnostic findings.

Table I. Prevalence rate in percentages of each diagnostic finding in both the rheumatoid and nonrheumatoid populations: Heath Examination Survey, 1960-62

Diagnostic finding	Percent in non-rheumatoid population	Percent in rheumatoid population (sensitivity)	True positive rate (percent)	Specificity (percent)
Morning stiffness, total-----	26.8	65.7	7.2	73.2
Severe and frequent-----	6.2	30.4	13.4	...
Mild and frequent-----	4.4	9.3	6.3	...
Severe and infrequent-----	1.7	5.9	9.8	...
Mild and infrequent-----	14.6	20.1	4.2	...
Tenderness-----	11.8	72.1	16.1	88.2
Pain on motion-----	2.2	17.6	20.0	97.8
Either tenderness or pain on motion-----	12.8	77.9	16.1	87.2
Both tenderness and pain on motion-----	1.3	11.8	22.9	98.7
Swelling, one joint-----	1.2	18.1	33.0	98.8
Swelling, two joints-----	0.1	8.8
Symmetrical swelling-----	0.0	62.3
Postive bentonite flocculation test-----	2.6	19.6	19.4	97.4
Positive X-ray-----	0.3	11.3	54.8	99.7
Subcutaneous nodules-----	*	*	*	*

specificity is the chance of correctly identifying a healthy person.

As can be seen from table II, all three indexes, i.e., sensitivity, specificity, and true positive rate, are derived from two factors. Factor I involves the correct diagnosis of a case as rheumatoid arthritis, and factor II involves the determination of the presence or absence of a particular diagnostic finding. Diagnostic errors in factor I and labeling errors in factor II will of necessity

result in some alteration of the values for the three indexes. Nevertheless it is likely that the values for the indexes detailed in table I give at least a rough approximation of the true picture.

It is interesting to compare some of these findings with the specificities found in the clinical material on which the original formulation of the ARA criteria were based¹⁸ (table III). Naturally, in a population study,

Table II. Derivation of sensitivity, specificity, and true positive rates

Diagnostic finding	Rheumatoid arthritis	Not rheumatoid arthritis
Diagnostic finding present-----	a	c
Diagnostic finding absent-----	b	d

$$\text{Sensitivity} = \frac{a}{a+b} \quad \text{Specificity} = \frac{d}{c+d}$$

$$\text{True positive rate} = \frac{a}{a+c}$$

Table III. Specificities in percent

Diagnostic finding	ARA clinical cases	HES population study
Morning stiffness, total-----	38	73.1
Morning stiffness (severe and frequent only)-----	---	93.8
Either tenderness or pain on motion-----	14	87.3
Joint swelling-----	41	98.8
X-ray changes-----	72	99.7
Subcutaneous nodules-----	95	99.9

where there are many people entirely free from joint complaints, the specificities are higher than in a clinical practice, where everyone coming under observation thinks he has some joint complaint. Therefore the diagnostic effectiveness of diagnostic findings of high specificity in population studies might more readily be ascertained by comparing their true positive rates (table I). With this difficulty in the use of specificities taken into account, the specificities reported by Ropes, and others,¹⁸ still roughly correspond in rank order of magnitude to those found in the HES.

The major discrepancy is the finding of a greater specificity in the clinical group for morning stiffness than for pain on motion and/or tenderness, which is a reversal of the HES finding. This reversal may be explained by the fact that the Health Examination Survey

did not specify any particular time interval for the duration of morning stiffness. Burch found in a population study that morning stiffness lasting less than 10 minutes had no association with rheumatoid arthritis.¹³ In a study by Abramson and others 324 out of 758 answered "yes" to the interview question "Do you wake up with stiffness or aching in joints or muscles?" Of these answering yes only 19 percent were recorded by a clinician as having genuine morning stiffness.¹⁹ Thus evaluation by a clinician probably acted to increase the specificity for morning stiffness in the original ARA clinical group. One can also note that more than half of all the morning stiffness found by HES was mild and infrequent. As noted previously this minimal morning stiffness had a very low true positive rate for rheumatoid arthritis.



APPENDIX V

DEMOGRAPHIC TERMS

Age.—The age recorded for each person is the age at last birthday. Age is recorded in single years.

Race.—Race is recorded as "white," "Negro," or "other." "Other" includes American Indian, Chinese, Japanese, and so forth. Mexican persons are included with "white" unless definitely known to be Indian or of another nonwhite race.

Population size.—The five classes comprising this characteristic were derived from the design of the sample, which accomplished a stratification of the primary sampling units by population size in each of three broad geographic locations. Because the survey was started in 1960, the primary sampling units within each of the five population-size classes were necessarily based on populations and definitions of the 1950 census. The name of each selected primary sampling unit within each population-size class and geographic location, along with other selected sample data, is presented in an earlier report.³

The definitions for each of the five population-size classes are as follows:

Giant metropolitan areas.—This class includes primary sampling units defined in the census as standard metropolitan statistical areas (SMSA's) having a population of 3,000,000 persons or more.

Other very large metropolitan areas.—Included in this class are standard metropolitan statistical areas with a population of 500,000 to 3,000,000 as defined by the 1950 census.

Other standard metropolitan statistical areas.—This class includes other SMSA's.

Other urban areas.—This includes primary sampling units which are highly urban in composition but are not defined as SMSA's.

Rural areas.—This includes primary sampling units which are primarily rural in composition according to census definitions.

Region.—For the purpose of classifying the population by geographic area, the United States was divided into three major regions. This division was especially

made for the design of the HES sample. The regions and the States included are as follows:

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

Urban and rural.—For the first six primary sampling units where examinations were conducted, the definition of urban and rural is the same as that used in the 1950 census. These locations are Philadelphia, Pa., Valdosta, Ga., Akron, Ohio, Muskegon, Mich., Chicago, Ill., and Butler, Mo. For the remainder of the sampling units the 1960 census definitions are used.

The change from 1950 to 1960 definitions is of small consequence in the survey, since only six locations are affected. The major difference is the designation in 1960 of urban towns in New England and of urban townships in New Jersey and Pennsylvania.

According to the 1960 definition, the urban population comprises all persons living in (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 25,000 inhabitants or more or a population of 2,500-25,000 and a density of 1,500 persons or more 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 not included in any urban fringe. The remaining population is classified as rural.

Place description.—In this survey the urban population is classified as living "in the central city" or "outside the central city" of an SMSA. The remaining urban population is classified as "not in SMSA."

The definitions and titles of standard metropolitan statistical areas are established by the U.S. Bureau of the Budget with the advice of the Federal Committee on Standard Metropolitan Statistical Areas.

The definition of an individual standard metropolitan statistical area involves two considerations: first, a city or cities of specified population to constitute the central city and to identify the county in which it is located as the central county; and, second, economic and social relationships with contiguous counties which are metropolitan in character so that the periphery of the specific metropolitan area may be determined.

Persons "in the central city" of an SMSA are therefore defined as those whose residency is in the city appearing in the standard metropolitan statistical area title. Persons residing in an SMSA but not in the city appearing in the SMSA title are considered to be residing "outside the central city."

The remaining population is allocated into rural-farm and rural-nonfarm groups. The farm population includes all persons living in rural territory on places of 10 acres or more from which sales of farm products amounted to \$50 or more during the previous 12 months or on places of less than 10 acres from which sales of farm products amounted to \$250 or more during the preceding 12 months. Other persons living in rural territory are classified as nonfarm. Persons are also classified as nonfarm if their household paid rent for the house but their rent did not include any land used for farming.

Employment status.—This term applies to the employment status of persons during the 2-week period prior to the week of interview. It is not intended that this term define the labor force or provide estimates of the employed or unemployed population at the time of the survey.

Persons who report that they either worked at or had a job or business at any time during the 2-week period prior to the week of interview are considered employed. This includes paid work as an employee of someone else, self-employment in business, farming, or

professional practice, and unpaid work in a family business or farm. Persons on layoff from a job and those absent from their job or business because of temporary illness, vacation, strike, or bad weather are considered employed if they expect to work as soon as the particular event causing their absence no longer exists. Free-lance workers are considered as currently employed if they have a definite arrangement with one or more employers to work for pay according to a weekly or monthly schedule either full time or part time. Excluded are such persons who have no definite employment schedule but work only when their services are needed. Also excluded are (1) persons receiving revenue from an enterprise in whose operation they do not participate, (2) persons doing housework or charity work for which they receive no pay, and (3) seasonal workers during the portion of the year they are not working. (It should be noted that these data were not collected for Philadelphia.)

Occupation.—A person's occupation may be defined as his principal job or business. For the purposes of this survey the principal job or business of a respondent is defined in one of the following ways. If the person worked during the 2-week-reference period of the interview or had a job or business, the question concerning his occupation (or what kind of work he was doing) applies to his job during that period. If the respondent held more than one job, the question is directed to the one at which he spent the most time. When equal time is spent at each job, the question refers to the one he considers most important. A person who has not begun work at a new job, is looking for work, or is on layoff from work is questioned about his last full-time civilian job. A full-time job is defined as one at which the person spent 35 hours or more per week and which lasted 2 consecutive weeks or more. A person who has a job to which he has not yet reported and has never had a previous job or business is classified as a "new worker."

The occupational groups are shown below with the appropriate census code categories.

<i>Occupational title</i>	<i>Census code</i>
Professional, technical, and managerial workers-----	R, 000-195, 250-285
Farmers and farm managers--	N, 222
Clerical and sales workers ---	S, Y, Z, 301-395
Craftsmen, foremen, and kindred workers-----	Q, 401-545
Operatives and kindred workers -----	T, W, 601-721
Private household and service workers-----	P, 801-803, 810-890
Farm and other laborers (except mine) -----	U, V, X, 901, 905, 960-973
Unknown (including new workers) -----	995 and all other codes

(U.S. Bureau of Census, 1960 Census of Population, Classified Index of Occupation and Industries, U.S. Government Printing Office, Washington, D.C., 1960.) This information was not collected for Philadelphia and Valdosta.

Industry.—The industry in which a person was reportedly working is classified by the major activity of the establishment in which he worked.

The only exceptions to the above are those few establishments classified according to the major activity of the parent organization, and they are as follows: laboratories, warehouses, repair shops, and places for storage.

The industry groupings are shown below. (Data on industries were not collected for Valdosta and Philadelphia.) The census code (the Classified Index of Occupation and Industries) and the Standard Industrial Classification (SIC) code components are also listed.

<i>Industry title</i>	<i>Census code</i>	<i>SIC code</i>
Agriculture, forestry, and fisheries-----	A, 017, 018	01, 02, 07(excludes 0713), 08, 09
Mining and construction -----	C, 126-156	10-14, 15-17
Manufacturing-----	B, M, 206-459	19-39, 0713
Transportation, communication, and other public utilities-----	L, 507-579	40-49
Wholesale and retail trade-----	D, F, G, 606-696	50, 52-59
Finance, insurance, and real estate-----	706-736	60-67
Service and miscellaneous----	E, H, K, 806-898	70, 72, 73, 75, 76, 78, 82, 84, 86, 88, 89
Government-----	J, 906-936	91-94
Unknown (including new workers)-----	999	99

The industry "government" differs somewhat from the usual industrial classification of government, since it is limited to the postal service and to 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 with the "service and miscellaneous" group.

Usual activity status.—All persons are classified according to their usual activity status during the 12-month period prior to the week of interview. The usual activity status, in case more than one is reported, is the one at which the person spent the most time during the 12-month period.

The categories of usual activity status are usually working, usually keeping house, retired, and other. For several reasons these categories are not comparable

with somewhat similarly named categories in official Federal labor force statistics. First, the responses concerning usual activity status are accepted without detailed questioning, since the objective of the question is not to estimate the numbers of persons in labor force categories but to identify crudely certain population groups which may have differing health problems. Second, the figures represent the usual activity status over the period of an entire year, whereas official labor force statistics relate to a much shorter period, usually 1 week. Finally, in the definitions of specific categories which follow, certain marginal groups are classified differently to simplify procedures.

Usually working includes persons who are paid employees; self-employed in their own business, profession, or in farming; or unpaid employees in a family business or farm. Work around the house or volunteer or unpaid work, such as for a church, is not counted as working.

Usually keeping house includes women whose major activity is described as "keeping house" and who cannot be classified as "working."

Retired includes persons 45 years of age and over who consider themselves retired. In case of doubt a person 45 years of age and over is counted as retired if he or she has either voluntarily or involuntarily stopped working, is not looking for work, and is not described as "keeping house." A retired person may or may not be unable to work.

Other in this report includes men not classified as "working" or "retired" and women not classified as "working," "keeping house," or "retired." Persons who are going to school are included in this group.

Education.—Each person is classified by education in terms of the highest grade of school completed. Only grades completed in regular schools, where persons are given a formal education, are included. A "regular" school is one which advances a person toward an elementary or high school diploma or a college, university, or professional school degree. Thus, education in vocational, trade, or business schools outside the regular school system is not counted in determining the highest grade of school completed.

Income of family or unrelated individuals.—Each member of a family is classified according to the total income of the family of which he is a member. Within the household all persons related to each other by blood, marriage, or adoption constitute a family. Unrelated individuals are classified according to their own income.

The income recorded is the total of all income received by members of the family in the 12-month

period preceding the week of interview. Income from all sources is included, e.g., wages, salaries, rents from properties, pensions, and help from relatives.

Marital status.—The categories of marital status are *married*, *widowed*, *divorced*, *separated*, and *never married*. Persons with common-law marriages are

considered married. *Separated* refers to married persons who have a legal separation, those living apart with intentions of obtaining a divorce, and other persons permanently or temporarily estranged from their spouse because of marital discord.



APPENDIX VI

DISTRIBUTION OF DIAGNOSTIC FINDINGS

This appendix contains a listing of all the patterns of distribution of the diagnostic findings found in the survey arranged according to the total ARA point count.

The frequency of occurrence of each pattern is included in table IV.

Table IV. Distribution of diagnostic findings by ARA point count: Health Examination Survey, 1960-62

Number of cases	Symmetrical swelling	Swelling, two joints	Swelling, one joint	Morning stiffness	Tenderness	Pain on motion	Positive BFT	Positive X-ray	Subcutaneous nodules
<u>Point count: 8</u>									
2-----	+			+	+		+	+	+
1-----	+			+	+		+	+	+
<u>Point count: 7</u>									
4-----	+			+	+		+	+	
1-----	+			+	+	+	+	+	
<u>Point count: 6</u>									
4-----	+			+	+		+		
4-----	+			+	+			+	
1-----	+			+	+		+	+	
1-----	+			+		+	+		
<u>Point count: 5</u>									
27-----	+			+	+				
8-----	+			+	+	+			
2-----	+			+	+		+		
1-----	+			+	+	+	+		
1-----		+	+	+		+	+	+	
1-----				+	+	+	+	+	+
<u>Point count: 4</u>									
22-----	+				+				
19-----	+			+					
6-----	+					+			
3-----		+		+	+	+			
3-----		+		+	+	+			
2-----	+			+	+	+			
1-----			+	+		+			+
1-----		+		+			+		
1-----	+						+		

Table IV. Distribution of diagnostic findings by ARA point count: Health Examination Survey, 1960-62—Con.

Number of cases	Symmetrical swelling	Swelling, two joints	Swelling, one joint	Morning stiffness	Tenderness	Pain on motion	Positive BFT	Positive X-ray	Subcutaneous nodules
<u>Point count: 3</u>									
26-----			+	+	+				
21-----	+			+	+				
11-----				+	+		+		
6-----		+			+		+		
3-----			+		+		+		
3-----				+	+	+			
3-----				+	+			+	
2-----		+		+					
2-----		+		+	+	+			
2-----			+	+	+				
2-----			+	+	+			+	
1-----			+	+			+		
1-----			+		+	+		+	
1-----				+	+	+			+
1-----				+	+	+		+	
1-----				+	+	+			+
1-----				+		+	+		
<u>Point count: 2</u>									
332-----				+	+				
45-----				+	+	+			
33-----			+		+				
31-----				+			+		
27-----				+		+			
14-----			+	+					
10-----					+		+		
6-----		+							
3-----							+	+	
3-----			+				+		
3-----						+	+		
3-----			+		+	+	+		
2-----			+	+				+	
1-----			+					+	
1-----					+			+	
1-----			+			+			+
1-----						+			
<u>Point count: 1</u>									
1,284-----				+					
33-----					+	+			
305-----					+				
31-----						+			
20-----			+						
113-----							+		
12-----								+	

—○○○—

APPENDIX VII

STATISTICAL NOTES

The Survey Design

The first cycle of the Health Examination Survey employed a highly stratified multistage probability design in which a sample of the civilian, noninstitutional population of the conterminous United States 18-79 years of age was selected. At the first stage, a sample of 42 primary sampling units (PSU's) was drawn from among the 1,900 geographic units into which the United States was divided. Random selection was controlled within regional and size-of-urban-place strata into which the units were classified. As used here a PSU is a standard metropolitan statistical area or one to three contiguous counties. Later stages result in the random selection of clusters of typically about four persons from a neighborhood within the PSU. The total sample included some 7,700 persons in 29 different States. The detailed structure of the design and the conduct of the survey have been described in previous reports, 2,3

Reliability

The methodological strength of the survey derives especially from its use of scientific probability sampling techniques and highly standardized and closely controlled measurement processes. This does not imply that statistics from the survey are exact or without error. Data from the survey are imperfect for three major reasons: (1) results are subject to sampling error, (2) the actual conduct of a survey never agrees perfectly with the design, and (3) the measurement processes themselves are inexact even though standardized and controlled.

The first-stage evaluation of the survey was reported in reference 3, which dealt principally with an analysis of the faithfulness with which the sampling design was carried out. This study notes that out of the 7,700 sample persons the 6,670 who were examined—a response rate of over 86 percent—gave evidence that they were a highly representative sample of the civilian, noninstitutional population of the United States. Imputation of nonrespondents was accomplished by attributing to nonexamined persons the characteristics of comparable examined persons as described in reference 3.

The specific procedure used amounted to inflating the sampling weight for each examined person in order to compensate for sample persons at that stand of the same age-sex group who were not examined.

Sampling and Measurement Error

In the present report, reference has been made to efforts to minimize bias and variability of the measurement techniques.

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 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

Table V. Standard errors in prevalence rates for rheumatoid arthritis in adults, by sex and age: United States, 1960-62

Age	Men	Women
Total, 18-79 years-----	0.3	0.6
18-24 years-----	0.2	0.3
25-34 years-----	-	0.2
35-44 years-----	0.4	0.5
45-54 years-----	0.6	0.7
55-64 years-----	1.3	1.0
65-74 years-----	1.0	3.2
75-79 years-----	7.2	6.4

variances, and (3) from the survey are coming thousands of statistics, 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 occasionally, when the number of cases is substantial.

Estimates of approximate sampling variability for selected statistics used in this report are presented in tables V and VI. These estimates have been prepared by a replication technique which yields overall variability through observation of variability among random subsamples of the total sample. The method reflects both "pure" sampling variance and a part of the measurement variance.

In accordance with usual practice, the interval estimate for any statistic may be considered the range within one standard error of the tabulated statistic, with 68 percent confidence; or the range within two standard errors of the tabulated statistic, with 95 percent confidence.

Expected Values

In tables 4-15 the actual prevalence rates for the various demographic variables are compared with the expected. The computation of expected rates was done as follows:

Suppose that in an area (say, the Northeast) the Health Examination Survey estimates that there are N_i persons in the i th age group ($i = 1, 2, \dots, 7$; sum of $N_i = N$).

Suppose the Health Examination Survey estimates that the RA prevalence rate for the United States in the i th age group is X_i .

Then the expected RA rate for the area is

$$\frac{1}{N} \sum_i N_i \bar{X}_i$$

Comparison of an actual value for, say, a region, with the expected value for that region is undertaken on the assumption that a meaningful statement can be made which holds, in some average way, for all persons in the region. This may or may not be true. The specified region may have higher values for young persons

and lower values for old persons than are found in other regions. In that case an average comparison will obliterate one or both of these differentials. A similar remark may be made with respect to values computed for all races together, since relationships found in one race may not be found in another. In arriving at the general conclusions expressed in the text, an effort was made to consider all the specific data, including data not presented in this report; but it must be recognized that balancing such evidence is a qualitative rather than a quantitative exercise. The standard error of the difference between an actual and an expected value 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 statistic has no meaning in itself except to indicate that the true quantity is small. Such numbers, if shown, have been included to convey an impression of the overall story of the table.

Tests of Significance

Tests of significance for the demographic variables were performed in two ways. The first was to divide the difference between the actual and expected values by the standard error of the actual value. For example, for unmarried women the actual value was 1.6 percent lower than expected, and the standard error was 0.4 percent. Since the difference was four times its standard error, it may be deemed statistically significant.

The second method was to examine the age-specific differences (not published) between the prevalence for the specified group and the prevalence for all persons. Thus, for widowed men the RA prevalence for all six age groups was less than the overall prevalence for these age groups. One of the seven age groups (25-34 years) had no cases of RA recorded and thus could not be used for purposes of comparison. The probability of such an occurrence is 0.02, and the difference is considered statistically significant.

Table VI. Standard errors in prevalence rates for rheumatoid arthritis in adults, by sex and selected characteristics: United States, 1960-62

Characteristic	Men	Women
<u>Race</u>		
White-----	0.4	0.9
Negro-----	0.8	1.4
Other-----	3.0	3.5
<u>Region</u>		
Northeast-----	0.4	1.0
South-----	0.6	1.1
West-----	0.6	1.0
<u>Population-size group</u>		
Giant metropolitan areas-----	0.6	1.1
Other very large metropolitan areas-----	0.6	0.9
Other standard metropolitan statistical areas-----	0.5	1.1
Other urban areas-----	0.9	1.9
Rural areas-----	0.7	1.0
<u>Place description</u>		
SMSA-in central city-----	0.4	1.0
SMSA-outside central city-----	0.5	0.9
Urban, not SMSA-----	0.8	1.7
Rural farm-----	1.2	2.2
Rural nonfarm-----	0.8	1.1
<u>Usual activity status</u>		
Usually working-----	0.3	0.7
Keeping house-----	-	1.0
Retired-----	2.0	7.9
Other-----	1.2	1.6
<u>Industry</u>		
Agriculture, forestry, and fisheries-----	1.1	2.9
Mining and construction-----	0.8	-
Manufacturing-----	0.5	1.4
Transportation, communication, and other public utilities-----	-	-
Wholesale and retail trade-----	0.6	1.2
Finance, insurance, and real estate-----	-	2.0
Service and miscellaneous-----	0.7	1.0
Government-----	-	2.9

Table VI. Standard errors in prevalence rates for rheumatoid arthritis in adults, by sex and selected characteristics: United States, 1960-62—Con.

Characteristic	Men	Women
<u>Occupation</u>		
Professional, technical, and managerial-----	0.3	1.1
Farmers and farm managers-----	1.6	9.0
Clerical and sales workers-----	0.8	0.8
Craftsmen, foremen, and kindred workers-----	0.5	-
Operatives and kindred workers-----	0.4	1.4
Private household and service workers-----	1.4	1.6
Farm and other laborers (except mine)-----	0.5	2.5
<u>Education</u>		
Under 5 years-----	2.0	3.3
5-8 years-----	1.0	1.5
9-12 years-----	0.2	0.6
13 years and over-----	0.2	1.1
<u>Family income</u>		
Under \$2,000-----	1.8	1.7
\$2,000-\$3,999-----	0.6	1.2
\$4,000-\$6,999-----	0.3	1.0
\$7,000-\$9,999-----	0.5	1.0
\$10,000 and over-----	0.7	1.2
<u>Marital status</u>		
Married-----	0.4	0.8
Widowed-----	1.2	3.1
Divorced-----	1.9	1.8
Separated-----	1.5	1.6
Never married-----	0.7	0.4

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