Rheumatic Fever and Rheumatic Heart Disease Among U.S. College Freshmen, 1956–60

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Prevalence

A STUDY of the prevalence of rheumatic fever and rheumatic heart disease among college freshmen began in 1956 as a 5-year cooperative effort between the Heart Disease Control Branch of the Public Health Service and the American College Health Association.

The need for such a study has been apparent for a number of years. Lacking a definition of the current size and scope of the rheumatic fever problem, it has been impossible to ascertain whether the disease has changed or to evaluate the effectiveness of rheumatic fever "control" programs. The absence of such a baseline reference point also precludes an appraisal of any future changes in its morbidity (incidence and sequelae) compared with the trend of mortality associated with rheumatic fever.

The decrease in mortality from this disease has been obvious for some time, particularly since the advent of steroid and antibiotic therapy for rheumatic fever and surgical intervention for rheumatic heart disease. There remains, however, a continuing question regarding the extent of a similar decrease in the morbidity of rheumatic fever, including that of nonfatal rheumatic heart disease.

Many clinicians believe that rheumatic fever is "no longer a problem" because they "rarely see a patient with this disease." Official and nonofficial public health agencies responsible for rheumatic fever control programs have a great need for statistical validation of this belief in order to implement and to evaluate their plans and operations within this field.

The clinician's optimism is perhaps based more on feeling than on fact in view of Dr. John R. Paul's statement, in his review of the problem in 1943, prior to either prophylaxis or surgical therapy (*1*): "Where there may be every indication that rheumatic fever is common, we hear physicians, usually older physicians, stoutly maintain that they 'hardly ever see a case of rheumatic fever among children'." The question then remains whether this clinical impression is more true today than it was 30 years ago. The prevalence studies reported in that era by Paul and Dublin (*1*, *2*) were based on relatively small population groups and these studies have not been repeated. Since rheumatic fever is a chronic disease, which may begin in early childhood, mortality statistics probably give us no better measurement of its

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extent and importance than would death rates used as an index of the prevalence of rheumatoid arthritis or psychosomatic illness.

Official morbidity statistics for rheumatic fever and rheumatic heart disease have always been meager in this country for a number of reasons. While rheumatic fever is a reportable disease in some States, the degree of compliance in such reporting leaves much to be desired. In fact, since 1956 when reporting of rheumatic fever incidence was first requested by the National Office of Vital Statistics, mortality figures have repeatedly exceeded those for morbidity in a number of States.

Various "spot samplings" of school populations, clinic populations, and physician questionnaire surveys have been conducted. The health interview surveys of the U.S. National Health Survey inquire as to the presence or absence of rheumatic fever and rheumatic heart disease. Undoubtedly, however, it will be a number of years before the health examination surveys include sufficient numbers to validate health interview data regarding the prevalence of this disease.

Ideally, an estimate of both the incidence and prevalence of rheumatic fever should be based on a prospective study of a nationwide random sample of the population aged 5–12 years, which is most susceptible to the disease. This is difficult, however, because young children cannot adequately report their own health histories. Then too, general school health examinations are of such varying quality, if they are indeed required, that it would be difficult to make comparative geographic evaluations. Retrospective surveys among adult groups, on the other hand, do not include those serious cases which terminate in early adolescent mortality, and industrial surveys are biased because a representative sample of rheumatic heart disease cannot reasonably be expected among the employed. Other disadvantages of the retrospective surveys among adults are inaccuracies in reporting childhood events and the fact that the diagnostic criteria of 30 or 40 years ago were considerably different from the Jones criteria accepted and employed since 1944.

It was felt, for the foregoing reasons, that a large sample of entering college freshmen would be a suitable and accessible population group in which to study the prevalence of rheumatic fever and rheumatic heart disease. The degree of generalization to the population as a whole in this age group would depend on the representativeness of the population surveyed.

College freshmen (predominantly 18 years of age) represent a group which has relatively recently passed through the period of highest incidence of rheumatic fever. Moreover, the high educational level of this group tends to minimize inaccuracies due to poor recall or to poor communication between physician, parent, and child. Finally, through agreement with cooperating colleges and universities it was possible to make this more than a study based on a questionnaire or interview alone. Each student queried was also given a physical examination for evidence of rheumatic heart disease.

Method

A specially designed individual questionnaire was completed for each freshman student entering the participating colleges. After review by the Student Health Service, the completed forms were forwarded to the Heart Disease Control Branch of the Public Health Service for analysis.

The questionnaire (fig. 1 for 1956–57 and fig. 2 for 1958–60) is in two parts: Section A, completed by the student as part of his admission procedure, and Section B, completed by a physician. Answers to Section B were based on a physical examination and a personal interview. When the student gave a history of rheumatic fever, the physician was asked for his opinion as to its validity. On the other hand, if the physician discovered unsuspected rheumatic heart disease he attempted to elicit a clinical history from the student.

The sum of numerical weights given to affirmative answers in both sections of the questionnaire provided the final score (figs. 1 and 2). The reason for the development of such a scoring system is discussed later. The weights, the scores, and the resultant classification of individuals into "negative," "questionable," and "positive" categories were checked repeatedly and pretested on several thousand reports. The final weights and scoring were evaluated for reliability and reproducibility by physicians in the Heart Disease Control Branch.

To establish categories for the analysis of the data, the numerical scores were divided into three groups as follows:

Group one: negative (scores between 0 and 2). In this group, though the student may have given a history of joint pains and swelling, heart murmur, St. Vitus dance, or any of the minor manifestations, the history was consid-

Figure 1. Questionnaire designed for entering college freshmen, 1956–57

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7-56

FORM APPROVED.
BUDGET BUREAU NO. 68-R597.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
HEART DISEASE CONTROL PROGRAM
IN COOPERATION WITH
AMERICAN COLLEGE HEALTH ASSOCIATION
RHEUMATIC HEART DISEASE RESEARCH PROJECT

This information is confidential. It has no bearing on your college standing and will be used for statistical purposes only.

A. TO BE FILLED IN BY STUDENT — DATE FILLED IN BY STUDENT

1. NAME (Last, First, Middle) | 2. SEX | 3. RACE | 4. DATE OF BIRTH

5. COLLEGE OR UNIVERSITY | 6. HOME ADDRESS (City and State)

7. HAVE YOU EVER HAD:

a. Inflammatory Rheumatism	☐ No	☒ Yes 2	☐ Don't know
b. Scarlet Fever	☐ No	☒ Yes 1	☐ Don't know
c. St. Vitus Dance (Chorea)	☐ No	☒ Yes 2	☐ Don't know
d. Joint Pains and Swelling	☐ No	☒ Yes 2	☐ Don't know
e. Leakage of the Heart Valve(s) (Heart Murmur)	☐ No	☒ Yes 2	☐ Don't know

8. HAVE YOU EVER BEEN TOLD BY A PHYSICIAN YOU HAD RHEUMATIC FEVER? ☐ No ☒ Yes 4 ☐ Don't know

If "yes", how many attacks? 2 if more than one | At what age(s)? | Residence at time (State)

9. IF YOU HAD RHEUMATIC FEVER, WERE YOU GIVEN MEDICINE TO PREVENT FURTHER ATTACKS?

☐ No ☒ Yes 2 ☐ Don't know. If "yes," which corresponds most nearly to your situation?—

Sulfa Tablet(s) Daily for _____ years, _____ months; From age _____ to age _____)
Penicillin Tablets Daily for _____ years, _____ months; From age _____ to age _____) +2 if longer than 1 month
Other (indicate) _____

10. ARE YOU NOW TAKING ANY MEDICINE FOR PREVENTION OF RHEUMATIC FEVER? ☐ NO ☒ YES 2

If "YES," WHAT? _____

B. TO BE FILLED IN BY COLLEGE PHYSICIAN

(When 8 above is answered "Yes", or when a history of rheumatic fever is otherwise determined, or when rheumatic heart disease is found in absence of a positive history)

1. HISTORY OF RHEUMATIC FEVER? ☐ NO ☒ YES 6 ☒ QUESTIONABLE 3

2. DIAGNOSIS (Check one or more as necessary):

14 ☒ DEFINITE RHEUMATIC HEART DISEASE
- ☐ WITH MITRAL INSUFFICIENCY
- ☐ WITH MITRAL STENOSIS
- ☐ WITH AORTIC INSUFFICIENCY
- ☐ OTHER (Specify) _____

8 ☒ POSSIBLE RHEUMATIC HEART DISEASE +3 if valve is mentioned
- ☐ NO RHEUMATIC HEART DISEASE
- ☐ OTHER HEART DISEASE (Specify) _____

DATE | SIGNATURE _____, M. D.

Use this space and reverse side for remarks if needed. Refer to items by letter and number, i. e., B-2.

☆ U. S. GOVERNMENT PRINTING OFFICE : 1956—O-392632

Figure 2. Questionnaire designed for entering college freshmen, 1958–60

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Form approved.
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DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
HEART DISEASE CONTROL PROGRAM
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AMERICAN COLLEGE HEALTH ASSOCIATION
RHEUMATIC HEART DISEASE RESEARCH PROJECT

TO THE STUDENT

The information you will provide in this statistical study will help in the evaluation of the national health picture.

SECTION A.—TO BE FILLED IN BY STUDENT

1. NAME (Last, First, Middle) | 2. AGE | 3. SEX ☐ Male ☐ Female | 4. RACE ☐ White ☐ Nonwhite

5. HOME ADDRESS (Street or rural route No.) | City | Zone | State

6. NAME OF UNIVERSITY | 7. DATE

8. HAVE YOU EVER HAD:

a. Frequent sore throats ☐ No ☒ Yes 1 ☐ Don't know
b. Scarlet fever ☐ No ☒ Yes 1 ☐ Don't know
c. St. Vitus dance (chorea) ☐ No ☒ Yes 2 ☐ Don't know
d. Joint pains and swellings ☐ No ☑ Yes 2 ☐ Don't know
e. Leakage of the heart valve(s) (heart murmer) ☐ No ☒ Yes 2 ☐ Don't know
f. Frequent nose bleeds ☐ No ☒ Yes 1 ☐ Don't know

9. HAVE YOU EVER HAD (OR BEEN TOLD THAT YOU HAD) RHEUMATIC FEVER? ☐ No ☒ Yes 4 ☐ Don't know

10. HAVE YOU EVER HAD (OR BEEN TOLD THAT YOU HAD) RHEUMATIC HEART DISEASE? ☐ No ☒ Yes 2 ☐ Don't know

If you answered YES to either question 9 or 10, please answer questions 11 through 14. If you answered NO to these two questions stop here.

11. HOW MANY ATTACKS OF RHEUMATIC FEVER HAVE YOU HAD? +2 if more than one | AT WHAT AGES? | RESIDENCE AT TIME (*City and State only*)

12. WHEN WERE YOU OR YOUR PARENTS TOLD BY A PHYSICIAN THAT YOU HAD RHEUMATIC FEVER?

2 ☒ During your illness? ☐ Not told.
1 ☒ After your illness? How long after? _____ ☐ Don't know.

13. WERE YOU EVER GIVEN MEDICINE FOR THE PREVENTION OF FURTHER RHEUMATIC FEVER OR RHEUMATIC HEART DISEASE? ☐ No ☒ Yes 2 ☐ Don't know

If YES, check below:
☐ Sulpha ☐ Penicillin tablets ☐ Penicillin injections ☐ Other (Specify) _____ ☐ Don't know

How often did you take it? _____ (*Daily, once a month, etc.*) How long? _____ (*Yrs.*) _____ (*Mo.*) From _____ (*Age*) to _____ (*Age*) + 2 if longer than 1 month.

14. ARE YOU NOW TAKING ANY MEDICINE FOR THE PREVENTION OF RHEUMATIC FEVER OR RHEUMATIC HEART DISEASE?

☐ No ☒ Yes 2 If YES, what? _____ How often do you take it? _____

SECTION B.—TO BE FILLED IN BY PHYSICIAN FOR EVERY STUDENT

1. IN YOUR OPINION, IS THERE A VALID HISTORY OF RHEUMATIC FEVER? ☐ No ☒ Yes 6 ☒ Questionable 3

2. IMPRESSION OR DIAGNOSIS (Check one or more as necessary):

☐ NO HEART DISEASE

☒ PROBABLY NO HEART DISEASE
1 ☒ With Physiologic Murmur
☐ Other _____ (*Specify*)

14 ☒ DEFINITE RHEUMATIC HEART DISEASE
☐ With Mitral Insufficiency
☐ With Mitral Stenosis
☐ With Aortic Insufficiency
☐ With Aortic Stenosis
☐ Other _____ (*Specify*)

8 ☒ PROBABLE RHEUMATIC HEART DISEASE
+3 if valve is mentioned
☐ With Mitral Insufficiency
☐ With Mitral Stenosis
☐ With Aortic Insufficiency
☐ With Aortic Stenosis
☐ Other _____ (*Specify*)

☐ OTHER HEART DISEASE _____ (*Specify*)

DATE | PHYSICIAN'S SIGNATURE M. D.

Use reverse side of this form for remarks if needed.

ered "negative" unless the physician interviewer specified a probable relationship between the symptom or symptoms and rheumatic fever. Students in this group obviously were not counted in the tabulation of "cases" in this report.

Group two: possible (scores between 3 and 10). Cases categorized as possible presented one or more major manifestations which the physician (part B) noted as "questionable" or "negative," but there was no additional positive information on either (*a*) the presence of rheumatic fever or rheumatic heart disease, (*b*) knowledge of the time of the rheumatic fever attack, or (*c*) memory as to use of prophylaxis against rheumatic fever. It was considered unlikely that students in this group had a valid history of either rheumatic fever or rheumatic heart disease, and therefore they too were not included in the calculation of prevalence rates.

Group three: probable and definite (scores over 10). The probable group was considered likely to have had rheumatic fever or rheumatic heart disease or both. No case was included in this group as probable unless there was at least a definite history of rheumatic fever accompanied by validation by the student's physician, or questionable rheumatic heart disease together with some prior knowledge of rheumatic fever symptoms or rheumatic heart disease. The probable group represented less than one-fourth of the total cases in the group three (probable and definite) category. The definite cases were those presenting either (*a*) a definite diagnosis of rheumatic fever or rheumatic heart disease validated by both history and physical examination or (*b*) information in Section A regarding definite signs and symptoms confirmed in the re-interview despite the absence of heart disease.

Although the questionnaire was changed slightly at the end of the second year of this 5-year study, the system used for scoring positive entries in the form was the same over the 5-year period. The data have been analyzed separately, however, for each of the two study periods and combined only when considered appropriate. When the findings for each period were markedly dissimilar, presumably due to changes in the phrasing of a particular question, the data shown were derived from information recorded on the revised form (fig. 2) and therefore relate only to the survey period 1958–60.

Results

Freshmen students matriculating at 137 colleges were surveyed during the 5-year study period; 56 colleges participated for the full 5 years, 20 for 4 years, 21 for 3 years, 21 for 2 years, and 19 for only 1 year.

A total of 517,129 students completed the questionnaire, and were then interviewed by a physician and given a physical examination.

More than 900 students were included in the study from every State except Alaska, Hawaii, and Vermont as shown in table 1. This table also shows the detailed distribution of the students by sex and according to their reported State of residence at the time of the survey. The ratio of males to females surveyed was approximately three to two.

The total yield of students who are believed to have had rheumatic fever was 9,044 cases, of which 7,427 were in the "definite" category and 1,617 were "probable" cases. This established an overall prevalence rate of 17.5 per 1,000 students examined (table 2). The prevalence rates for each of the 50 States ranged from as high as 39.5 per 1,000 student residents of Nevada to as low as 6.3 per 1,000 student residents of Texas. The prevalence rates were similar for males (17.7) and females (17.2).

The geographic distribution of the computed prevalence rates, grouped in quartiles, discloses that rheumatic fever prevalence is highest in the northern temperate zones, particularly among the residents of the Rocky Mountain area (fig. 3). The rates observed for students residing in the Middle Atlantic and New England States were somewhat lower than expected from findings in other studies, such as those by Paul (*1*).

A total of 23,443 nonwhite students were surveyed. Of these, 323 were classified as having had rheumatic fever, a prevalence rate of 13.8 per 1,000. Since a large proportion of these nonwhite students resided in States generally found to have relatively low prevalence rates for white residents, the difference between the overall white and nonwhite rate is not considered significant.

Table 1. Number of students examined, by sex and State of residence at time of survey, 1956–60

State of residence	Total	Male	Female	Sex not stated	Percent male
Total	517, 129	309, 172	206, 552	1, 405	59. 8
Alabama	2, 532	1, 864	667	1	73. 6
Alaska	169	105	63	1	62. 1
Arizona	4, 112	2, 481	1, 608	23	60. 3
Arkansas	1, 099	714	378	7	65. 0
California	21, 986	12, 027	9, 888	71	54. 7
Colorado	8, 908	4, 768	4, 110	30	53. 5
Connecticut	5, 424	3, 598	1, 809	17	66. 3
Delaware	4, 318	2, 445	1, 872	1	56. 6
District of Columbia	5, 186	2, 949	2, 224	13	56. 9
Florida	6, 885	5, 117	1, 738	30	74. 3
Georgia	5, 490	3, 390	2, 080	20	61. 7
Hawaii	482	268	211	3	55. 6
Idaho	4, 601	3, 143	1, 450	8	68. 3
Illinois	16, 245	8, 952	7, 265	28	55. 1
Indiana	1, 225	820	400	5	66. 9
Iowa	13, 620	8, 291	5, 290	39	60. 9
Kansas	11, 314	7, 335	3, 930	49	64. 8
Kentucky	9, 264	5, 506	3, 728	30	59. 4
Louisiana	4, 795	3, 018	1, 754	23	62. 9
Maine	1, 715	1, 172	541	2	68. 3
Maryland	2, 830	2, 134	689	7	75. 4
Massachusetts	24, 707	16, 202	8, 446	59	65. 6
Michigan	58, 616	32, 267	26, 303	46	55. 0
Minnesota	30, 358	19, 397	10, 888	73	63. 9
Mississippi	5, 929	4, 269	1, 586	74	72. 0
Missouri	12, 681	7, 672	4, 926	83	60. 5
Montana	8, 076	5, 043	2, 986	47	62. 4
Nebraska	9, 207	6, 178	3, 012	17	67. 1
Nevada	936	573	362	1	61. 2
New Hampshire	5, 176	3, 646	1, 523	7	70. 4
New Jersey	9, 994	4, 854	5, 101	39	48. 6
New Mexico	1, 246	721	520	5	57. 9
New York	31, 202	15, 505	15, 628	69	49. 7
North Carolina	5, 673	1, 273	4, 382	18	22. 4
North Dakota	4, 054	2, 967	1, 082	5	73. 2
Ohio	70, 212	41, 090	29, 034	88	58. 5
Oklahoma	12, 450	7, 535	4, 849	66	60. 5
Oregon	975	516	457	2	52. 9
Pennsylvania	21, 058	13, 976	7, 034	48	66. 4
Rhode Island	2, 014	1, 288	721	5	64. 0
South Carolina	3, 653	2, 908	741	4	79. 6
South Dakota	4, 811	3, 226	1, 568	17	67. 1
Tennessee	3, 748	1, 768	1, 975	5	47. 2
Texas	9, 431	5, 583	3, 840	8	59. 2
Utah	10, 310	5, 859	4, 425	26	56. 8
Vermont	465	290	173	2	62. 4
Virginia	7, 205	4, 880	2, 315	10	67. 7
Washington	11, 005	6, 785	4, 153	67	61. 7
West Virginia	7, 002	4, 577	2, 404	21	65. 4
Wisconsin	5, 028	2, 905	2, 099	24	57. 8
Wyoming	3, 676	2, 293	1, 365	18	62. 4
Foreign group	4, 031	3, 029	959	43	75. 1

Table 2. Prevalence rates of probable or definite rheumatic fever per 1,000 students surveyed, by sex and State of residence at time of survey, 1956–60

Rank[1]	State of residence	Total		Male		Female	
		Cases	Rate per 1,000 examinations	Cases	Rate per 1,000 examinations	Cases	Rate per 1,000 examinations
	Total	[2] 9, 044	17. 5	5, 474	17. 7	3, 552	17. 2
47	Alabama	17	6. 7	11	5. 9	6	9. 0
	Alaska	19	112. 4	14	133. 3	5	79. 4
9	Arizona	110	26. 8	64	25. 8	46	28. 6
43	Arkansas	12	10. 9	9	12. 6	3	7. 9
29	California	327	14. 9	177	14. 7	148	15. 0
11	Colorado	225	25. 3	109	22. 9	113	27. 5
32	Connecticut	73	13. 5	39	10. 8	34	18. 8
38	Delaware	51	11. 8	28	11. 5	23	12. 3
	District of Columbia	46	8. 9	21	7. 1	25	11. 2
33	Florida	91	13. 2	69	13. 5	22	12. 7
36	Georgia	69	12. 6	40	11. 8	29	13. 9
	Hawaii	4	8. 3	2	7. 5	2	9. 5
13	Idaho	110	23. 9	63	20. 0	47	32. 4
22	Illinois	292	18. 0	170	19. 0	121	16. 7
7	Indiana	40	32. 7	26	31. 7	14	35. 0
16	Iowa	302	22. 2	195	23. 5	107	20. 2
18	Kansas	243	21. 5	163	22. 2	79	20. 1
26	Kentucky	145	15. 7	78	14. 2	66	17. 7
34	Louisiana	63	13. 1	46	15. 2	17	9. 7
23	Maine	31	18. 1	20	17. 1	11	20. 3
31	Maryland	41	14. 5	28	13. 1	13	18. 9
45	Massachusetts	258	10. 4	161	9. 9	97	11. 5
39	Michigan	688	11. 7	388	12. 0	300	11. 4
15	Minnesota	684	22. 5	430	22. 2	254	23. 3
40	Mississippi	68	11. 5	58	13. 6	9	5. 7
19	Missouri	263	20. 7	152	19. 8	111	22. 5
4	Montana	296	36. 7	162	32. 1	133	44. 5
20	Nebraska	188	20. 4	135	21. 9	53	17. 6
1	Nevada	37	39. 5	27	47. 1	10	27. 6
30	New Hampshire	75	14. 5	49	13. 4	25	16. 4
27	New Jersey	150	15. 0	80	16. 5	70	13. 7
6	New Mexico	42	33. 7	19	26. 4	23	44. 2
35	New York	394	12. 6	234	15. 1	160	10. 2
21	North Carolina	106	18. 7	22	17. 3	84	19. 2
25	North Dakota	70	17. 3	46	15. 5	24	22. 2
24	Ohio	1, 237	17. 6	776	18. 9	459	15. 8
42	Oklahoma	136	10. 9	80	10. 6	56	11. 5
2	Oregon	37	37. 9	22	42. 6	15	32. 8
14	Pennsylvania	495	23. 5	340	24. 3	154	21. 9
46	Rhode Island	21	10. 4	13	10. 1	8	11. 1
41	South Carolina	42	11. 5	33	11. 2	9	12. 0
8	South Dakota	142	29. 5	91	28. 2	51	32. 5
28	Tennessee	56	14. 9	26	14. 7	30	15. 2
48	Texas	59	6. 3	37	6. 6	22	5. 7
3	Utah	382	37. 1	229	39. 1	153	34. 6
44	Vermont	5	10. 8	3	10. 3	2	11. 6
37	Virginia	86	11. 9	60	12. 3	26	11. 2
12	Washington	277	25. 2	161	23. 7	115	27. 7
17	West Virginia	152	21. 7	99	21. 6	52	21. 6
10	Wisconsin	134	26. 7	68	23. 4	66	31. 4
5	Wyoming	126	34. 3	85	37. 1	40	29. 3
	Foreign group	27	6. 7	16	5. 3	10	10. 4

[1] Rank of prevalence rates for total group surveyed in each State of continental United States. Rank not assigned to ratios observed in Alaska, District of Columbia, Hawaii, and foreign students.

[2] Only 18 cases were found in the sex not stated category and are not included in this table.

Of the 9,044 cases of definite or probable rheumatic fever, 2,971, or 5.7 per 1,000 students examined, were reported by a physician as having a murmur indicative of rheumatic heart disease. The prevalence of rheumatic heart disease per 1,000 students examined is listed by State in table 3. A rather wide variation is evident in the rates according to the student's State of residence at the time of the survey, from a low of 2.0 per 1,000 for Alabama to a high of 12.3 per 1,000 for Oregon. In general, the geographic distribution of rheumatic heart disease prevalence rates, as shown in figure 4, is similar to that observed for the prevalence of rheumatic fever regardless of the presence of evidence of rheumatic heart disease.

The prevalence rates for rheumatic heart disease were similar for males (6.0) and for females (5.4), as well as for white students (6.3) and nonwhite students (6.4).

Discussion

Several major methodological problems were recognized in the design and course of this study. The first related to the expected variability of findings based on interviews and physical examinations conducted by a large number of physicians in different parts of the country. Recognition of this inherent variable was accompanied, however, by the realization that there was no means of assessing the difference among physicians in their background, training, or degree of interest in conducting the study.

The variability of training and experience of physicians in any one geographic area due to the nationwide origin, dissemination, and mobility of physicians today was felt to be a mitigating factor which tended to minimize the physician variable. Indeed, these differences could only be completely eliminated by the impossible alternative of having only one physician conduct the entire one-half million interviews and examinations.

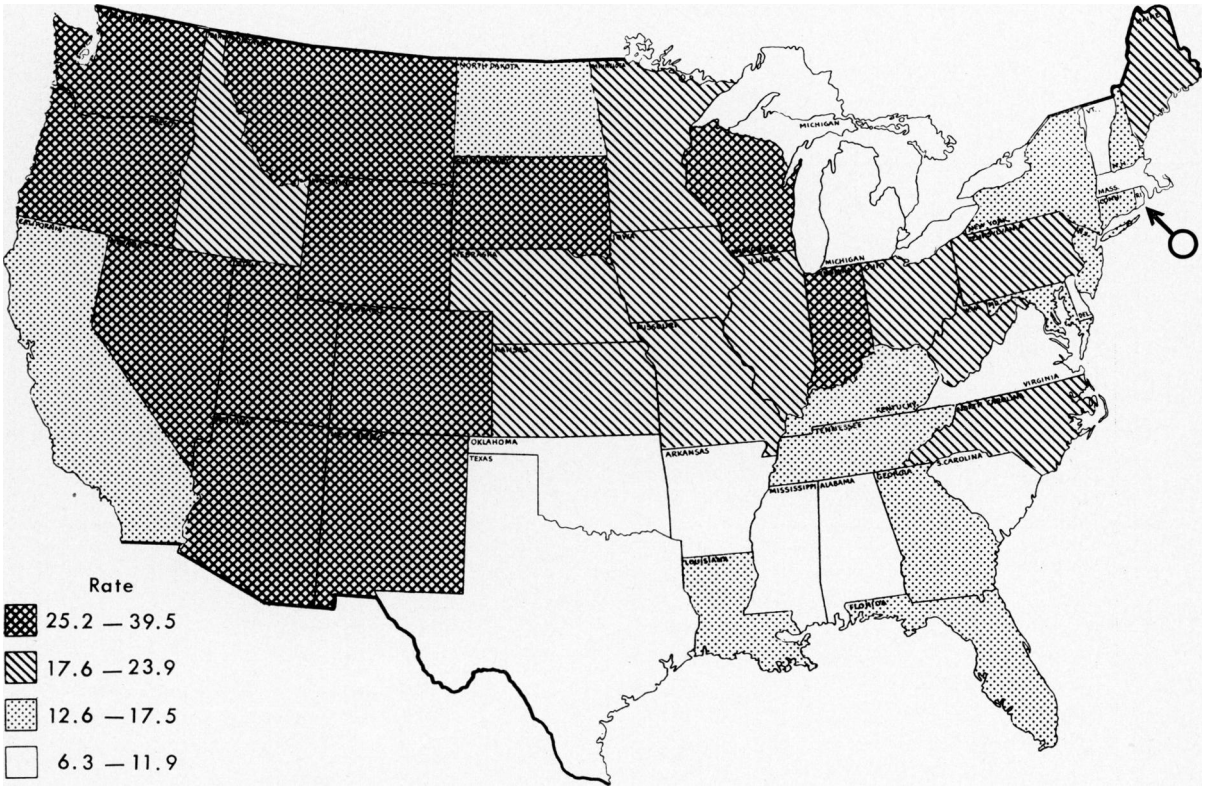
The other major difficulty concerned the final definition of the "positive" or "negative" case in the review of the records submitted to the Heart Disease Control Branch for analysis. The theoretically objective analysis of these records by several staff physicians was quickly found to be quite subjective when disagreement both between "jurors" and on the part of the same juror was shown to be present on "blind" re-insertion of previously reviewed records.

For this reason, the scoring system previously described was developed and applied to all records submitted. During a pretest period, high levels of agreement were noted between the scoring technique and the "physician conference" clinical evaluation on several thousand records.

While such a scoring system helped to minimize the "reader" or "analyzer" variable, it was also recognized that the disease itself brought with it a combination of problems. A determination of the occurrence of this variable disease, especially by means of a retrospective history is fraught with difficulty. This is due to a number of factors, including the lack of a specific diagnostic laboratory test, the sometimes "loose" application of the Jones criteria, and the absence of a residual heart murmur in most patients. While the emotional impact of the diagnosis on the family is a definite advantage in recall, such recall may reflect only the mere mention of the disease by a physician in considering his differential diagnosis of an acute nonrheumatic febrile illness, which was erroneously taken as confirmation of this diagnosis.

Taking these considerations into account it appears that complete acceptance of the student's history of rheumatic fever in view of the tendency toward over-diagnosis of febrile illnesses during childhood would lead to the inadvertent inclusion of a number of false positives, thus yielding a rate higher than the hypothetical true value. Conversely, using only the examining physician's retrospective evaluation of a history of rheumatic fever would yield too many false negatives, since it has been our experience that many physicians do not feel justified in confirming a past diagnosis in the absence of demonstrable rheumatic heart disease at the time of their own examination. We were pleased and considerably reassured as to the value of the scoring system used in this study to find, as shown in table 4, that the number of "positives" as classified by this method lay between these two extremes and may be presumed, therefore, to approximate more closely the hypothetical true value than would either of the other two alternatives.

Figure 3. Prevalence rates of definite and probable rheumatic fever including rheumatic heart disease among college freshmen, in quartiles, by State of residence at time of survey



Less than one-third of the total rheumatic fever cases would have been identified by physical examination only. There is no question, however, of the usefulness of including physical examination as part of a prevalence survey, since one-fourth of those found to have rheumatic heart disease on this examination had no prior history of the disease and would therefore not have been detected or counted if we had examined only those with a positive history of rheumatic disease (table 4).

Those cases that theoretically have been missed by the combined method of questionnaire, physician interview, and physical examination would consist of an unknown number of students without recalled history and without current signs of rheumatic heart disease. These could be detected in such a retrospective study only by having access to complete past medical records for each student. The foregoing methodological problems must be kept in mind when using the data derived from this study and particularly when comparing this study with other studies that are based on either medical history or physical examination alone.

The wide disparity noted in the prevalence rates by State of residence raised the question of how representative of the nationwide prevalence of rheumatic fever among young adults is the rate observed in our study group. The geographic distribution of students surveyed might be expected to be different from that of all persons in the United States of their age group (18–21 years) for two principal reasons: (*a*) the percentage of 18-year-old students who enter college varies widely from State to State, and (*b*) the number of students surveyed from any State was the fortuitous resultant of the number of colleges that volunteered to participate and the time period over which they participated. To appraise the effect of this disproportionate geographic selection process on the estimated national prevalence rate of rheumatic fever among young adults, we compared the percentage distribution of the surveyed students by State of residence with that of the

Table 3. Prevalence rates of probable or definite rheumatic heart disease per 1,000 students, surveyed, by sex and State of residence at time of survey, 1956–60

Rank[1]	State of residence	Total		Male		Female	
		Cases	Rate per 1,000 examinations	Cases	Rate per 1,000 examinations	Cases	Rate per 1,000 examinations
	Total	[2] 2,971	5.7	1,853	6.0	1,115	5.4
48	Alabama	5	2.0	3	1.6	2	3.0
	Alaska	3	17.8	3	28.6	0	0
9	Arizona	34	8.3	21	8.5	13	8.1
46	Arkansas	3	2.7	1	1.4	2	5.3
37	California	90	4.1	51	4.2	39	3.9
11	Colorado	71	8.0	36	7.6	34	8.3
35	Connecticut	24	4.4	11	3.1	13	7.2
43	Delaware	13	3.0	10	4.1	3	1.6
	District of Columbia	20	3.9	11	3.7	9	4.0
40	Florida	26	3.8	19	3.7	7	4.0
41	Georgia	19	3.5	12	3.5	7	3.4
	Hawaii	3	6.2	2	7.5	1	4.7
17	Idaho	32	7.0	22	7.0	10	6.9
18	Illinois	105	6.5	61	6.8	44	6.1
6	Indiana	11	9.0	6	7.3	5	12.5
15	Iowa	101	7.4	71	8.6	30	5.7
19	Kansas	74	6.5	45	6.1	29	7.4
28	Kentucky	46	5.0	28	5.1	18	4.8
42	Louisiana	15	3.1	11	3.6	4	2.3
10	Maine	14	8.2	9	7.7	5	9.2
32	Maryland	13	4.6	10	4.7	3	4.4
29	Massachusetts	119	4.8	78	4.8	41	4.9
38	Michigan	236	4.0	144	4.5	92	3.5
24	Minnesota	174	5.7	116	6.0	58	5.3
39	Mississippi	24	4.0	18	4.2	6	2.8
22	Missouri	80	6.3	41	5.3	39	7.9
3	Montana	82	10.2	49	9.7	32	10.7
31	Nebraska	42	4.6	29	4.7	13	4.3
8	Nevada	8	8.5	5	8.7	3	8.3
27	New Hampshire	28	5.4	18	4.9	10	6.6
26	New Jersey	54	5.4	40	8.2	14	2.7
7	New Mexico	11	8.8	8	11.1	3	5.8
30	New York	143	4.6	79	5.1	64	4.1
13	North Carolina	43	7.6	7	5.5	36	8.2
36	North Dakota	17	4.2	11	3.7	6	5.5
12	Ohio	537	7.6	360	8.8	177	6.1
47	Oklahoma	28	2.2	11	1.5	17	3.5
1	Oregon	12	12.3	3	5.8	9	19.7
14	Pennsylvania	158	7.5	113	8.1	45	6.4
33	Rhode Island	9	4.5	5	3.9	4	5.5
45	South Carolina	10	2.7	6	2.1	4	5.4
4	South Dakota	48	10.0	29	9.0	19	12.1
23	Tennessee	23	6.1	10	5.7	13	6.6
44	Texas	25	2.7	17	3.0	8	2.1
2	Utah	106	10.3	68	11.6	38	8.6
21	Vermont	3	6.5	2	6.9	1	5.8
25	Virginia	40	5.6	25	5.1	15	6.5
20	Washington	71	6.5	40	5.9	31	7.5
34	West Virginia	31	4.4	21	4.6	10	4.2
5	Wisconsin	49	9.7	28	9.6	21	10.0
16	Wyoming	26	7.1	17	7.4	8	5.9
	Foreign group	12	3.0	12	4.0	0	0

[1] Rank of prevalence rates for total group surveyed in each State of continental United States. Rank not assigned to rates observed in Alaska, District of Columbia, Hawaii, and foreign students.

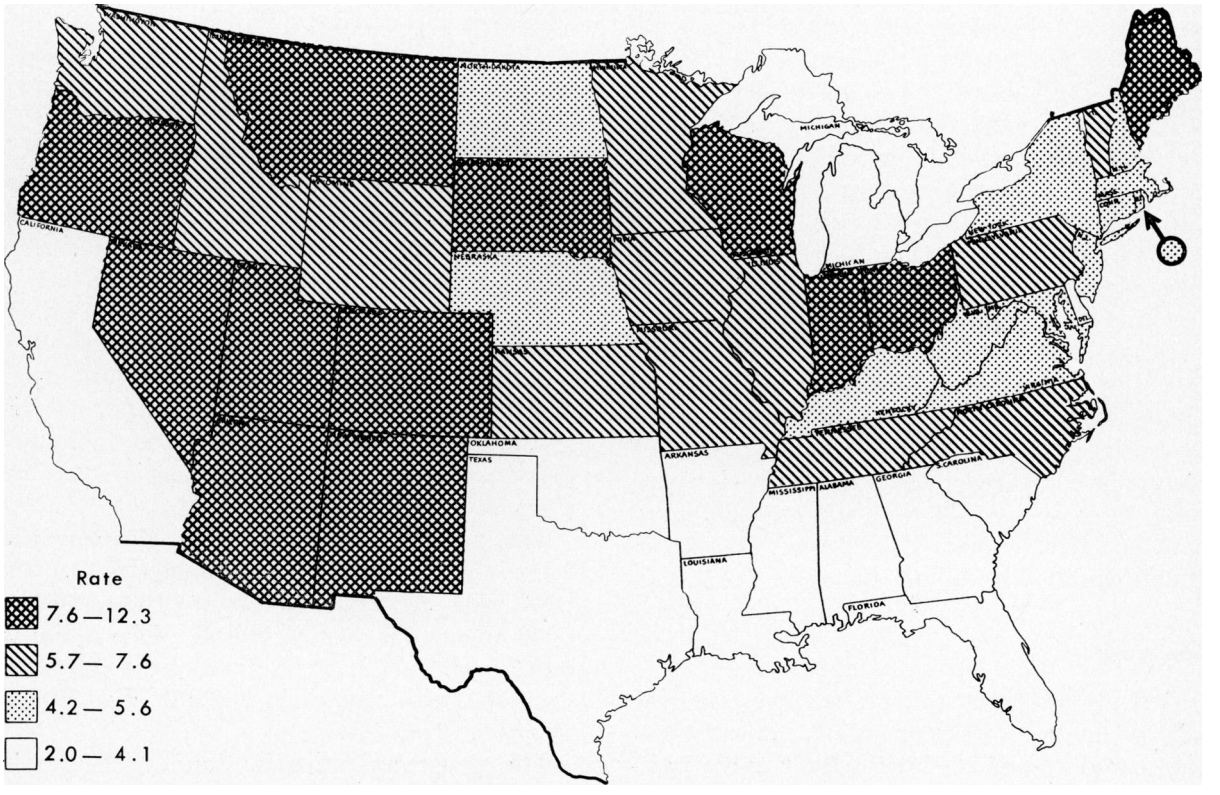
[2] Only 3 cases were found in the sex not stated category and are not included in this table.

enumerated 15- to 19-year-old population in the 1960 census. When these percentages are grouped into quartiles according to the computed prevalence rates for rheumatic fever in each State, the students residing in the 12 States having the highest rheumatic fever prevalence rates (first quartile) comprised only 11.8 percent of the total students surveyed, but this compared favorably with the 11.3 percent for 15- to 19-year-old persons residing in these same States.

A somewhat higher percentage (39.4 percent) of the students surveyed resided in States comprising the second quartile, than the percentage (29.3) of the general population aged 15 to 19 years residing in those States. On the other hand this relationship was reversed for States comprising the third quartile (21.6 percent of the surveyed population versus 34.5 percent of the 15- to 19-year-old population). The fourth quartile (lowest rheumatic fever prevalence rates) had again about the same proportion of students aged 15 to 19 years in the general population as in the group surveyed (26.8 compared with 24.3 percent). It can be concluded then, that the students surveyed were slightly more concentrated in States having rheumatic fever prevalence rates above the computed national average than the total population of young adults from which they were selected. A crude adjustment for this selection bias reduces the rheumatic fever prevalence rates for U.S. students only slightly, from 17.5 to 17.1 per 1,000 examinations.

The adjusted national rheumatic fever prevalence rate would be representative of all young adults if we could assume that there is no difference between the rheumatic fever prevalence rate among college freshmen and those in the same age group who do not enter college. College freshmen, however, may be considered to have a far more favorable socioeconomic status than their noncollege contemporaries. This tends to lead to the assumption that the computed adjusted rate of 17.1 per 1,000 is in all probability an underestimate for this general

Figure 4. Prevalence rates of current rheumatic heart disease among college freshmen, in quartiles, by State of residence at time of survey



age group, since rheumatic fever incidence is generally considered to vary inversely with the socioeconomic status. Moreover, the rates observed among the highest socioeconomic group represented by college freshmen are understated to the extent that rheumatic heart disease can be sufficiently disabling to preclude college admission.

A review of the literature discloses no large-scale studies among 18- to 21-year age groups designed to determine the combined prevalence of a validated history of rheumatic fever and of rheumatic heart disease. Dublin (*2*), in his study of a small sample of the U.S. National Health Survey (1935–36), estimated that the prevalence of rheumatic fever among children 5–14 years of age ranged between 12 to 20 per 1,000.

In regard to the prevalence of rheumatic heart disease, Cole (*3*) noted a rate of approximately 8 per 1,000 among 28,000 students at the University of Wisconsin between the years 1931 and 1939; Paul and Leddy (*4*) reported a rate of 8.2 per 1,000 among 7,914 Yale students in 1932; Hedley (*5*), in a review of health examinations of 46,000 students in 14 large universities with well-organized student health services, noted a prevalence of 6.4 per 1,000 population for rheumatic heart disease. Interestingly, the rate of 7 per 1,000 observed in 1947–48 by Shearer and associates (*6*) among the university students in Colorado was approximately the same as that observed among Colorado students in our study. The criteria used for defining rheumatic heart disease in the Shearer study, however, appear to be more restrictive than those used in the current survey.

Despite the decline in reported morbidity and mortality from rheumatic fever and rheumatic heart disease the findings in the present prevalence survey among young adults, although they cannot be compared with those obtained in past prevalence surveys because of methodological differences, have shown this disease to be of continuing public health importance.

Table 4. Number of cases of rheumatic fever and rheumatic heart disease identified among 517,129 college students, by methods of identification, 1956–60

Method	Number of cases	Rate per 1,000 examinations
Scoring system:		
Rheumatic fever and rheumatic heart disease	9,044	17.5
Definite	7,427	14.4
Probable	1,617	3.1
History reported by student:		
Rheumatic fever and rheumatic heart disease	11,285	21.8
Physician validation of history by interview:		
Rheumatic fever and rheumatic heart disease	7,500	14.5
Physical examination by physician:		
Rheumatic heart disease	2,971	5.7
With known history of rheumatic fever	2,218	4.2
Without history of rheumatic fever	753	1.5

Summary

A study of 517,129 college freshmen, entering 137 colleges over a 5-year period, indicates that the prevalence of rheumatic fever and particularly rheumatic heart disease remains an important public health problem. These findings are in sharp contrast to the decrease shown in official morbidity reporting, in mortality statistics for this disease, and to the apparent decrease in the incidence of streptococcal disease as officially reported throughout the United States.

Differences between the sexes in prevalence of heart disease were not significant. Race differentials were also not considered significant, in view of the small and somewhat geographically biased sample of nonwhite students surveyed.

Findings were based on a two-part questionnaire; a history completed by the student, and a physical examination report filled out by a private or student health physician. Analysis of the questionnaires revealed 9,044 "definite" and "probable" cases of rheumatic fever or rheumatic heart disease, or both.

The national prevalence rate of rheumatic fever in this population age group was 17.5 per 1,000, with a range from 6 per 1,000 to 40 per 1,000 among the various States. The national rate for rheumatic heart disease was about 5.7 per 1,000, with a range in the individual States from 2 to 12 per 1,000.

The geographic distribution of rheumatic

fever with or without rheumatic heart disease shows the highest rates in the Rocky Mountain area and in the northern temperate zone.

Prophylaxis

This section of our report examines the degree of application of prophylaxis against recurrent attacks of rheumatic fever among college freshmen who had an initial or subsequent attack of rheumatic fever at a time when secondary prophylaxis was generally recommended.

The efficacy of daily chemical or antibiotic prophylaxis against the development of recurrent attacks of rheumatic fever has been known for more than two decades and it is amply documented. Recent well-controlled studies by Feinstein and associates (*7*) have shown that well over 90 percent protection is afforded patients who receive such prophylaxis.

The first official recognition of this public health measure was the statement published by the American Heart Association in 1953 (*8*). Two years before, however, *Modern Concepts of Cardiovascular Disease* contained an article suggesting the same principles, based on the work of Massell and others in 1948 (*9*). The effectiveness of the sulfonamides had been reported earlier by Kuttner and Reyersbach in 1943 (*10*), Thomas and associates in 1941 (*11*), and Dodge and associates in 1940 (*12*). Coburn and Moore had suggested and used chemoprophylaxis in 1939 (*13*).

Little would be gained in this report by a review and perpetuation of the seemingly endless discussion as to whether the group A streptococcus is the "sufficient" cause of the attack of rheumatic fever. It appears certain that this organism is at the very least a "necessary" cause and that prophylaxis does indeed regularly and almost completely prevent subsequent attacks of this disease in the susceptible host. The importance of other factors, whether hereditary, environmental, or emotional, are not germane to this report.

In the face of such clear-cut evidence for almost one generation, it is becoming increasingly difficult to understand or to justify the singular lack of acceptance of this preventive measure against a disease which still kills more children and young adults than either poliomyelitis or tuberculosis. The discovery of a preventive measure against disease does not automatically make the elimination of that disease a fait accompli.

Nonapplication of this preventive measure cannot be explained or rationalized by reason of rheumatic fever having become a numerically unimportant cause of illness. Such reasoning is simply untenable in light of the evidence derived from this study and other indices of current morbidity. One is also forced to reflect upon the basis for the numerous and stoutly defended "practical" compromises with which we have been preoccupied in recent years. Suggestive findings that one group or another may not require prophylaxis may discourage its use for those in whom there is no question of the need. There is, in fact, up to the present time no concrete evidence to justify the routine exclusion of any special group of rheumatic fever patients from prophylaxis programs. It would seem far more rewarding to direct our attention first toward the determination of the actual extent of current usage of rheumatic fever prophylaxis and, if this is found to be as low as general impressions indicate, to find out why.

The factors to be considered in such investigation include physician acceptability, economic feasibility, practicality of continuous medication, patient education and acceptability, and a large number of medical care administrative problems. Several short-term studies have sought to determine the duration of successful administration of rheumatic fever prophylaxis in indigent clinic populations. Lendrum and Kobrin (*14*) and Wallace and associates (*15*) have noted that as many as 50 percent of patients have discontinued followup and prophylaxis after only 1 to 1½ years. Considerable attention has subsequently been drawn to the fact that these studies were focused on indigent clinic patients and by implication on a relatively uneducated or uneducable group. Corollary emphasis is given to the statement that the private patient will and does follow instructions much more adequately and continuously.

The retrospective study of rheumatic fever among college freshmen provides the opportu-

Table 5. Use of prophylactic medication by students with rheumatic fever or rheumatic heart disease, or both, by State of residence at time of attack, 1956–60

State of residence	Total	Ever on prophylaxis			Currently on prophylaxis		
		Cases	Percent	Rank [1]	Cases	Percent	Rank [1]
Total	9,044	4,583	50.7		1,101	12.2	
Alabama	18	12	66.7	2	0	0	47
Alaska	30	16	53.3	0	4	13.3	0
Arizona	67	32	47.8	35	11	16.4	7
Arkansas	21	12	57.1	12	1	4.8	46
California	308	151	49.0	32	28	9.1	35
Colorado	228	133	58.3	6	35	15.4	11
Connecticut	75	43	57.3	11	18	24.0	2
Delaware	42	12	28.6	48	7	16.7	6
District of Columbia	37	19	51.4	0	5	13.5	0
Florida	59	28	47.5	36	3	5.1	44
Georgia	65	36	55.4	16	8	12.3	19
Hawaii	5	1	20.0	0	0	0	0
Idaho	129	54	41.9	41	8	6.2	42
Illinois	321	170	53.0	22	41	12.8	18
Indiana	65	27	41.5	42	6	9.2	34
Iowa	301	138	45.8	39	35	11.6	21
Kansas	247	123	49.8	30	18	7.3	41
Kentucky	139	79	56.8	13	18	12.9	16
Louisiana	61	41	67.2	1	3	4.9	45
Maine	32	16	50.0	28	8	25.0	1
Maryland	53	29	54.7	19	12	22.6	3
Massachusetts	242	93	38.4	44	38	15.7	9
Michigan	662	359	54.2	20	101	15.3	12
Minnesota	646	362	56.0	14	91	14.1	14
Mississippi	69	38	55.1	17	7	10.1	28
Missouri	265	142	53.6	21	26	9.8	32
Montana	303	147	48.5	33	30	9.9	31
Nebraska	179	90	50.3	26	16	9.0	36
Nevada	30	12	40.0	43	3	10.0	30
New Hampshire	57	30	52.6	23	9	15.8	8
New Jersey	168	84	50.0	27	18	10.7	25
New Mexico	52	33	63.5	3	5	9.6	33
New York	461	227	49.2	31	80	17.4	5
North Carolina	110	64	58.2	7	12	10.9	24
North Dakota	77	43	55.8	15	4	5.2	43
Ohio	1,170	545	46.6	38	136	11.6	20
Oklahoma	129	80	62.0	4	10	7.8	39
Oregon	47	27	57.4	10	5	10.6	27
Pennsylvania	527	263	49.9	29	59	11.2	23
Rhode Island	21	9	42.9	40	3	14.3	13
South Carolina	40	22	55.0	18	4	10.0	29
South Dakota	147	85	57.8	9	23	15.6	10
Tennessee	62	36	58.1	8	8	12.9	17
Texas	62	23	37.1	46	7	11.3	22
Utah	377	176	46.7	37	40	10.6	26
Vermont	6	2	33.3	47	0	0	47
Virginia	95	36	37.9	45	7	7.4	40
Washington	235	122	51.9	25	33	14.0	15
West Virginia	160	77	48.1	34	14	8.8	38
Wisconsin	157	82	52.2	24	14	8.9	37
Wyoming	118	72	61.0	5	21	17.8	4
Foreign	67	30	44.8	0	8	11.9	0

[1] Rank of percentages ever on and currently on prophylaxis in each State of continental United States. Rank not assigned to percentages observed in Alaska, District of Columbia, Hawaii, and foreign students.

nity for an evaluation of the use of secondary prophylaxis against rheumatic fever. The number of cases (approximately 9,000 derived from the total surveyed population of slightly over one-half million students) was sufficiently large for detailed analysis of pertinent variables. Geographic distribution of this age group was not remarkably different from that of the general population. The relatively high socioeconomic and educational level of the study group allowed a determination of the degree to which physicians and patients have been convinced of the necessity for continuous secondary prophylaxis and minimized the economic and communication artifacts. Students in this age group (18–21 years) also passed through their period of maximum susceptibility to rheumatic fever attacks (ages 5 through 12 years) at a time when physicians were applying the Jones criteria and were generally aware of the value of prophylaxis against recurrences.

Method

Using the rheumatic fever questionnaire described in the preceding paper, students reporting a positive history of an attack of rheumatic fever were asked to answer a series of questions concerning medication received. They were requested to identify the drug or antibiotic, the age at which it was first administered, the duration of such administration, and whether they were currently taking any medications to prevent recurrent attacks of rheumatic fever.

Analysis was restricted to the 9,044 students who, on the basis of their history and clinical findings, were considered to have had rheumatic fever or rheumatic heart disease. This excluded some 2,000 students who reported that they had suffered an attack of rheumatic fever, but whose history was not validated by the examining physician.

Included, however, were 753 students with definite current rheumatic heart disease but who could recall no history of rheumatic fever. They represent a group in whom prophylaxis is indicated. They also point up the failure of prior school health examinations to reveal this diagnosis and to bring it to the attention of the student.

Results

The percentages of students currently on prophylaxis according to State of residence at the time of attack are shown in table 5. Nationally, of the 9,044 students who should have been receiving prophylactic medication only 12.2 percent were actually receiving it. The percentage of students currently receiving prophylaxis varied from none (Vermont and Alabama) to 25.8 percent (Maine). No clear geographic pattern is observed with reference to the level at which long-term prophylaxis is maintained. The percentage of students receiving prophylaxis in a particular State is not altered appreciably when the data are analyzed according to the State of residence at the time of survey rather than residence at time of attack as shown in figure 5.

Knowledge of the State of residence during the known first attack and the additional information as to whether prophylaxis had ever been prescribed afforded an opportunity to determine the physician's awareness of and the use of prophylaxis at the time of this attack. Of the 9,044 students, 4,583, or 50.7 percent reported receiving prophylaxis at some time following their initial attack (table 5). Once again the range is quite wide, from a low of 28.6 percent for Delaware residents to 67.2 for residents of Louisiana. There does not appear to be any strong association between the level of use of prophylaxis and the relative prevalence of the disease.

A comparison of the two categories of ever on prophylaxis and currently on prophylaxis shows no correlation between States having an original high level of prophylaxis and States having a high level of continuation of such prophylaxis.

The nature of the prophylactic agent used by the 4,583 students reporting using one or a combination of drugs is shown in table 6. Almost half of the treated group received penicillin alone, one-sixth received a combination of penicillin and sulfa drugs, another sixth received sulfa alone, and the remaining sixth did not specify the drug.

An increasing use of prophylaxis at the time of the initial attack would be expected as the knowledge of this preventive measure became more widely disseminated between the years 1940 and 1960. The 50.7 percent overall per-

centage may thus be giving an erroneous picture of the more recent application of this measure. As shown in table 7, the initial use of this preventive measure was noted in almost 80 percent of the students whose first attack occurred between 1955 and 1960. The "maintenance" of this prophylaxis, however, remains a problem because there is a considerable dropout of patients on prophylaxis, even during the later period (table 7).

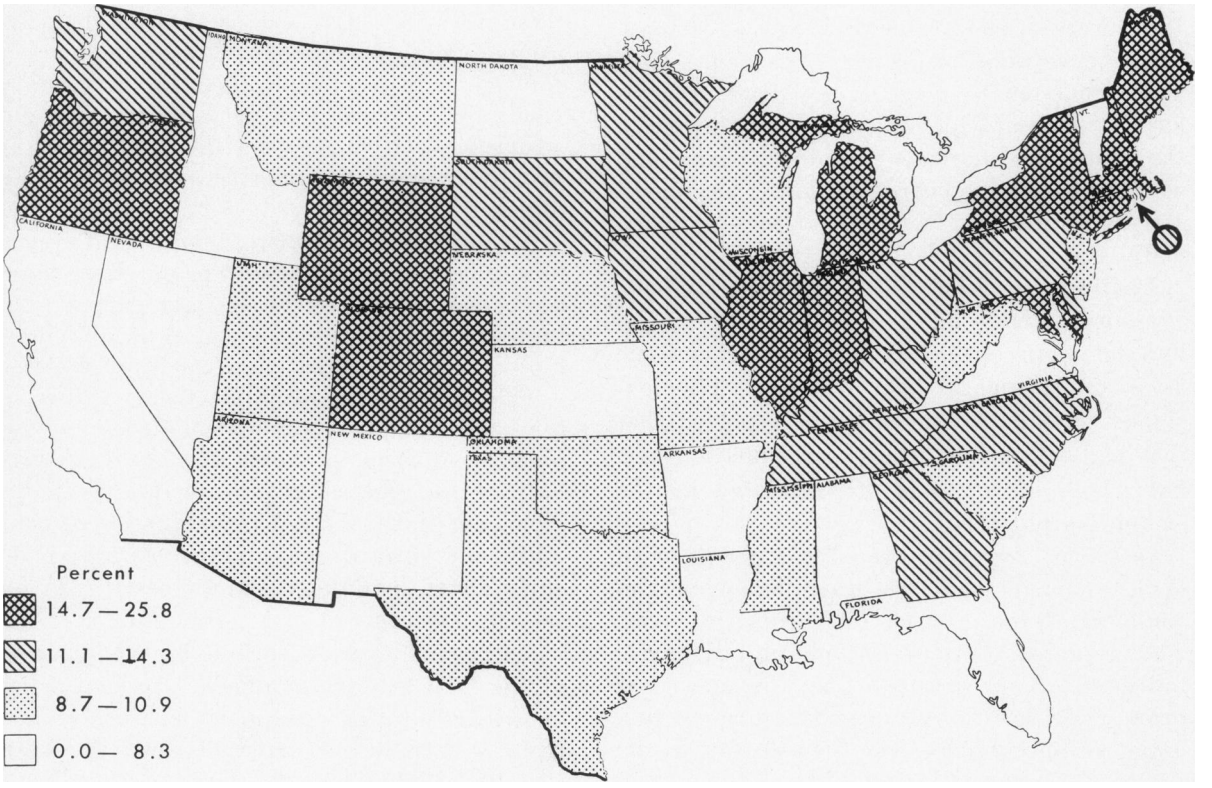
It would likewise be assumed that patients with known heart disease would be impressed with the need for protection against the recurrent damaging attacks of rheumatic fever. This is indeed the case, but again despite an initial high usage, the percentage of those continuing in the category "currently on" is still discouragingly small, with a maximum of 38.7 percent in the definite rheumatic heart disease group (table 8).

The further analysis of the relationship of initial usage and current usage of prophylaxis requires attention to the length of time elapsed between the date of the first attack and the time of the college entrance examination. This is shown in table 9, which illustrates the gradually decreasing percentage of use with the passage of time from onset of the disease. It is quite

Table 6. Reported use of prophylaxis by 9,044 students with rheumatic fever or rheumatic heart disease, or both, 1956–60

Use of prophylaxis	Number	Percent of total	Percent given prophylaxis
Total cases	9,044	100.0	
Unknown	2,516	27.8	
Not given	1,945	21.5	
Agent given	4,583	50.7	100.0
Penicillin tablets	1,249		27.3
Penicillin injections	809		17.7
Penicillin, type unspecified	120		2.6
Penicillin and sulfa drugs	763		16.6
Sulfa drugs alone	846		18.5
Type not specified	796		17.4

Figure 5. Percentage of students currently on prophylaxis, in quartiles, according to State of present residence



evident that this percentage had already dropped to a low of 33 percent even before the often used "magic number" of 5 years following the attack has elapsed.

Finally, in completing the characterization of the group "ever on" and "currently on" prophylaxis it is of value to determine whether those who have had several attacks of rheumatic fever are more likely to have been placed on such a prophylactic program and whether they would also tend to remain on such medication. These students have already had one or more recurrent attacks and have, in a sense, proved to themselves and to their physicians their susceptibility to such recurrences. A positive correlation between the number of recurrent attacks and both the initiation and continuation of prophylaxis is shown in table 10. Here, too, however, there is little comfort to be gained concerning the success of rheumatic fever prevention programs when only one-third of those who have already had multiple attacks are being maintained on prophylaxis.

Discussion

This study reveals a surprising and disappointing lack of application of prophylaxis against recurrent attacks of rheumatic fever among entering college students. This is most significant, because this age group (18–21 years) comprises young men and women who had their initial or subsequent attack following the general acceptance of the efficacy of such secondary prophylaxis against the disease.

Table 7. Students with rheumatic fever or rheumatic heart disease, or both, ever on prophylaxis and currently on prophylaxis at time of survey, 1956–60

Year of first attack	Number of cases	Ever on prophylaxis		Currently on prophylaxis	
		Number	Percent	Number	Percent of those ever on prophylaxis
Total	9, 044	4, 583	50. 7	1, 101	24. 0
Unknown	1, 608	335	20. 8	107	31. 9
Known	7, 436	4, 248	57. 1	994	23. 4
Before 1935	65	21	32. 3	3	14. 3
1935–39	147	41	27. 9	8	19. 5
1935	19	5	26. 3	0	0
1936	20	4	20. 0	0	0
1937	21	6	28. 6	2	33. 3
1938	28	3	10. 7	1	33. 3
1939	59	23	39. 0	5	21. 7
1940–44	1, 297	584	45. 0	78	13. 4
1940	82	30	36. 6	2	6. 7
1941	131	45	34. 4	7	15. 6
1942	191	83	43. 5	9	10. 8
1943	357	161	45. 1	27	16. 8
1944	536	265	49. 4	33	12. 5
1945–49	3, 105	1, 693	54. 5	301	17. 8
1945	655	320	48. 9	46	14. 4
1946	640	342	53. 4	45	13. 2
1947	636	345	54. 2	69	20. 0
1948	634	378	59. 6	79	20. 9
1949	540	308	57. 0	62	20. 1
1950–54	2, 186	1, 410	64. 5	360	25. 5
1950	547	328	60. 0	56	17. 1
1951	452	260	57. 5	62	23. 8
1952	440	276	62. 7	79	28. 6
1953	411	298	72. 5	77	25. 8
1954	336	248	73. 8	86	34. 7
1955–59	623	488	78. 3	238	48. 8
1955	253	202	79. 8	93	46. 0
1956	155	114	73. 5	42	36. 8
1957	99	78	78. 8	43	55. 1
1958	68	56	82. 4	34	60. 7
1959	48	38	79. 2	26	68. 4
1960	13	11	84. 6	6	54. 5

There is some evidence from this study that physician education toward the use of this preventive technique has been quite successful and that special educational efforts can be effective (table 7). Note the greater than usual rise in the percentage of patients placed on prophylaxis in 1953, the year during which "Heart Association Recommendations" were published.

The increased usage of prophylaxis correlated positively with recency of attack, with the students' knowledge of a diagnosis of rheumatic heart disease, and with the number of attacks. These data also give further evidence of the effectiveness of both physician and public education over the past decade.

In the area of long-term maintenance of the needed prophylaxis, the greatest failure becomes evident. The gradual "dropping out," which occurs with each year following the onset of the disease is shown in table 9. The maintenance of prophylaxis is completely dependent on regular and continuing contact between the physician and the patient. Thus it becomes evident that the major public health problem in this prevention program is one of medical care administration in achieving this continuing direct physician-patient contact. The problem faced by the private physician in recalling a delinquent patient to his office is a difficult one both logistically and ethically. At this point, the public health agencies can and should be providing their maximum service by encouraging the patient to return to medical supervision on a regular basis.

Patient delinquency is not unique to private medical practice, it is shared even by special rheumatic fever clinics. An unpublished study by one of us noted that transfer of patients from a children's cardiac clinic to an adult cardiac clinic for reasons of age alone, caused approximately a 50 percent loss of these patients to care and supervision because of inadequate administrative mechanisms for the transfer and recall of patients.

In addition to the administrative problems of continuity of care, there are two other more clinically oriented questions which might possibly be contributory to the poor record of prophylaxis found in this study. The first is a point of view recently presented by Feinstein and Spagnuolo (*16*) that only those patients suffering definite heart damage during the first attack are in need of such a preventive measure. It is held that if heart involvement does not occur during the first attack it will not occur in subsequent attacks. This has not been true in our experience with individual cases nor in the recent study by Kuttner and Mayer (*17*). This hypothesis would thus require much more documentation before it could become a generally acceptable reason for nonadministration of prophylaxis following definite rheumatic fever attacks.

The second clinical question relates to the

Table 8. Students on prophylaxis at time of survey, according to history of rheumatic heart disease, 1958–60

History	Number cases	Ever on prophylaxis		Currently on prophylaxis	
		Number	Percent	Number	Percent
Total	5, 933	3, 117	52. 5	771	13. 0
Reported rheumatic fever and rheumatic heart disease	5, 573	3, 117	55. 9	771	13. 8
Physician stated no history of rheumatic fever but found evidence of rheumatic heart disease	360				
Reported rheumatic fever but no rheumatic heart disease	2, 819	1, 537	54. 5	317	11. 2
Reported rheumatic heart disease but not confirmed by examination	773	416	53. 8	85	11. 0
Reported rheumatic heart disease, and rheumatic heart disease confirmed by examination	599	388	64. 8	179	29. 9
Definite rheumatic heart disease	346	249	72. 0	134	38. 7
Probable rheumatic heart disease	253	139	54. 9	45	17. 8

NOTE: Data on students' history of rheumatic heart disease not available for 1956–57.

Table 9. Percentage of students receiving secondary prophylaxis for varying periods of time, 1956–60

Average interval between onset of rheumatic fever and college entrance examination	Ever on prophylaxis	Currently on prophylaxis	
		Number	Percent
Total	4, 583	1, 101	24. 0
Unknown onset	335	107	31. 9
Known onset	4, 248	994	23. 4
4 months	44	29	65. 9
1 year, 2 months	104	67	64. 4
2 years, 2 months	123	54	43. 9
3 years, 2 months	158	68	43. 0
4 years, 2 months	214	72	33. 6
5 years, 2 months	275	85	30. 9
6 years, 2 months	312	90	28. 8
7 years, 2 months	299	60	20. 1
8 years, 2 months	307	69	22. 5
9 years, 2 months	306	61	19. 9
10 years, 2 months	364	63	17. 3
11 years, 2 months	384	69	18. 0
12 years, 2 months	400	65	16. 3
13 years, 2 months	368	58	15. 8
14 years, 2 months	234	32	13. 7
15 years, 2 months	147	21	14. 3
16 years and over	209	31	14. 8

duration of the need for prophylaxis following an attack of rheumatic fever. A number of empirical judgments have been made and several studies have attempted to determine the point in time following such an attack when the risk of recurrence becomes negligible; that is, when it approximates the risk incurred by persons of comparable age in the general population (*18*). Dublin's estimate (*2*) of the yearly incidence of rheumatic fever during the preantibiotic era was 2 per 1,000 per annum in the 5- to 14-year age group of the general population.

The data obtained from the college health examination included the dates at which the first and second attacks occurred. Using those patients who gave the age and date of first attacks as the population at risk, we calculated second attack rates at yearly intervals subsequent to the first attack by means of a life table procedure. The calculated second attack rates for all age groups combined, and second attack rates specific for the age of the patient at the time of first attack are given in table 11.

The theoretical risk of second attacks of rheumatic fever is summarized in table 12 for individual years and for 5-year periods following initial attack, and also by the age of the patient at the time of first attack.

The low risk of attacks observed in this study must not be compared with other studies in which no prophylaxis had been given to the study group. The college group reported here was exposed to an originally high usage of prophylaxis and some are still continuing this medication.

The life table has, however, one useful purpose in demonstrating that even though the risk in this partially protected group is quite low, there is no definite point in time covered by our observation period of 15 years following initial attack at which the risk of a recurrent attack can be considered negligible. The recurrence

Table 10. Students on prophylaxis at time of survey, according to number of attacks of rheumatic fever, 1956–60

Number of attacks	Number	Ever on prophylaxis		Currently on prophylaxis	
		Number	Percent	Number	Percent
Total cases	9, 044	4, 583	50. 7	1, 101	12. 2
Not stated [1]	1, 512	308	20. 4	78	5. 2
Uncertain	69	49	71. 0	13	18. 8
Known	7, 463	4, 226	56. 6	1, 010	13. 5
One	6, 030	3, 285	54. 5	676	11. 2
Two	1, 050	669	63. 7	223	21. 2
Three	289	199	68. 9	78	27. 0
Four or more	94	73	77. 7	33	35. 1

[1] Includes students diagnosed as having rheumatic heart disease but having no history of rheumatic fever.

Table 11. Risk of second attacks of rheumatic fever, by age of patient at initial attack and interval from onset of initial attack, 1956–60

Average interval in years from onset of first attack (*x*)	Persons exposed to risk at beginning of period (*lx*)	Person-years of exposure to risk (*Lx*)	Number of second attacks (*dx*)	Number of persons withdrawn from observation during period (*wx*)	Second attack rate per 1,000 (*qx*)
	Total, all ages				
0	7, 322	7, 296. 0	[1] 54	52	[1] 14. 8
1	7, 216	7, 155. 0	297	122	41. 5
2	6, 797	6, 726. 5	256	141	38. 1
3	6, 400	6, 311. 5	149	177	23. 6
4	6, 074	5, 938. 0	139	272	23. 4
5	5, 663	5, 496. 5	89	333	16. 2
6	5, 241	5, 038. 0	86	406	17. 1
7	4, 749	4, 550. 0	66	398	14. 5
8	4, 285	4, 078. 0	43	414	10. 5
9	3, 828	3, 613. 0	22	430	6. 1
10	3, 376	3, 129. 0	20	494	6. 4
11	2, 862	2, 605. 0	16	514	6. 1
12	2, 332	2, 024. 0	10	616	4. 9
13	1, 706	1, 413. 0	6	586	4. 2
14	1, 114	919. 5	2	389	2. 2
15	723	[2]	[2]	[2]	[2]
	0- to 2-year age group				
0	158	158. 0	[1] 2		[1] 25. 3
1	156	156. 0	4		25. 6
2	152	152. 0	7		46. 1
3	145	145. 0	2		13. 8
4	143	143. 0	3		21. 0
5	140	[2]	[2]	[2]	[2]
	3- to 4-year age group				
0	686	686. 0	[1] 2		[1] 5. 8
1	684	684. 0	25		36. 5
2	659	659. 0	32		48. 6
3	627	627. 0	14		22. 3
4	613	613. 0	14		22. 8
5	599	599. 0	13		21. 7
6	586	586. 0	14		23. 9
7	572	572. 0	13		22. 7
8	559	559. 0	2		3. 6
9	557	557. 0	7		12. 6
10	550	[2]	[2]	[2]	[2]

See footnotes at end of table.

rate between the 10th and 15th year following the last attack was still between 2 and 6 per 1,000.

Summary

The use of prophylaxis against recurrent attacks of rheumatic fever was found to be disappointingly low in a group of 9,044 college freshmen with definite and probable rheumatic fever or rheumatic heart disease, or both. Approximately 12.2 percent of those requiring such prophylaxis were actually receiving it.

The initiation of prophylaxis at the time of the attack was as high as 80 percent during recent years, indicating that physician education has been relatively adequate.

The major difficulty appears to be the administrative mechanism of maintaining continuity of care, which is a definite requirement for ef-

Table 11. Risk of second attacks of rheumatic fever, by age of patient at initial attack and interval from onset of initial attack, 1956–60—Continued

Average interval in years from onset of first attack (x)	Persons exposed to risk at beginning of period (lx)	Person-years of exposure to risk (Lx)	Number of second attacks (dx)	Number of persons withdrawn from observation during period (wx)	Second attack rate per 1,000 (qx)
	5- to 9-year age group				
0	3,335	3,335.0	[1] 17		[1] 10.2
1	3,318	3,318.0	131		39.5
2	3,187	3,187.0	117		36.7
3	3,070	3,070.0	80		26.1
4	2,990	2,990.0	83		27.8
5	2,907	2,907.0	43		14.8
6	2,864	2,863.5	55	1	19.2
7	2,808	2,803.5	40	9	14.3
8	2,759	2,715.0	31	88	11.4
9	2,640	2,494.5	13	291	5.2
10	2,336	2,128.5	14	415	6.6
11	1,907	1,675.5	10	463	6.0
12	1,434	1,154.5	4	559	3.5
13	871	640.5	3	461	4.7
14	407	330.0		154	
15	253	[2]	[2]	[2]	[2]
	10- to 14-year age group				
0	2,384	2,384.0	[1] 21		[1] 17.6
1	2,363	2,363.0	110		46.6
2	2,253	2,251.5	86	3	38.2
3	2,164	2,136.5	47	55	22.0
4	2,062	1,959.0	36	206	18.4
5	1,820	1,668.0	27	304	16.2
6	1,489	1,299.5	12	379	9.2
7	1,098	917.0	10	362	10.9
8	726	571.0	8	310	14.0
9	408	347.0	1	122	2.9
10	285	[2]	[2]	[2]	[2]
	15-year and over age group				
0	759	733.0	12	52	[1] 32.7
1	695	634.0	27	122	42.6
2	546	477.0	14	138	29.4
3	394	333.0	6	122	18.0
4	266	233.0	3	66	12.9
5	197	[2]	[2]	[2]	[2]

[1] Number reporting a second attack, on the average, within 6 months after first attack; the computed second attack rate multiplied by two to represent an annual attack rate.
[2] Number of persons exposed to risk too small to warrant calculation of second attack rate.

fective prophylaxis. The students' awareness of heart damage and the recency of attack and multiple attacks correlated positively with increased level of use of prophylaxis.

The risk of second attack is still at a significant level between the 10th and 15th year following the first attack. The risk beyond the 15th year unfortunately could not be determined from this study.

The rheumatic fever-rheumatic heart disease complex remains an important public health problem, and the solution to this problem is by no means receiving the benefit of the knowledge which has been available for several decades.

Table 12. Theoretical risk of second attacks of rheumatic fever by age of patient at initial attack and interval from onset of initial attack, 1956–60

Interval in years from onset of first attack (x)	Persons exposed to risk at beginning of period (lx)	Second attack rate per 1,000 (qx)	Number of second attacks (dx)
Total, all ages			
0	1,000	14.8	14.8
1	985.2	41.5	40.9
2	944.3	38.1	36.0
3	908.3	23.6	21.4
4	886.9	23.4	20.7
5	866.2	16.2	14.0
6	852.2	17.1	14.6
7	837.6	14.5	12.1
8	825.5	10.5	8.7
9	816.8	6.1	5.0
10	811.8	6.4	5.2
11	806.6	6.1	4.9
12	801.7	4.9	3.9
13	797.8	4.2	3.4
14	794.4	2.2	1.7
15	792.7	[1]	[1]
0–4	1,000	133.8	133.8
5–9	866.2	62.8	54.4
10–14	811.8	23.5	19.1
15	792.7	[1]	[1]
0- to 2-year age group			
0	1,000	25.3	25.3
1	974.7	25.6	25.0
2	949.7	46.1	43.8
3	905.9	13.8	12.5
4	893.4	21.0	18.8
5	874.6	[1]	[1]
0–4	1,000	125.4	125.4
5–9	974.7	[1]	[1]
3- to 4-year age group			
0	1,000	5.8	5.8
1	994.2	36.5	36.3
2	957.9	48.6	46.6
3	911.3	22.3	20.3
4	891.0	22.8	20.3
5	870.7	21.7	18.9
6	851.8	23.9	20.4
7	831.4	22.7	18.9
8	812.5	3.6	2.9
9	809.6	12.6	10.2
10	799.4	[1]	[1]
0–4	1,000	129.3	129.3
5–9	870.7	81.9	71.3
10–14	799.4	[1]	[1]
5- to 9-year age group			
0	1,000	10.2	10.2
1	989.8	39.5	39.1
2	950.7	36.7	34.9
3	915.8	26.1	23.9
4	891.9	27.8	24.8
5	867.1	14.8	12.8
6	854.3	19.2	16.4
7	837.9	14.3	12.0
8	825.9	11.4	9.4
9	816.5	5.2	4.2
10	812.3	6.6	5.4
11	806.9	6.0	4.8
12	802.1	3.5	2.8
13	799.3	4.7	3.8
14	795.5		
15	795.5	[1]	[1]
0–4	1,000	132.9	132.9
5–9	867.1	63.2	54.8
10–14	812.3	20.7	16.8
15	795.5	[1]	[1]
10- to 14-year age group			
0	1,000	17.6	17.6
1	982.4	46.6	45.8
2	936.8	38.2	35.8
3	900.8	22.0	19.8
4	881.0	18.4	16.2
5	864.8	16.2	14.0
6	850.8	9.2	7.8
7	843.0	10.9	9.2
8	833.8	14.0	11.7
9	822.1	2.9	2.4
10	819.7	[1]	[1]
0–4	1,000	135.2	135.2
5–9	864.8	52.2	45.1
10–14	819.7	[1]	[1]
15-year and over age group			
0	1,000	32.7	32.7
1	967.3	42.6	41.2
2	926.1	29.4	27.2
3	898.9	18.0	16.2
4	882.7	12.9	11.4
5	871.3	[1]	[1]
0–4	1,000	128.7	128.7
5–9	871.3	[1]	[1]

[1] Number of persons exposed to risk too small to warrant calculation of second attack rate.

Although maintenance of prophylaxis depends on a regular, continuing relationship between physician and patient, private physicians are faced with both logistic and ethical problems in setting up systems for patient recall. It is here that public health agencies can and must exercise their community responsibilities by providing the facilities and services to maximize medical supervision of patients on a regular basis.

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