

Rheumatic Fever in Cincinnati in Relation to Rentals, Crowding, Density of Population, and Negroes

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RHEUMATIC heart disease is now the first cause of death among children aged 10 to 14, and is second only to tuberculosis at ages 15 to 25.¹ Despite the importance of this disease its cause is not known and its epidemiology is not completely established. Epidemiological thought in the past has been influenced by the early English report² that rheumatic fever was an affliction of the artisan class, and not of the impoverished. However, all authorities do not agree with this view, and Glover³ expresses his opinion as follows: "The incidence of acute rheumatism increases directly with poverty, malnutrition, overcrowding, and bad housing." The association of these conditions with rheumatic infections has been examined critically in only a few surveys covering an entire community, namely those in England,^{2,4,5} Dublin, Ireland,⁶ Australia,^{7,8} New Haven,⁹ and Philadelphia.¹⁰ The epidemiology of rheumatic infections, including the epidemiology of acute hemolytic streptococcal infections, has been well summarized by Paul.¹¹

* The material for this paper was collected when the authors were associated with the Department of Bacteriology, University of Cincinnati College of Medicine, The Max Stern Heart Station for Rheumatic Heart Disease, and Children's Hospital, Cincinnati, Ohio.

METHOD OF SURVEY

The authors have recently completed an examination of all hospital admissions with rheumatic conditions, at all ages, in Cincinnati for the 11 year period 1930-1940.¹² There were 3,475 admissions and 2,178 cases studied in the survey (Table 1).^{*} Among these 2,178 cases there were 583 persons with a listing of rheumatic fever with or without rheumatic heart disease or chorea. Among these, home addresses in Cincinnati were available for 517. The home addresses used were given at the time of the first hospital admission during the period under study. These 517 patients had acute rheumatic infections, most of them with joint symptoms. All of them were not necessarily initial infections. It was believed that these acute cases would provide the most significant epidemiological data. All persons who had rheumatic heart disease without rheumatic fever, and all persons with uncomplicated chorea were omitted from the socio-economic analysis reported at this time.

Through the courtesy of Dr. Floyd P. Allen, Director of the Research

* It should be noted that a distinction has been made between persons, cases, and admissions. One case represents one hospital's records on one person, although that case may include one, two, or more admissions.

TABLE 1

*Cases of Rheumatic Infections Admitted to Cincinnati Hospitals from
January 1, 1930, to December 31, 1940*

	Number		Cases Utilized * in this Socio-Economic Analysis
All rheumatic heart disease	1,770		
Rheumatic heart disease with rheumatic fever and subacute bacterial endocarditis		9	9
Rheumatic heart disease with subacute bacterial endocarditis		51	
Rheumatic heart disease with rheumatic fever and chorea		8	8
Rheumatic heart disease with rheumatic fever		312	312
Rheumatic heart disease with chorea		52	
Rheumatic heart disease, uncomplicated		1,338	
Rheumatic fever without rheumatic heart disease	254		
Rheumatic fever with chorea		7	7
Rheumatic fever, uncomplicated		247	247
Chorea, uncomplicated	154	154	
Total	2,178	2,178	583

* in so far as addresses were available (517 of the cases)

Division, Cincinnati Public Health Federation, the authors were able to locate each home address in its proper census tract in the city. Dr. Allen has also kindly supplied the following information for each census tract:

1. Median monthly rental, 1940.
2. Per cent of occupied dwellings with 1.51 or more persons per room, 1939-1940. (This served as an index of crowding.)
3. Per cent of dwellings occupied by persons of a race other than white, 1939-1940. (Essentially an index of Negro population.)
4. Persons per net habitable acre, 1940. (This was taken as an index of density of population.)

There is a difference between *crowding*, or persons per room, and *density of population*, or persons per acre. The former is more important epidemiologically. The latter may simply be the result of many apartment houses or private homes close together.

DISTRIBUTION OF RHEUMATIC FEVER BY CENSUS TRACTS

A graphic presentation of the distribution of rheumatic fever in Cincinnati is given in Figure 1. A few words of explanation are necessary in this connection. There are 107 census

tracts. Four of these were omitted for reasons as follows:

1. C. T. 32 includes an Orphans' Home and the Cincinnati General Hospital. Four of the 5 cases occurred among the inmates or professional staff of these two institutions, and the home addresses were therefore considered inadmissible.

2. C. T. 59 had only one case in 11 years, but the sparse population caused the annual incidence to appear to be more than 10 cases per 100,000.

3. C. T. 85 had only 3 cases in the 11 year period, also in an area of sparse population, so its incidence likewise appeared to be more than 10 per 100,000.

4. C. T. 24 had a median rental of \$16, 17 per cent crowding, 57 persons per habitable acre, and 11 per cent Negroes, but an annual incidence of only 3 cases of rheumatic fever per 100,000 population. This tract is located entirely on a steep hillside (Sycamore Hill to Vine Street). It was omitted because the authors believed that the inhabitants were a selected population. No one would willingly move into or remain in the area unless in good health and able to endure the daily hill climbing. These 4 regions are indicated in Figure 1 by the number of the tract plus a question mark. The minor effect which the omission or inclusion of these 4 tracts had on the statistical significance of the data is described later.

Four other census tracts presented unusual features but were nevertheless

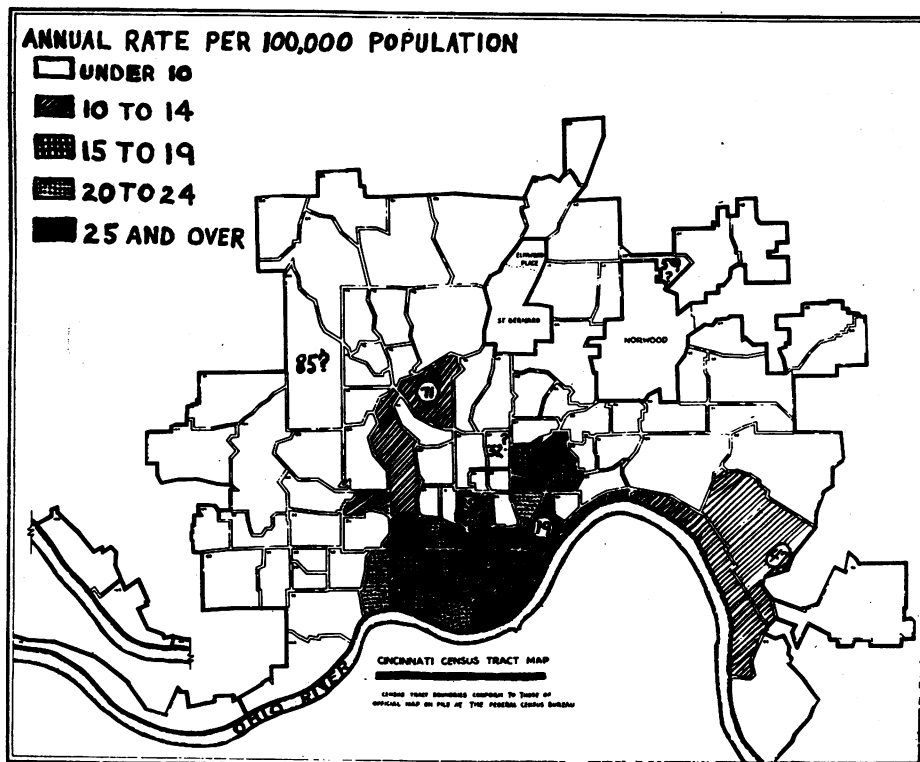


FIGURE 1—Distribution by city census tracts of 517 cases of rheumatic fever admitted to Cincinnati hospitals during 1930–1940, based on the mean annual number of cases per 100,000 population. Population based on an average of the U. S. Census of 1930 and Census of 1940. (See text regarding Census Tracts 19, 25, 47, 71 and 24, 32, 59, 85.)

included. All had an annual incidence of more than 10, but the median rentals were over \$21.65, and there was no crowding and there were no Negroes. Census tracts 19 and 47 were not economically uniform and contained homes of both the poor and well-to-do. C. T. 25 was rather uniformly an area of lower middle class homes, and C. T. 71 an area of expensive homes, but one less case in each tract would have reduced the annual incidence of rheumatic fever to less than 10 per 100,000 population.

TOPOGRAPHY OF THE CITY IN RELATION TO RHEUMATIC FEVER

Most of the patients resided in four sections of the city (Figure 1):

1. The "basin area," which is between the river front and the hills rising about a mile northward. This includes most of the slums and all of the central business district.
2. The Mill Creek Valley industrial area which runs northward in a finger-like process on the western side of the city.
3. C. T. 43 and 44 which extend eastward along the river below Columbia Parkway. This parkway is a broad concrete highway along the river above which are bluffs where part of the better residential district is located.
4. C. T. 34, 35, 36, and 37 in the Lincoln Heights District adjoining the basin area on the northeast.

The last group of tracts is easily identified in Figure 2 as comprising those marked by either cross-hatching or diagonally-slanted lines. This is not

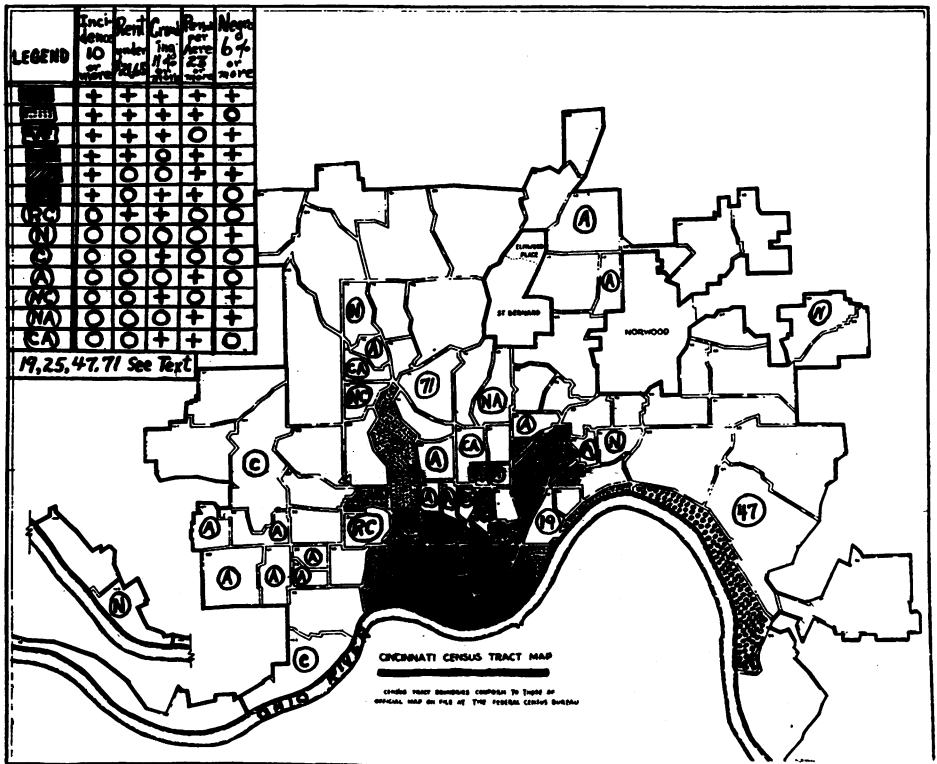


FIGURE 2—Annual incidence of hospitalized rheumatic fever per 100,000 population in each census tract, in relation to rentals, crowding, density of population, and Negro population. Letters in circles indicate characteristics of tracts so designated; thus, RC means rents low and crowded, N means high proportion of Negroes, etc.

a slum area but has a large Negro population, respectively 18, 7, 97, and 46 per cent. Furthermore, it is not a low lying or damp section but is in an elevated part of the city. This would seem to eliminate dampness and proximity to water courses as a possible major factor of importance.

SOCIO-ECONOMIC DISTRIBUTION OF RHEUMATIC FEVER

The relation of rentals, crowding within the home, density of population per acre, and Negro population to the incidence of rheumatic fever by census tracts is portrayed in Figure 2. There are some striking correlations. All 11 tracts (marked in solid black) which had low rents, crowding, dense popula-

tion, and Negroes, also had a significant level (10 or more annual cases) of rheumatic fever. All 12 tracts (stippled) which had low rents, crowding, dense population, but no Negroes (less than 6 per cent), also had a significant level of rheumatic fever. We might therefore say that the Negro was no factor, if it were not for the 4 tracts which had only dense population and Negroes. These are indicated by diagonal lines (3 tracts), or "NA" (1 tract). Three of these tracts had a significant incidence of rheumatic fever. This is consistent with the picture of rheumatic infections in Cincinnati as reported in previous papers.^{12, 13} The Negro had a higher incidence and a more severe form of this disease than

TABLE 2

Distribution by Census Tracts of 517 Cases of Rheumatic Fever Admitted to Cincinnati Hospitals During 1930-1940, in Relation to Rentals, Crowding, Density of Population, and Negro Population*

Characteristics of Census Tracts	Annual Cases Rheumatic Fever per 100,000 Population in Each Census Tract		(N=1) X ²
	10 Cases or More (C. T.)	Less than 10 Cases (C. T.)	
1. Rental less than \$21.65 monthly	25	1	
Rental \$21.65 or more	8	69	61.8
2. Crowding 11 per cent or more	25	6	
Crowding less than 11 per cent	8	64	45.0
3. Persons per acre 23 or more	30	19	
Persons per acre less than 23	3	51	34.1
4. Negroes 6 per cent or more	16	6	
Negroes less than 6 per cent	17	64	19.0
5. Negroes 15 per cent or more	12	2	
Negroes less than 15 per cent	21	68	18.7
Rental less than \$21.65			
Crowding 11 per cent or more (Omit Persons per acre and Negroes)	24	1	58.9
6. Rental \$21.65 or more			
Crowding less than 11 per cent (Omit Persons per acre and Negroes)	7	64	
Census Tracts not assignable above	(2)	(5)	
Crowding 11 per cent or more			
Persons per acre 23 or more (Omit Rentals and Negroes)	24	2	54.5
7. Crowding less than 11 per cent			
Persons per acre less than 23 (Omit Rentals and Negroes)	2	47	
Census Tracts not assignable above	(7)	(21)	

* 103 Census tracts after omission of C. T. 24, 32, 59, 85 (see text).

the white. Whether this is the result of racial susceptibility or of a different pattern of living cannot be determined exactly.

Table 2 summarizes the statistical relationship between the annual incidence of rheumatic fever and rentals, etc. The selection of (1) \$21.65 rental, (2) 11 per cent crowding, (3) 23 persons per acre, and (4) 6 per cent Negroes, was made after a trial and error method had determined that these limits gave the best correlation with the presence or absence of a significant amount of rheumatic fever. Such selection is necessary because the rental value of any one type of housing will vary in different cities and nations. Likewise the level at which crowding, density of population, or Negro population becomes important will vary somewhat in different cities depending upon other

factors such as climate and living habits. The limit of 10 annual cases of rheumatic fever per 100,000 population was also used by Hedley.¹⁰

It is evident that the order of importance is: (1) rentals, (2) crowding, (3) density of population, and (4) Negroes. For instance, there were 77 census tracts each of whose median monthly rental was over \$21.65. Only 8 of these areas had an appreciable incidence of rheumatic fever. Of 26 tracts with rental under \$21.65, 25 had a marked incidence of rheumatic fever.

According to the chi squared test, where $N = 1$, a X^2 between 3.5 and 4.0 means that the association could occur by chance alone 5 times in 100. Any larger X^2 is considered significant. For example, if the association of rentals and rheumatic fever yielded a X^2 of 10, with $N = 1$, the association could occur

by chance only 16 times in 10,000. Actually the X^2 in this instance was 61.8. All the associations in Table 2 show a high degree of significance.

Earlier in this article it was stated that C. T. 32, 59, 85, and 24 had been omitted. Inclusion of these 4 tracts in Table 2 would not seriously alter the significance of the data. In Table 2 the chi square for rentals would be changed from 61.8 to 52.7 and the other chi squares would become, reading downward in the table: 37.7, 32.9, 14.9, 17.0, 49.8, and 49.3.

SUMMARY AND COMMENT

This survey again emphasizes the importance of poverty and crowding in the genesis of rheumatic fever. However, poverty and crowding are only signposts pointing to a more fundamental epidemiological principle. It is instructive to compare the information gained by such surveys as this with what is now known about rheumatic infections in military camps in the United States. There is a comparatively high incidence of rheumatic fever in the military forces in Colorado, Idaho, and Utah. These camps are in dry* areas, removed from water courses, and at relatively high altitudes. Needless to say, poverty is no factor, and the housing, sanitation, and diet are excellent. In fact, there are only two features common both to the military forces in these states and to the impoverished civilians in areas with a high incidence of rheu-

matic fever, namely (1) crowding, and (2) inability to control the microclimate. It is not always possible for either the poor man or the military man to rest whenever he is tired, get warm when he is cold, and keep dry when it is raining. In civilian life, poverty, diet, proximity to water courses, etc., might be said to be important only in so far as they are a part of the two features mentioned, and so reduce the power of the body to resist disease.

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* Annual inches rainfall: Colorado 16, Idaho 18, Utah 13.