Natural Occurrence of Hemolytic Streptococci in Normal School Children

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High streptococcal carrier rates found among typical school children in an area where such infections are assumed to be lower than in more rigorous climates suggests caution in interpreting similar "throat culture" surveys.

Little is known about the natural occurrence of hemolytic streptococci and the epidemiology of streptococcal infections in civilian populations, in contrast to the extensive studies that have been performed in the armed services. The importance of learning more about this subject is emphasized by the observations that rheumatic fever and nephritis can be prevented by prophylaxis or treatment of streptococcal infections.[1, 2] The recent reports which show that acute glomerulonephritis often follows infections caused by certain serologic types of Group A streptococci also point toward the need for more extensive classification of these microorganisms.[2] With these items in mind a study was designed to investigate over a period of years the following problems: (1) the carrier rates for hemolytic streptococci in a specific age group of children; (2) the serologic groups and types of these streptococci; (3) the persistence or change in groups and types during the time of observation; and (4) the effect of socioeconomic and environmental factors on groups, types, and carrier rates. It is the object of this paper to report the results of the first two years of this study.

Description of Study

This study was conducted in 1953–1954 and 1954–1955 in Nashville, Tenn., a city with a population of 174,000 located along the Cumberland River. The temperature is kept within reasonable limits so that great extremes of heat or cold rarely occur. The mean annual temperature since 1910 has been 59.7° F, with a mean maximum of 69.2° and a mean minimum of 50.1°. The mean annual rainfall since 1910 has been 46.4 inches per year occurring principally in the winter and early spring. In 1955 the average relative humidity at 6:30 a.m. was 83 per cent and at 12:30 p.m. it was 55 per cent.[3]

Third-grade children from two schools, Clemons and Park, and fourth-grade children from Ransom School were studied during the school year 1953–1954. In 1954–1955 third-grade

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Table 1—Age and Sex of Study-Population in Three Nashville Schools

School and Year	No. of Children Studied	Age in Years			Sex	
		8–9	9–10	10+ *	M	F
1953–1954						
Ransom	59	1	29	29	26	33
Clemons	67	29	36	2	35	32
Park	43	17	18	8	20	23
Total	169	47	83	39	81	88
1954–1955						
Ransom	63	47	16	0	27	36
Clemons	54	29	24	1	22	32
Park	51	32	11	8	20	31
Total	168	108	51	9	69	99
Grand Total 1953–1954 1954–1955	337	155	134	48	150	187

* Oldest child was 13 years old.

children from all three schools were observed (Table 1). Permission for this work was obtained from the School Board of Nashville and consent for participation in the study was required from the parents of each child.* Only those children who attended school for at least four-fifths of the school year were included in the tabulations. In each school there were three or four each year who left school early or entered late. In 1953–1954, 169 children were studied and in 1954–1955 there were 168. In the two study years 155 children were eight to nine years of age, 134 were nine to 10, and 48 were 10 or older. One hundred and eighty-seven were females and 150 were males.

Excerpts from census tract data [4] (Table 2) illustrate clearly some of the socioeconomic differences among the populations of the census tracts in which the three schools were located. A majority of the children actually lived in the census tract in which "their" school was located, the remainder lived in bordering census tracts with similar characteristics. Ransom School, located in census tract 21, had the highest economic level, the highest educational attainments, better heating and toilet facilities, and there was less crowding in the homes than in the census tracts occupied by Clemons and Park Schools. Census tract 14 (Clemons) was intermediate and census tract 28 (Park) was definitely inferior in the categories listed in Table 2.

Beginning in mid-November of 1953 and 1954 and ending at the end of school in May, each of three physicians visited one of the schools and obtained throat cultures from each child in the study group present at school, weekly in 1953–1954 and every two weeks in 1954–1955. Cultures were taken in a standardized manner using dry, sterile, cotton swabs. The swabs were returned to individual sterile tubes and taken to the laboratory where each swab was streaked within one hour onto agar containing 5 per cent sheep's blood. The agar was also cut with the streaking wire to enhance the growth of subsur-

* The cooperation of the school health and educational authorities of the City of Nashville is gratefully acknowledged. Dr. Walter R. Manlove, director of the school health service for Nashville schools, his staff of public health nurses, the school principals, and teachers have been extremely helpful.

Table 2—Socioeconomic Characteristics of Census Tracts in Which the Study Schools Were Located *

	Census Tract 21 Ransom	Census Tract 14 Clemons	Census Tract 28 Park
Dwelling Units:			
Median monthly rent	$61.00	$44.02	$30.98
Per cent with dilapidated or no private bath	4.0	23.6	30.1
Per cent with central heating †	87.5	73.6	49.0
Crowding in Homes:			
Per cent of dwellings with persons per room > 1.01	2.5	8.5	15.0
> 1.51	0.5	1.5	5.0
Education:			
Persons 25+ years of age with 1+ years of college †	34	16	6
Family Income:			
Median income	$3,393.00	$3,021.00	$2,994.00
Per cent with income > $6,000	28	9	7

* U. S. Bureau of Census 1950.
† Twenty per cent sample.

face colonies. After incubation for 18–24 hours at 37° C the plates were observed for the presence of hemolytic colonies on the surface and in the cut areas. The number of surface hemolytic colonies was estimated as follows: less than 10 colonies, 1+; 10 to 50 colonies, 2+; more than 50 colonies but not the predominant growth, 3+; and predominant or pure growth, 4+. To isolate the hemolytic streptococci from the original plate one colony was picked and transferred. Grouping and typing were done following the procedure of Swift, Wilson, and Lancefield,[5] with the exception that 10.0 ml of bacto-brain heart infusion (Difco) was the growth medium and the entire extraction procedure was carried out in the same tube. If no group reaction could be obtained by the usual procedure, Maxted's [6] extract method, using the enzyme of Streptomyces albus, was performed. In 1953–1954 an attempt was made to classify approximately every fourth isolate from each pupil. In 1954–1955 91.9 per cent of all the isolates were classified. Isolates were stored at 4° C in liquid medium and some strains would not grow on subculture. Five different grouping antisera and 37 or 38 typing antisera were used.*

Results

Carrier Rates (Figure 1)—In the presentation of this data a differentia-

* 1953–1954: Groups A, B, C, D, and G. Types: 1–6; 8; 11–15; 17–19; 22–33; 36–44; 46; 47.
1954–1955: In 1954–1955 type 27 antiserum was omitted.
Grouping and typing sera were supplied through the courtesy of Dr. Elaine L. Updyke, Communicable Disease Center, Chamblee, Ga.

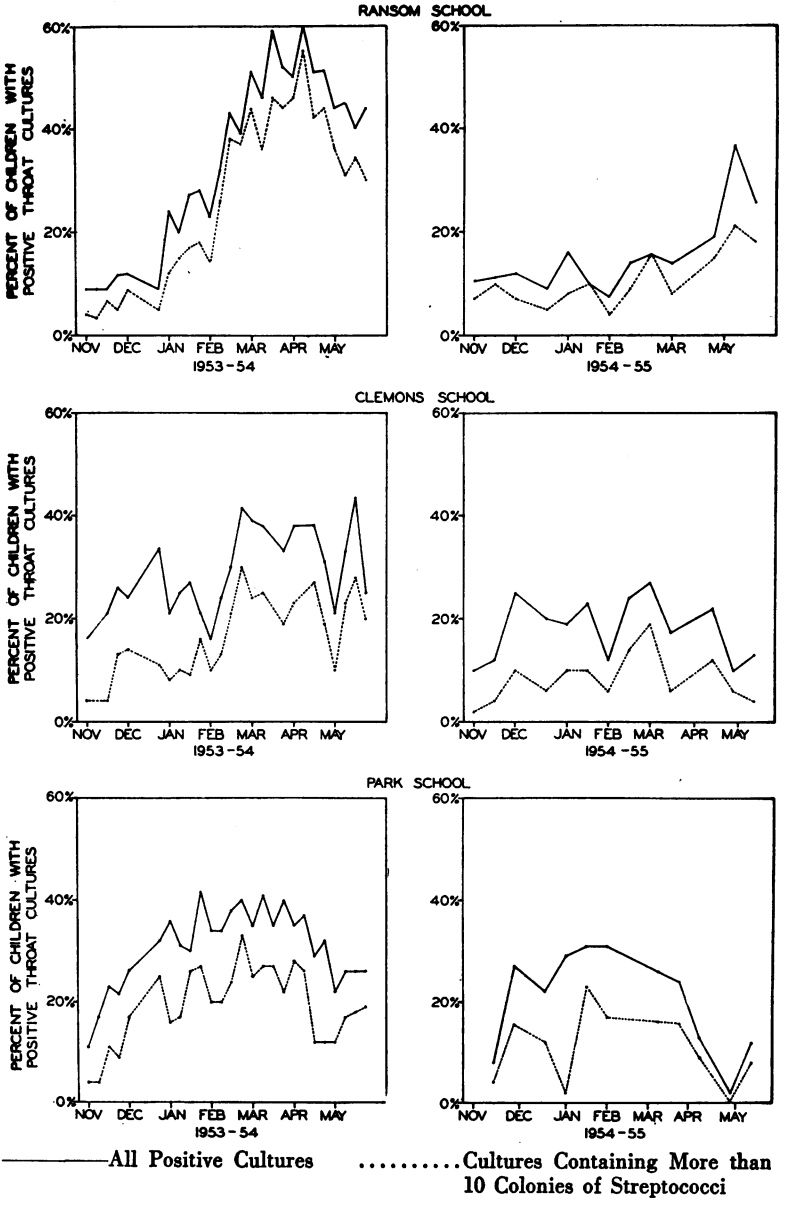


Figure 1—Per cent of Children from Three Nashville Schools Showing Hemolytic Streptococci in Throat Cultures 1953–1954 and 1954–1955.

tion has been made between cultures showing fewer than 10 colonies per plate and those showing more than 10 colonies per plate. In unpublished data from the Streptococcal Disease Laboratory, Francis E. Warren Air Force Base in Cheyenne, Wyo., it has been observed that throat cultures containing large numbers of streptococci are associated more frequently with an acute or recent

infection and the numbers of streptococci decrease over a period of weeks or months. The division of the groups is an arbitrary one and is used only to indicate roughly the quantity of streptococci carried by children.

Ransom School—The over-all carrier rates began at about the same level, 10–12 per cent at the beginning of the study in mid-November for each year. In 1953–1954 there was a steady rise to 60 per cent on April 12, whereas in 1954–1955 there was no significant increase until a very sharp rise to 42 per cent on May 9. The carrier rates, when only cultures containing more than 10 colonies are included, followed rather closely the incidence curves for the over-all rates. Seventy-nine per cent of positive cultures contained a 2+ or greater growth of streptococci in 1953–1954 and 67 per cent in 1954–1955.

Clemons School—The rates in this school began much lower and rose much less in 1954–1955 than 1953–1954. The highest carrier rates observed during the two study-years were 43 per cent on May 20, 1954, and 26 per cent on March 17, 1955. The carrier rates for the cultures containing 2+ or more colonies also followed the over-all incidence curves closely during both study-years, but the per cent of the total positive cultures was lower than Ransom School, being 57 in 1953–1954 and 47 in 1954–1955.

Park School—The over-all rates began at about the same level in each study year, 11 per cent and 8 per cent. In 1953–1954 there was a gradual rise to 41 per cent on February 2, followed by a plateau of approximately the same rates until March 30, and then a steady decline. In 1954–1955 the over-all rates reached their highest level of 31 per cent in early February and then diminished rather sharply. As in the other two schools the rates for cultures containing 2+ or greater growth of streptococci followed the over-all incidence pattern closely, at a level averaging 62 per cent of the over-all rates during each study-year.

Cumulative Percentages of Children with Hemolytic Streptococci in Throat Cultures

The cumulative percentages of children with positive throat cultures are shown in Figure 2. Eighty-eight per cent of the Ransom School children had a positive throat culture at least once

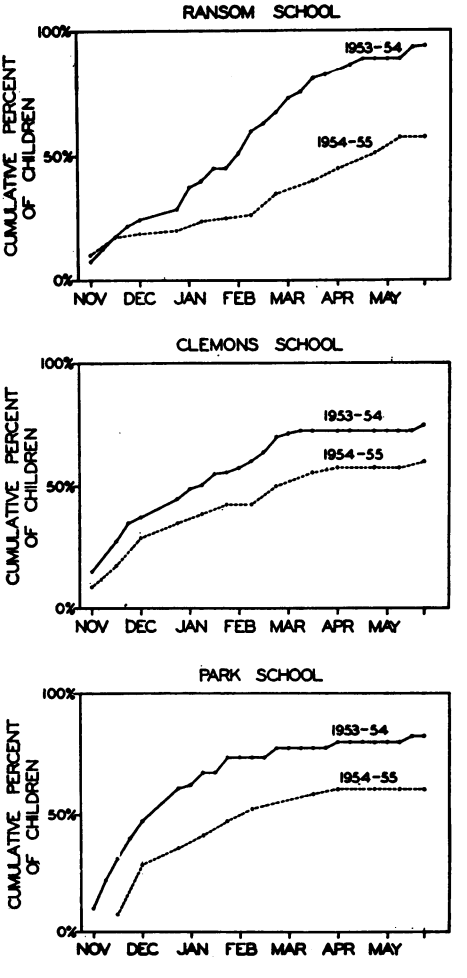


Figure 2—Cumulative Per cent of Children from Three Nashville Schools Showing Streptococci in Throat Cultures 1953–1954 and 1954–1955.

during the study period 1953–1954. The cumulative rates for Clemons School, 75 per cent, and Park School, 82 per cent, for the same year were slightly lower. Cumulative percentages were lower during the second study-year, but were similar in the three schools as follows: Ransom School 57 per cent, Clemons School 59.3 per cent, and Park School 60.8 per cent.

Bacteriologic Findings

The data for individual schools are presented in Table 3, in which are recorded by years: (1) the total number of throat cultures; (2) the number and per cent of cultures positive for hemolytic streptococci regardless of the degree of positivity; (3) the number and per cent of isolates which were grouped; (4) the number and per cent of isolates which were Group A; and (5) the number and per cent of Group A isolates that were typeable. Data for individual schools by study year follow:

Ransom School — 1953–1954—59 children. Fourteen hundred sixty-three throat cultures were taken of which 499 (34.1 per cent) were positive. Of 153 that were grouped, 143 (93.5 per cent) were Group A and of the Group A isolates 106 (74.1 per cent) were typeable.

1954–1955—63 children. Seven hundred and twenty-nine throat cultures were taken and 115 (15.8 per cent) were positive. One hundred and nine strains were grouped and 79 (72.5 per cent) were Group A. Sixty-four (81 per cent) of the Group A's were typeable. In Ransom School in 1954–1955 the average carrier rate was less than half that of 1953–1954, the per cent of isolates classified was lower, but more of the Group A's could be typed.

Clemons School — 1953–1954—67 children. Fourteen hundred and eighty-four cultures yielded 427 (28.8 per cent) positives. One hundred and forty were grouped, of which 132 (94.3 per cent) were Group A. Fifty-seven (43.2

Table 3—Bacteriologic Results

School and Year	Total No. of Throat Cultures Taken	No. and Per cent of Total Cultures Which Were Positive *		No. and Per cent of Positive Cultures Grouped †		No. and Per cent of Those Grouped Which Were Group A		No. and Per cent of Group A Typeable ‡	
		No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Ransom									
1953–1954	1,463	499	34.1	153	30.7	143	93.5	106	74.1
1954–1955	729	115	15.8	109	94.8	79	72.5	64	81.0
Clemons									
1953–1954	1,484	427	28.8	140	32.8	132	94.3	57	43.2
1954–1955	660	118	17.9	101	85.6	99	98.0	19	19.2
Park									
1953–1954	1,116	340	30.5	138	40.6	110	79.7	70	63.6
1954–1955	541	110	20.3	105	95.5	70	66.7	8	11.4
Total	5,993	1,609	26.8	746	46.4	633	84.9	324	51.2

* Includes all positive cultures regardless of the degree of positivity.
† Groups A, B, C, D, and G.
‡ Group A streptococci which could be typed with the available antisera, usually 37 or 38 types.

Table 4—Distribution of Groups of Hemolytic Streptococci

School and Year	Streptococcal Groups						
	A	B	C	D	G	NG *	Total
Ransom							
1953–1954	143	2	4	0	4	0	153
1954–1955	79	0	0	0	30	2	111
Clemons							
1953–1954	132	0	5	0	3	0	140
1954–1955	99	0	0	0	2	5	106
Park							
1953–1954	110	0	26	0	2	0	138
1954–1955	70	0	3	1	31	2	107
Total	633	2	38	1	72	9	757

* NG = No group; not groupable with A, B, C, D, or G grouping sera.

per cent) of the Group A's were typeable.

1954–1955—54 children. During this school year 660 cultures were obtained and 118 (17.9 per cent) were positive, this rate being a little over half that of 1953–1954. One hundred and one were grouped (85.6 per cent) and 99 (98.0 per cent) were Group A; 19 (19.2 per cent) of the Group A's were typeable.

Park School — 1953–1954—43 children. Of 1,116 cultures, 340 (30.5 per cent) were positive. One hundred and thirty-eight (40.6 per cent) of this number were grouped, and of these, 110 (79.7 per cent) were Group A. Seventy (63.6 per cent) of the Group A strains were typeable.

1954–1955—51 children. There were 541 cultures taken and 110 (20.3 per cent) were positive, an average carrier rate two-thirds that of the previous school year. One hundred and five were grouped, 70 (66.7 per cent) being

Table 5—Distribution of Types of Group A Streptococci

School and Year	Types of Group A Streptococci												
	1	3	4	5	6	12	18	19	24	28	41	NT *	Total
Ransom													
1953–1954	41	17	7	0	37	2	2	0	0	0	0	37	143
1954–1955	0	1	4	0	22	37	0	0	0	0	0	15	79
Clemons													
1953–1954	33	0	10	0	0	8	2	3	1	0	0	75	132
1954–1955	7	4	1	0	0	3	0	0	0	4	0	80	99
Park													
1953–1954	45	1	3	13	1	7	0	0	0	0	0	40	110
1954–1955	5	0	1	0	0	0	0	0	0	0	2	62	70
Total	131	23	26	13	60	57	4	3	1	4	2	309	633

* NT = No type; not typeable with available typing sera.

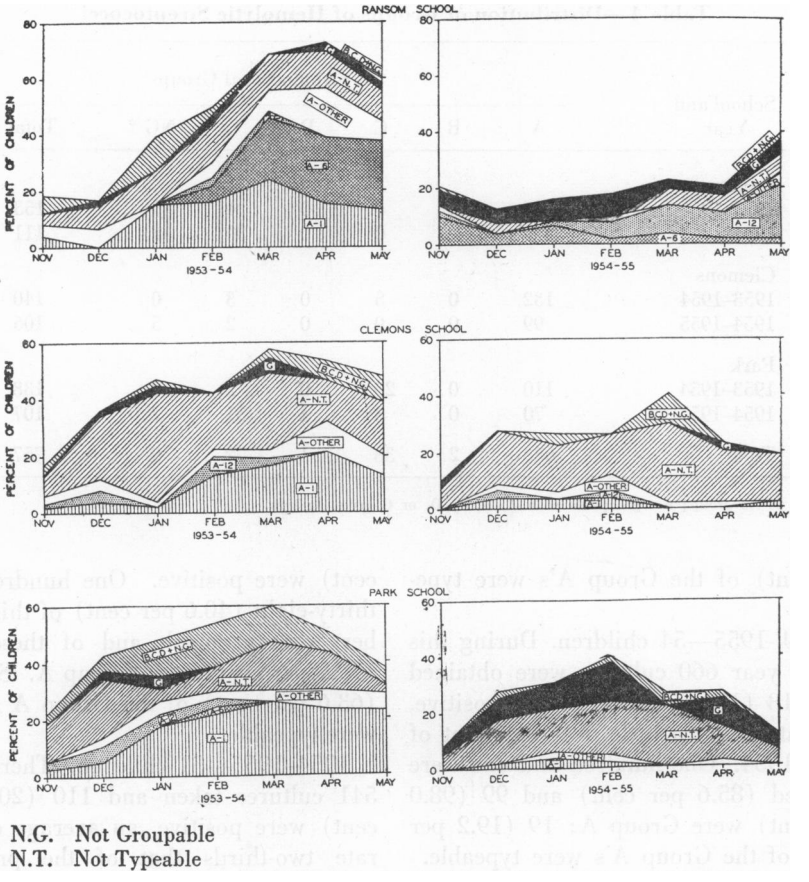


Figure 3a, b, and c—Percentage Distribution of Children According to the Various Groups and Types of Streptococci Isolated in the Indicated Months by School and Year.

NOTE—The width of each band on the vertical scale is proportional to the per cent of children with positive throat cultures for that particular group and type. The total number of children on which each percentage is based is made up of those children who had at least one throat culture during the month. Children positive one or more times during the month were counted as positive for the predominant group and type; a specific group and type was chosen arbitrarily over an unclassifiable one in a few cases. In the few instances where two types were isolated with equal frequency, the first type recovered during the month was recorded. Cases where throat cultures were positive but grouping and typing was not done were prorated according to the frequencies found for those which were grouped and typed during that month. These amounted to 13.6 per cent of the total cases in 1953–1954 and 1.5 per cent in 1954–1955. The total number of children represented in Figure 3 a, b, and c (Ransom School, approximately 60 each year; Clemons School, about 70 in 1953–1954 and 50 in 1954–1955; Park School, about 50 each year) was slightly higher than in Table 1 because of the inclusion of all children, even those few who dropped out or registered late. These numbers were denominators for calculating the percentages in Figure 3 a, b, and c.

Group A. Only eight (11.4 per cent) of the Group A's as compared with 63.6 per cent in 1953–1954 were typeable.

Serologic Groups and Types of Hemolytic Streptococci

There were marked differences in the occurrence of groups and types of hemolytic streptococci, not only during the two years of study, but also among each of the three schools during each school year. In Table 4 is shown the distribution of hemolytic streptococci that were grouped and in Table 5 the distribution of types from children in the three schools during both study years.

Almost 84 per cent of all streptococci grouped were Group A, 5 per cent were Group C, 9.6 per cent Group G, and the remainder were nongroupable. The per cent of the total number of children in the study who had positive throat cultures for each of the groups and types of streptococci by month is shown in Figures 3 a, b, and c for each of the three schools. An attempt was made to type 633 Group A isolates, but only 51.2 per cent were typeable. Types 1, 6, and 12 were the most common types. Altogether 11 different types, 1, 3, 4, 5, 6, 12, 18, 19, 24, 28, and 41, were identified during the two study years. In 1953–1954 Type 1 was the most common, increasing gradually in all three schools then declining after March or April. In 1954–1955 this type was found rarely. Type 6, isolated almost exclusively in Ransom School, increased in frequency in 1953–1954 but almost disappeared during the next school year. Type 12 was isolated in very small numbers in all three schools in 1953–1954, but after its appearance in three cultures in Ransom School on February 28, 1955, it was the most common typeable strain in this school, and the sharp increase in carrier rates on May 9 was due primarily to this type. Nontypeable strains were prominent throughout both study years, especially in Clemons and Park Schools.

Effect of Socioeconomic and Environmental Factors

In order to check the effect of socioeconomic and environmental factors on streptococcal carrier rates schools were chosen from census tracts that varied in these respects. In contrast to what

Table 6—Crowding Data for the Homes of Children in the Study

School and Year	No. of Persons per Room *	Per cent of Homes with Three or More Persons in Child's Bedroom	Per cent of Homes with Two or More Persons in Child's Bed
1953–1954			
Ransom	0.71	9.6	24.1
Clemons	0.79	18.4	29.2
Park	1.32	50.0	70.4
1954–1955			
Ransom	0.68	8.4	15.2
Clemons	0.81	24.5	43.3
Park	1.30	50.0	62.0

* Number = $\frac{\text{Number of persons living in house}}{\text{Number of rooms in house}}$

was anticipated, Ransom School, in the tract with the highest socioeconomic and environmental standards, also had the highest carrier rates during both study years. When these unexpected results were obtained, the homes and classrooms of the children were studied to determine if crowding at the time the study was in progress might have some influence on the differences in the carrier rates observed. Three criteria of crowding were used; the number of persons per room, the number of persons per bedroom, and the per cent of children sleeping two or more per bed. These data are recorded in Table 6 for both years of the study. Ransom School children were consistently less crowded than either of the other two groups of children; Clemons School children were intermediate as far as crowding in the home was concerned; Park School children were consistently and significantly more crowded at home but the carrier rates were not significantly higher in these children. The number of children per schoolroom and the number of cubic feet of air space per child in the schoolrooms were not significantly different in any of the schools for either school year. No correlation could be made, therefore, between increased streptococcal carrier rates and crowding in the homes or schools.

Effect of the Presence or Absence of Tonsils on Carrier Rates

In 1953–1954 the presence or absence of tonsils did not affect the carrier rates markedly because the rates for children with tonsils and for children without tonsils were not significantly different in any of the schools (Table 7). In 1954–1955, however, there was a decided difference and there were significantly more children with positive throat cultures whose tonsils were present than among those without tonsils.

Individual Case Records

During the 1953–1954 study year the results of the throat cultures of several

Table 7—The Effect of the Presence or Absence of Tonsils on the Occurrence of Hemolytic Streptococci in Throat Cultures

School and Year	Tonsils Present		Tonsils Absent	
	No. of Children	Per cent of These Children Who Were Streptococcal Carriers *	No. of Children	Per cent of These Children Who Were Streptococcal Carriers *
1953–1954				
Ransom	40	85	19	95
Clemons	58	78	9	56
Park	36	83	7	71
Total	134	81	35	80
1954–1955				
Ransom	40	68	23	39
Clemons	42	69	12	25
Park	39	72	12	25
Total	121	69	47	32

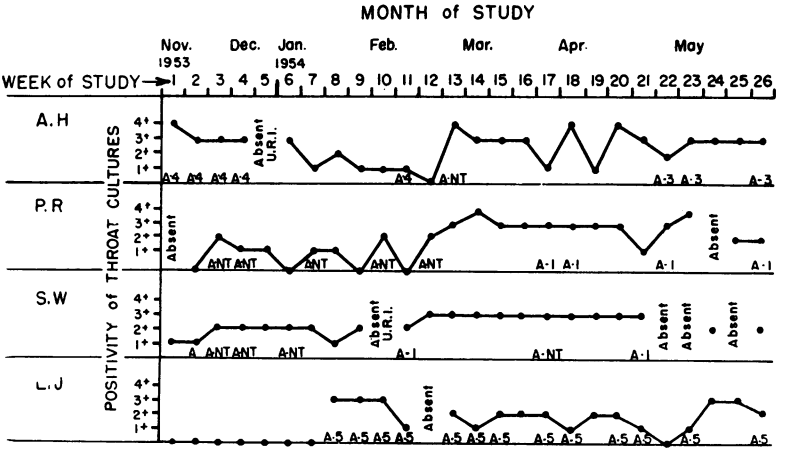
* The per cent of children who had positive throat cultures for hemolytic streptococci on one or more occasions.

children were remarkable enough to warrant special mention. In these individuals hemolytic streptococci were isolated from almost all cultures; the groups and types changed in some and remained constant in others. Complete individual case records are shown in Figure 4. Child A.H. had a positive throat culture each week of the study, with one exception when she was home with a "cold." During the school year A-4, A-NT, and A-3 were isolated from her throat. P.R. had a few colonies of A-NT for several weeks, then the colony counts rose to 3+ and 4+, after which A-1 was recovered during the rest of the school year. The child was not absent from school because of illness at the time of the change in type. S.W. had A-NT for nine weeks and was then absent with an upper respiratory infection. On return to school the cultures were positive for A-1, which remained for at least eleven weeks. L.J.'s culture became positive during the ninth study week and remained positive for A-5 during the remainder of the 19 weeks of school.

Discussion

In contrast to the intensive studies of the epidemiology of streptococcal infections in World War II in military populations in which streptococci were classified by group and type,[7–10] there have been few such studies in civilian populations. Noteworthy is the scarcity of adequate data on the natural occurrence of hemolytic streptococci in nonepidemic periods in civilian populations.

The finding of carrier rates for hemolytic streptococci ranging at their peak in 1953–1954 from 43 to 60 per cent and cumulative rates from 75 to 88 per cent was remarkable for several reasons. These rates, which appear to be unusually high, occurred in an area of the middle southern United States where it has often been said that streptococcal infections and rheumatic fever do not occur as frequently as in areas further north, and at a time when antibiotics were being employed extensively and irrationally in the treatment of many respiratory infections. Accurate in-



1+ = less than 10 colonies; 2+ = 10 to 50 colonies; 3+ = more than 50 but not the predominant growth; 4+ = predominant or pure growth.
A = Group A; C = Group C; G = Group G.
1, 3, 4, 5 = Types of Group A; NT = Group A, Nontypeable.

Figure 4—Occurrence of Hemolytic Streptococci in Four Children During the Study Year 1953–1954.

formation on the use of antibiotics in these children was not available but the results in general suggest, that if antibiotics were having a diminishing effect on carrier rates, the effect must have been minimal.

In a recent report, Packer, et al.,[11] found in Memphis, Tenn., a city not far from Nashville, carrier rates for orphanage children in the same general range as those of Nashville children. Another recent attempt to determine carrier rates for hemolytic streptococci in children was that of Saslaw and Streitfield[12] in Miami, Florida, a tropical city. They found that 20.1 per cent of children harbored hemolytic streptococci in their throats at least once in a four-month study period in 1954. Pike and Fashena[13] have summarized the hemolytic streptococcus carrier studies in civilian populations up to 1946 in which serologic grouping was reported. The highest carrier rates were those observed in their own study of children attending venereal disease and dental clinics in Dallas, Tex. Twenty-five per cent of 900 throat cultures obtained from 756 children over a 13-month period were positive for Group A streptococci. These three studies noted briefly above[11–13] done in different areas of southern United States indicate that high carrier rates are not confined to Nashville. In support of the idea that streptococcal infections are common in children is the work of Rantz and his co-workers in San Francisco[14] who found that new hemolytic streptococcal infections occurred commonly in infants and that few children reached the age of five without having at least one and often several apparent or inapparent infections due to the hemolytic streptococcus. Holmes and Williams[15] during an 11-week period in the autumn of 1949 in England, found throat carrier rates of 22.7 per cent for children attending schools or day nurseries.

In view of the findings above, the carrier rates for hemolytic streptococci in Nashville school children appear to be unusually high. The experience of these Nashville children is not unique, however, because many of the findings of Schwentker, Janney, and Gordon[16] of the epidemiology of scarlet fever in Rumania, such as the presence of a large number of different types in nonepidemic times, the change of serologic types from year to year in the same community, and the seasonal and yearly changes in streptococcal carrier rates were similar to these of the continually changing picture in Nashville.

The findings of the present study are of special interest because they furnish information on the occurrence of specific groups and types of hemolytic streptococci in two separate groups of normal preadolescent school children in three different schools during two school years. Since the majority of the cultures showed large numbers of Group A hemolytic streptococci, it is believed that this is evidence of recent or present infection. The studies of Bloomfield and Felty,[17] Rhoades, et al.,[18] and unpublished data from the Streptococcal Disease Laboratory, Francis E. Warren Air Force Base, furnish strong support for this belief. Although this study was not designed to make careful clinical observations, only one case of rheumatic fever was reported to the public health nurse (school nurse) in 1953–1954. No cases of glomerulonephritis were reported in either school year. The marked difference in carrier rates during the two study years and the change in groups and types of hemolytic streptococci in each of the schools during each study year indicate that the natural occurrence of streptococci is a continually changing process and one cannot predict accurately what will happen from year to year.

If, as several investigators indicate, immunity to streptococcal infections is

type-specific [19–22] the large number of types would preclude the possibility that any large segment of the community would become immune to very many types. Immunity to one or two types may be acquired by a child during a school year, but if the prevalent types change in the community (as they did in these Nashville schools) the individual would be susceptible to the new types. There was no single strain predominating at any one time in either year as was the case in the mammoth epidemics of streptococcal infections which occurred during World War II in recruit training centers of all the armed services. Rather, the situation in regard to the prevalence of different types at different times was similar to that in the Rumanian villages studied by Schwentker and his colleagues.[16]

Why the carrier rates changed markedly from year to year and why the prevalent serologic types changed remains unanswered. Changes in the weather were insignificant, meteorologic conditions being quite similar during both study years; and these factors therefore do not explain why the rates changed. The environmental factors in the schoolrooms, such as crowding, were similar in all three schools and do not offer any help in explaining the differences in carrier rates. Environmental conditions in the homes, such as crowding, also did not explain the differences. Contrary to what might be expected, Park School children, whose homes were consistently more crowded and of the poorest physical condition did not have the highest carrier rates in either of the study-years.

The effect of the presence or absence of tonsils on the carrier state is complex. The findings in 1953–1954, in which the presence or absence of tonsils had little effect on the carrier rates, were at variance with those of the Commission on Acute Respiratory Diseases [7] in which there was a definite association between the presence of tonsils and the duration of the carrier state following a food-borne epidemic of streptococcal infections. Likewise the findings in 1953–1954 differed from those of Holmes and Williams [15] whose data showed a striking positive correlation between throat carriers of hemolytic streptococci and the presence of tonsils. Although the problem of the effect of tonsils on carrier rates is being studied, more data will be needed before any conclusions can be reached.

Summary

This paper presents the findings of the first two years of a study in which throat cultures were obtained from third- and fourth-grade children attending three Nashville schools serving three different socioeconomic areas. Cultures were obtained every week during the study-year 1953–1954 and every two weeks in 1954–1955. Hemolytic streptococci were classified according to serologic groups and types; carrier rates were determined; and certain epidemiological correlations were made.

The carrier rates were highest in Ransom School, in the best socioeconomic area, reaching a high of 60 per cent in 1953–1954 and 42 per cent in 1954–1955. The highest for Clemons in the middle, and Park in the lower socioeconomic areas were 45 per cent, 26 per cent and 41 per cent and 30 per cent, respectively, in 1953–1954 and 1954–1955.

Cumulative percentages of children with positive throat cultures were 88 per cent, 75 per cent, and 82 per cent for Ransom School, Clemons School, and Park School, respectively, in 1953–1954 and approximately the same for all three schools, about 60 per cent, in 1954–1955.

Group A streptococci composed 83.7 per cent of all streptococci recovered, Group C (4.7 per cent) and Group G

(9.8 per cent) accounting for most of the other hemolytic streptococci.

Approximately 52 per cent of all the Group A strains were typeable. The typeable strains isolated most frequently were 1, 6, and 12. Types changed in each school in each study year.

The degree of crowding in the home and school and meteorologic conditions did not seem to influence the carrier rates directly.

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