Group A Beta Hemolytic Streptococcus and Rheumatic Fever in Miami, Fla.

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A LONG-TERM STUDY of the relationship of group A beta hemolytic streptococcus to rheumatic fever in Miami, Fla., was undertaken to explain why rheumatic fever seems less severe and occurs less frequently in Miami than reported elsewhere (*1–3*). A survey of the prevalence, type, and virulence of this group of organisms and the immunological response of the host over a period of years, we felt, would yield a pattern of host-organism relationship which might enable us to answer this question.

Our preliminary observations from February through May 1953 revealed the presence of group A beta hemolytic streptococcus in the throats of 16.3 percent of 343 school children in Miami (*4*) at some time during the 4-month period. This suggested that factors other than the mere presence of this group of organisms are responsible for the apparent difference in rheumatic fever in Miami's "tropical" climate (*5, 6*), as compared with other more northerly geographic localities.

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Since the preliminary findings were limited to a 4-month study period, we continued to culture samples from the throats of these children for group A beta hemolytic streptococcus from October 1953 through May 1954 in order to obtain a more comprehensive picture of the prevalence of this group of bacteria in the Miami area. In addition, antistreptolysin O studies were performed to determine whether the strains of group A beta hemolytic streptococcus isolated evoked a systemic response. This is a report of the bacteriological and immunological data obtained during this 8-month period and a discussion of the significance of the results.

Material and Methods

Throat Culture Studies

During the 8-month period, October 1953 through May 1954, pairs of throat swabs were taken monthly from an average of 351 children attending grades 1 and 2 in three schools in Miami, for a total of 2,809 pairs of swabs. In all, 417 children were included in the study, and each child's throat was swabbed an average of 6.7 times.

The children came from grades 1 and 2 in the same three schools previously studied (*4*); these represented a low-income white group, a middle-income white population, and a mixed-income Negro group. The sample selected, though not truly random, represents the stable school population. A high-income group was omitted because such a group does not maintain year-round residence in Miami and therefore does not permit long-term observation. The first graders were new to the study. Only 189 second graders who had participated the year before, as first-grade students, were included. Written permission of the parents had been obtained for each child.

In all, 1,050 children were registered in grades 1 and 2 of the three schools. Thus, the 417 children in the study represented 39.7 percent of the total registration in these two grades.

As in the preliminary study (*4*), throat swabs were taken in duplicate from all children present in school during the mornings set aside for this phase of the work. The same technician performed all the swabbings within a 2-hour period. All the collected swabs were taken promptly to the laboratory for immediate plating. One swab was streaked on a plate of Difco blood agar base (DBAB) and the other on a plate of Difco neopeptone heart infusion agar (DNHI); both media were enriched with 4 percent defibrinated sheep's blood. DNHI had been used in May 1953 as an adjunct to DBAB to insure recovery of the highest number of positive isolates. Incubation, isolation, and subculturing of the cultures were carried out as previously. Grouping and typing were performed again under the supervision of Dr. Elaine Updyke at the Streptococcus Laboratory, Communicable Disease Center, Public Health Service.

No attempt was made to obtain cultures from the throats of children absent on the days set for study. However, the school nurses checked the reason for absence in most instances.

Antistreptolysin O Studies

Blood samples were taken simultaneously with throat swabs every 2 months. The serums were kept in deep freeze until the end of the study, when antistreptolysin O titer determinations were made using a single lot of commercial Difco Bacto streptolysin O reagent. In all, 996 serums from 356 children were tested by standard procedure (*7*) at titers of <12, 12, 50, 100, 125, 166, 250, 333, 500, 625, and 833.

The bacteriological findings were classified into four categories as follows:

1. Serums from children whose throats yielded no beta hemolytic streptococcus or group B beta hemolytic streptococcus only. The latter group was included in this category because it does not produce streptolysin O (*8*).
2. Serums from those with nontypable strains of group A beta hemolytic streptococcus, either alone or in combination with other groups of beta hemolytic streptococcus.
3. Serums from children bearing typable strains of group A beta hemolytic streptococcus found at least once, either alone or in combination with other groups of beta hemolytic streptococcus.
4. Serums from children from whom group C or group G beta hemolytic streptococcus, or both, were recovered. Some strains of these groups produce streptolysin O (*8*).

In order to correlate and evaluate our bacteriological and serologic findings, an antistreptolysin O index (*9*) was established for each bacteriological category. The antistreptolysin O titers were assigned numerical rank from 1 to 11, respectively. The index was calculated according to the following formula:

Where R=numerical rank and S=number of samples for the particular rank:

Antistreptolysin O index=

$$\frac{(R_1 \times S_1) + (R_2 \times S_2) + \ldots (R_{11} \times S_{11})}{\text{Total samples per category}}$$

Average peak titers were calculated for each of the four bacteriological categories and for the total number of children studied. The peak titer for each child was the highest antistreptolysin O level obtained during the study.

The antistreptolysin O index has the advantage of overcoming excessive weighting caused by small numbers of samples at high titer levels. Average antistreptolysin O titers are included for comparative purposes because average computations of titers are in common usage.

Results

Throat Culture Studies

The groups and types of beta hemolytic streptococcus isolated from the throats of the children studied from October 1953 through May 1954, together with a summary of the findings for February through May 1953 (*4*), are shown in tables 1, 2, and 3. The highest percentage of positive cultures (15.4 percent) was obtained in May 1954 (table 1), the lowest (6.2 percent) in December 1953. The average percentage of positive cultures was 11.4 percent for the 8-month period and 6.2 percent for the 4-month period. The earlier 4-month study, of course, is not comparable quantitatively to the later 8-month survey.

Group A organisms were found at least once in 126 children, or 35.9 percent of the average of 351 children studied in the 8-month period (table 2). This percentage was about the same for each of the three schools (table 3), and no significant differences were found in the number of isolates from first grade children compared with second graders. The average monthly recovery rate of group A beta hemolytic streptococcus was 8.0 percent.

Nine types of group A beta hemolytic streptococcus (table 4) were encountered in October 1953 through May 1954, in contrast to strains of type 12 only (with the exception of a single strain of type 28) in February through May

Table 1. Grouping of beta hemolytic streptococcus isolated from 2,809 throat cultures in 417 children over an 8-month period, October 1953–May 1954, and comparison with February–May 1953, Miami, Fla.

Month	Number of children		Number of children positive 1st time					
	Absent	Present and cultured	Group A	Other groups				Total
				B	C	F	G	
Oct. 1953	35	382	24	4	2	----	4	34
Nov. 1953	45	372	25	2	4	2	2	35
Dec. 1953	46	371	4	2	----	----	1	7
Jan. 1954	55	362	12	2	----	----	2	16
Feb. 1954	78	339	17	2	3	----	2	24
Mar. 1954	93	324	8	----	2	----	1	11
Apr. 1954	89	328	15	1	3	----	2	21
May 1954	86	331	7	----	7	----	2	16
Total, Oct. 1953–May 1954	--------	2, 809	112	13	21	2	16	164
Summary Feb.–May 1953	--------	1, 154	46	6	4	[1] 1	1	58

Month	Number of cultures positive 2d, 3d, 4th, etc., times									Total positive cultures	
	Group A			Other groups					Total	Number	Percent
	1st time	New type	Same type	B	C	F	G	NG [1]			
Oct. 1953	------	------	------	----	----	----	----	------	------	34	8. 9
Nov. 1953	1	------	7	1	----	----	----	1	10	45	12. 1
Dec. 1953	1	------	9	3	----	----	3	------	16	23	6. 2
Jan. 1954	------	------	13	2	2	----	1	------	18	34	9. 4
Feb. 1954	3	3	13	2	2	----	2	------	25	49	14. 5
Mar. 1954	2	2	12	2	3	----	4	------	25	36	11. 1
Apr. 1954	3	2	14	4	4	1	----	------	28	49	14. 9
May 1954	4	------	24	1	5	----	1	------	35	51	15. 4
Total, Oct. 1953–May 1954	14	7	92	15	16	1	11	1	157	321	11. 4
Summary Feb.–May 1953	1	1	11	----	----	----	----	1	14	72	6. 2

[1] Nongroupable.

Table 2. Group A beta hemolytic streptococcus isolated from 2,809 throat cultures in 417 children over an 8-month period, October 1953–May 1954, Miami, Fla.

Month	Number of children cultured	Number of children with group A for the first time						
		Ao	At	At+Ao	Change to group A		Total	
					Ao	At	Number	Percent
Oct. 1953	382	22	2	-----	-----	-----	24	6.3
Nov. 1953	372	16	9	-----	-----	1	26	7.0
Dec. 1953	371	2	2	-----	1	-----	5	1.3
Jan. 1954	362	9	2	1	-----	-----	12	3.3
Feb. 1954	339	13	3	1	2	1	20	5.9
Mar. 1954	324	5	3	-----	1	1	10	3.1
Apr. 1954	328	6	9	-----	1	2	18	5.5
May 1954	331	5	2	-----	2	2	11	3.3
Total	2,809	78	[1] 32	[1] 2	7	[1] 7	126	35.9
Average per month	351.1	-----	-----	-----	-----	-----	-----	4.5

Month	Group A type changes		Total new group A isolates		Number of cultures positive 2d, 3d, 4th, etc., times				Total positive group A cultures	
	Ao	At	Number	Percent	Ao	At	Total		Number	Percent
							Number	Percent		
Oct. 1953	-----	-----	24	6.3	-----	-----	-----	-----	24	6.3
Nov. 1953	-----	-----	26	7.0	6	1	7	1.9	33	8.9
Dec. 1953	-----	-----	5	1.3	6	3	9	2.4	14	3.8
Jan. 1954	-----	-----	12	3.3	8	5	13	3.6	25	6.9
Feb. 1954	1	2	23	6.8	9	4	13	3.8	36	10.6
Mar. 1954	1	1	12	3.7	9	3	12	3.7	24	7.4
Apr. 1954	1	1	20	6.1	12	2	14	4.3	34	10.4
May 1954	-----	-----	11	3.3	15	9	24	7.2	35	10.6
Total	3	[1] 4	133	38.0	65	27	92	26.2	225	64.0
Average per month	-----	-----	-----	4.7	-----	-----	-----	3.3	-----	8.0

Ao=nontypable group A beta hemolytic streptococcus; At=typable group A beta hemolytic streptococcus.
[1] The 45 typable cases in these 4 columns are listed as total new isolates in table 4.

1953. Although type 12 predominated during the 8-month study and occurred in 26 instances, types 1 and 4 also were found frequently, type 1 in 17 and type 4 in 13 cases.

In 60 children, group A organisms were recovered 2 to 7 times during the 8-month period (table 5). Both typable and nontypable organisms were isolated from 8 children. In 8 other children, a strain of group B, C, F, or G beta hemolytic streptococcus was isolated, as well as a typable or nontypable strain of group A.

Of the 58 children who had beta hemolytic streptococci in their throats during the pilot study, only 29 could be included in the 8-month study. Of these 29 children, 21 (72 percent) continued to show the presence of beta hemolytic streptococci in their throats; 14 (48 percent) maintained the same type or group of organism; 5 had a different organism, and 2 had two different organisms. Eight were negative for beta hemolytic streptococcus. Fourteen of the twenty-four children with group A streptococcus in the first year continued to carry the same group of organisms in the second year.

A comparison of the number of positive cultures isolated on each of the two media used during the 8 months of the study showed that had a single culture plate been used we would have failed to recover approximately one-third of the total beta hemolytic streptococci and one-third of the group A organisms isolated. Both media were found to be equally effective in the isolation of beta hemolytic streptococci and of group A organisms. Present studies are being conducted to determine the effect of streaking the initial swabs on three plates.

Numbers of colonies of beta hemolytic streptococcus present on initial plates were recorded. Approximately one-fifth of all children with group A organisms recovered from their throats yielded more than 10 colonies on at least one of the 2 initial plates; four-fifths had under 10 colonies.

Some strains that showed alpha hemolysis on initial surface plating were found to give beta hemolysis on subsurface culturing. The failure of these strains to produce streptolysin S probably explains the absence of surface beta hemolysis, which depends on the formation of this lysin. On the other hand, subsurface beta hemolysis, the criterion for classifying a beta hemolytic streptococcus, is due to the formation of the oxygen-labile streptolysin O (*10*).

Table 6 lists children from whom the different groups of beta hemolytic streptococcus were isolated, according to the number of throat specimens cultured for each child. Higher

Table 3. School distribution of group A beta hemolytic streptococcus, October 1953–May 1954, Miami, Fla.

School	Average number of children studied	Children with group A		Total number of cultures taken	Total group A isolates	
		Number	Percent		Number	Percent
K	148. 4	54	36. 4	1, 187	98	8. 3
C	77. 3	25	32. 3	618	50	8. 1
D	125. 5	47	37. 5	1, 004	77	7. 7
Total	351. 1	[1] 126	[1] 35. 9	2, 809	225	8. 0

[1] In 7 of these children, changes in types or typability occurred, making a total of 133 different strains of group A beta hemolytic streptococcus isolated (37.9 percent).

Table 4. Types of group A beta hemolytic streptococcus isolated from 2,809 throat cultures in 417 children over an 8-month period, October 1953–May 1954, and comparison with February–May 1953, Miami, Fla.

Month	Typable group A new isolates (1st time)										Subsequent typable group A isolates					
	1	3	4	12	23	28	31	33	44	Total	1	3	4	12	28	Total
Oct. 1953	----	----	----	2	----	----	----	----	----	2	----	----	----	----	----	----
Nov. 1953	----	1	2	2	1	3	----	1	----	10	----	----	----	1	----	1
Dec. 1953	----	----	----	2	----	----	----	----	----	2	----	1	----	2	----	3
Jan. 1954	----	----	----	[1] 3	----	----	----	----	----	3	----	1	1	2	1	5
Feb. 1954	----	----	3	3	----	----	----	[1] 1	----	7	----	1	1	1	1	4
Mar. 1954	----	----	2	1	----	----	1	----	1	5	----	1	----	2	----	3
Apr. 1954	8	----	3	----	----	----	1	----	----	12	----	----	----	2	----	2
May 1954	3	----	----	1	----	----	----	----	----	4	6	----	1	2	----	9
Total	11	1	10	14	1	3	2	2	1	[2] 45	6	4	3	12	2	27
Summary Feb.–May 1953	----	----	----	25	----	1	----	----	----	26	----	----	----	1	----	1

[1] Includes 1 case of double infection with nontypable group A as second organism.
[2] Includes from table 2: At; At + Ao; At (change to group A); and At (type change).

Table 5. Sixty children with repeatedly positive throat cultures, October 1953–May 1954, Miami, Fla.

Case No.	1953			1954				
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
1003	Neg.	Neg.	Neg.	Neg.	Ao	Neg.	Neg.	Ao
1006	Abs.	Neg.	Neg.	Neg.	Abs.	Abs.	Ao	Ao
1007	Neg.	Neg.	Neg.	Neg.	A33+Ao	Ao	Ao	Ao
1009	Neg.	Neg.	Neg.	Neg.	A12	Abs.	A12	A12
1024	Neg.	Neg.	A12	Neg.	A12	Neg.	Neg.	Neg.
1027	A12	A12	Neg.	A12	A12	A12	A12	A12
1033	Ao	Neg.	Neg.	Neg.	Neg.	Neg.	Ao	C
1055	Neg.	A12	A12	Neg.	Ao	Ao	Ao	Neg.
1063	Abs.	Neg.	Neg.	Neg.	Neg.	Neg.	A1	A1
1064	Neg.	Neg.	Neg.	Neg.	A4	Neg.	Neg.	A4
1106	Neg.	Ao	Neg.	Neg.	Ao	Trans.	----------	----------
1113	Ao	Ao	Ao	Neg.	A12	A12	A1	A1
1116	Neg.	Neg.	Neg.	Neg.	C	Neg.	A1	A1
1117	Neg.	Ao	Neg.	Ao	[1]	[1]	[1]	[1]
1124	C	Neg.	Neg.	Neg.	Ao	Neg.	Neg.	Ao
1126	Neg.	Ao	Neg.	Ao	Neg.	Trans.	----------	----------
1133	Neg.	Neg.	Neg.	Neg.	Neg.	Abs.	A1	A1
1135	Ao	Ao	Neg.	Ao	Ao	Neg.	Neg.	Ao
1140	Neg.	Neg.	Ao	Ao	Ao	Neg.	Neg.	Neg.
1144	Neg.	Ao	Neg.	Ao	Neg.	Neg.	Neg.	Neg.
1151	Neg.	Abs.	Abs.	Ao	A4	Neg.	Neg.	Neg.
1169	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	A1	A1
1173	Neg.	Neg.	Neg.	Neg.	Neg.	Abs.	A1	A1
1183	Neg.	Neg.	Neg.	Neg.	Ao	Neg.	A44	Neg.
1309	Neg.	Neg.	Neg.	A12	Neg.	Neg.	Ao	Ao
1314	Neg.	Neg.	Ao	Neg.	Ao	Neg.	Neg.	Neg.
1315	Neg.	A12	A12	Neg.	[1]	[1]	[1]	[1]
1317	Neg.	F	Ao	Neg.	Neg.	Neg.	Neg.	Ao
1320	Ao	Neg.	Neg.	Ao	Ao	Neg.	Neg.	Ao
1334	Neg.	A4	Neg.	A4	Neg.	Neg.	Neg.	Neg.
1344	Neg.	Neg.	Neg.	Neg.	Neg.	Ao	Ao	Neg.
1357	Neg.	Ao	Neg.	Neg.	Neg.	Neg.	Ao	Trans.
1360	Neg.	A28	Neg.	A28	A28	Trans.	----------	----------
1368	Neg.	Ao	Ao	Neg.	Abs.	Neg.	Neg.	Neg.
1371	Neg.	Ao	Ao	Neg.	Neg.	Ao	Ao	Neg.
1373	Neg.	Neg.	Neg.	Ao	Ao	Ao	Neg.	Ao
1388	Neg.	A3	A3	A3	A3	A3	Neg.	Neg.
1389	Abs.	Neg.	Neg.	Ao	Neg.	Ao	Abs.	Neg.
1609	Ao	Ao	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
1611	Ao	Ao	Neg.	Neg.	Neg.	Abs.	Neg.	Neg.
1619	Neg.	Neg.	B	Neg.	Ao	Neg.	Ao	Neg.
1620	Neg.	Neg.	Neg.	Neg.	Ao	Ao	Ao	Neg.
1622	Neg.	Ao	Ao	Neg.	Neg.	Neg.	Neg.	Neg.
1626	Neg.	Neg.	Neg.	Neg.	Neg.	Abs.	Ao	Ao
1628	Neg.	Neg.	A12	A12	Neg.	Ao	Neg.	Neg.
1640	Ao	Neg.	Neg.	Neg.	Ao	Neg.	Neg.	Neg.
1656	Neg.	B	Neg.	Neg.	Neg.	Neg.	Ao	Ao
1660	Neg.	Ao	Ao	Neg.	Ao	Neg.	Neg.	Neg.
1673	Neg.	Abs.	Neg.	Ao	Abs.	Ao	Ao	Neg.
1675	Neg.	Neg.	Neg.	A12+Ao	Neg.	Neg.	Ao	Neg.
1684	Neg.	Neg.	Neg.	Neg.	Ao	Neg.	Ao	Neg.
1685	Neg.	Ao+G	Ao	Ao	Neg.	Neg.	Neg.	Ao
1694	Neg.	Neg.	Neg.	Neg.	Ao	Ao	Neg.	Neg.
1695	Neg.	Neg.	Neg.	Neg.	Abs.	Ao	Ao	Neg.
1702	Ao	Ao+G	Neg.	Neg.	Neg.	Neg.	C	Ao+C
1703	Neg.	Neg.	Neg.	Neg.	Ao	Neg.	Neg.	Ao
1707	Neg.	Ao	Neg.	Ao	Abs.	Neg.	Neg.	Ao
1709	Neg.	Neg.	Neg.	Neg.	Neg.	Abs.	Ao	Ao
1718	Neg.	Neg.	Neg.	Ao	Ao	Abs.	Neg.	Neg.
1742	Ao	Ao	Neg.	Abs.	Abs.	Neg.	Neg.	Neg.

[1] Withdrawn from study.

Ao=nontypable group A beta hemolytic streptococcus (ABHS); A1=type 1; A3=type 3; A4=type 4; A12=type 12; A28=type 28; A33=type 33; and A44=type 44 ABHS; B, C, F, and G each designates a beta hemolytic streptococcus group.

Neg.=negative; Abs.=absent; Trans.=transferred.

percentages of positive cultures recovered from those children from whom smaller numbers of swabbings per child were taken may reflect absenteeism due to streptococcal throat infections. However, the numbers are too small within each category to be interpreted finally.

Antistreptolysin O Studies

Table 7 shows the antistreptolysin O titers in relation to bacteriological categories, and gives the average antistreptolysin O titer and index for each bacteriological category. The antistreptolysin O index (4.6) of children with group A beta hemolytic streptococcus was elevated over the index (3.5) of children from whom no beta hemolytic streptococcus or only group B was recovered. Although children with typable strains of group A had a higher average antistreptolysin O titer than those with nontypable strains of group A, the antistreptolysin O index was the same for both. Children from whom groups C or G organisms, or both

Table 6. Relationship between number of cultures per child and frequency of recovery of various groups of beta hemolytic streptococcus

Number of months specimens were taken	Number of children cultured	Total cultures	Number of children negative	Number of children positive by number of months each child was positive							Positive cultures	
				1	2	3	4	5	6	7	Number	Percent
Group A												
8	212	1, 696	143	34	20	5	5	3	0	2	138	8. 1
7	89	623	57	19	10	3	----	----	----	----	48	7. 7
6	37	222	26	7	4	----	----	----	----	----	15	6. 8
5	26	130	16	5	3	2	----	----	----	----	17	13. 1
4	16	64	12	1	3	----	----	----	----	----	7	10. 9
3	12	36	12	----	----	----	----	----	----	----	0	--------
2	13	26	13	----	----	----	----	----	----	----	0	--------
1	12	12	12	----	----	----	----	----	----	----	0	--------
Total	417	2, 809	291	66	40	10	5	3	0	2	225	8. 0
Group B												
8	212	1, 696	200	5	4	----	3	----	----	----	25	1. 5
7	89	623	88	1	----	----	----	----	----	----	1	. 2
6	37	222	36	1	----	----	----	----	----	----	1	2. 7
3	12	36	11	1	----	----	----	----	----	----	1	8. 3
Total	417	2, 809	402	8	4	0	3	----	----	----	28	1. 0
Group C												
8	212	1, 696	190	15	4	1	[1]2	----	----	----	34	2. 0
7	89	623	87	1	1	----	----	----	----	----	3	3. 4
6	37	222	35	2	----	----	----	----	----	----	2	5. 4
Total	417	2, 809	391	18	5	1	2	----	----	----	39	1. 4
Group F												
8	212	1, 696	210	2	----	----	----	----	----	----	2	. 1
4	16	64	15	1	----	----	----	----	----	----	1	1. 6
Total	417	2, 809	414	3	----	----	----	----	----	----	3	. 1
Group G												
8	212	1, 696	203	[1]7	2	----	----	----	----	----	11	. 6
7	89	623	83	2	[2]3	----	----	----	[2]1	----	14	2. 2
6	37	222	34	1	2	----	----	----	----	----	5	2. 3
4	16	64	15	1	----	----	----	----	----	----	1	1. 6
Total	417	2, 809	398	11	7	----	----	----	1	----	31	1. 1

[1] Includes 2 children who, on 1 occasion, were found to have group A organisms plus organisms of another group simultaneously. In table 1 these children are listed in group A columns only, thus accounting for apparent discrepancies in numbers of cultures of groups other than group A.
[2] Includes 1 such child as above.

Table 7. Antistreptolysin O (ASO) titers of 996 serums taken from 356 children, by bacteriological category of child

Numerical rank	ASO titer	Bacteriological category [1]								Total serums
		I		II		III		IV		
		Number of serums	Percent	Number of serums	Percent	Number of serums	Percent	Number of serums	Percent	
1	<12	99	16. 6	5	2. 5	5	4. 6	1	1. 1	110
2	12	157	26. 3	22	10. 8	28	25. 7	10	11. 5	217
3	50	77	12. 9	28	13. 7	8	7. 3	23	26. 5	136
4	100	75	12. 6	41	20. 2	10	9. 2	15	17. 3	141
5	125	72	12. 1	38	19. 2	16	14. 7	10	11. 5	137
6	166	91	15. 1	47	23. 2	23	21. 1	16	18. 4	177
7	250	13	2. 2	17	8. 4	6	5. 5	9	10. 4	45
8	333	4	. 7	4	2. 0	8	7. 3	1	1. 1	17
9	500	3	. 5	0	-------	4	3. 7	1	1. 1	8
10	625	5	. 8	0	-------	0	-------	1	1. 1	6
11	833	1	. 2	0	-------	1	. 9	0	-------	2
Total	--------	597	100. 0	203	100. 0	109	100. 0	87	100. 0	996
Number of children		223		70		34		29		356
Average number serums per child		2. 7		2. 9		3. 2		3. 0		2. 8
Titers of 166 or above		117	19. 6	68	33. 5	42	38. 5	28	32. 2	[2] 255
Titers of 250 or above		26	4. 4	21	10. 3	19	17. 4	12	13. 8	[3] 78
Average ASO titer		81		119		134		120		100
Average peak ASO titer		97		134		209		138		119
ASO index		3. 5		4. 6		4. 6		4. 4		4. 0

[1] I. Children with no beta hemolytic streptococci or group B only; II. children with nontypable strains of group A beta hemolytic streptococcus, either alone or in combination with other groups; III. children with typable strains of group A beta hemolytic streptococcus at least once, either alone or in combination with other groups; IV. children with group C or group G beta hemolytic streptococcus, or both.

[2] 25.6 percent.

[3] 7.7 percent.

groups, were isolated demonstrated approximately the same average antistreptolysin O titer and index as those with nontypable group A streptococcus. Analysis of the peak antistreptolysin O titers indicated that the average peak was lowest in children from whom no beta hemolytic streptococci were isolated, higher in those with group C and group G or nontypable group A streptococcus, and highest in children with typable strains of group A organisms.

The number and percentage of serums with titers of 166 and above, as well as those of 250 and above, are also listed for each of the 4 bacteriological categories. Where beta hemolytic streptococci were isolated, the percentage of high titers was greater than where these organisms were not recovered.

Discussion

The present study confirms our preliminary impression (*4*) that the low incidence of rheumatic fever, when diagnosed in conformity with Jones' criteria (*11*), and of rheumatic heart disease in Miami, Fla. (*1*), cannot be attributed to the infrequency of group A beta hemolytic streptococcus in this "tropical" climate. The finding of group A beta hemolytic streptococcus in the throats of 126 of the total of 417 children (30.2 percent) or 35.9 percent of the average monthly attendance figure of 351 children in three Miami schools during the 8-month period, October 1953 through May 1954, demonstrates that those organisms were common in this area. Additional studies now in progress in 900 children attending the first three grades in 36 other schools in Dade County, Fla., further indicate that this rate can be applied to the entire school population in the 6- to 9-year age group.

The streptococcal recovery rate must be considered minimal since no throat swabs were taken from absentees and no data on therapeutic use of antibiotics were available. If many of the absences were due to streptococcal infections, collection of throat swabs from these children during their absence might have yielded a higher recovery rate.

Furthermore, the rate must be considered minimal for other reasons. The technical impossibility of swabbing the faucial surfaces in their entirety resulted in the loss of some organisms. The use of dry swabs as well as the time required to collect all specimens, return them to the laboratory, and plate them might have resulted in death of some streptococci. The mechanics of preparing streaked plates undoubtedly led to some loss. Some organisms probably failed to survive after plating, while others, lacking in streptolysin S, did not cause surface hemolysis, and therefore these colonies might have escaped recognition. Subsurface plating initially would have demonstrated organisms containing streptolysin O, but such a procedure was impractical in our study.

Finally, our observation that the use of a single initial throat swab and plate would have caused the recovery rate to appear 25–35 percent lower than it actually was leads us to speculate that had third, fourth, or even more initial throat swabs and plates been used, the rate might have been higher.

Despite these valid objections to accepting our recovery rate as a true index of incidence or prevalence, the figures observed provide irrefutable evidence of the minimum frequency of occurrence of beta hemolytic streptococci.

Before drawing any conclusions as to the significance of the presence of group A beta hemolytic streptococcus in such a large proportion of the children studied, let us consider three possibilities regarding the host-organism relationship in these cases.

1. Is group A beta hemolytic streptococcus a harmless inhabitant of the throat with no systemic effect on the host? We cannot definitely answer this question as yet. Our studies thus far lead us to believe that in most cases this is not so. Antistreptolysin O determinations showed higher average titers and an increased percentage of high titers associated with the presence of group A beta hemolytic streptococcus, suggesting that the organisms found in the throat evoked a systemic response. School attendance records, observations at the time throat swabs were taken, and nurses' followups indicated that about half of the children with positive cultures had respiratory illnesses (colds, "virus infections," tonsillitis, bronchitis, pneumonia, ear infection) either immediately before, during, or after the time that their throat specimens were cultured. These records did not include data on therapy.

2. Does the finding of group A beta hemolytic streptococcus reflect an infectious process (clinical or subclinical)? If an elevation in antistreptolysin O titer is indicative of previous clinical or subclinical streptococcal infection, our overall serologic findings would support this hypothesis.

3. Does the finding of group A beta hemolytic streptococcus signify the postinfection carrier state? The postinfection carrier state may have existed in 24 of the 126 children from whom group A organisms were isolated. Streptococci were recovered from these 24 children during October 1953, the first month of the study, and we have no way of determining whether these were new isolates or whether they had persisted from previous months. In the remaining 102 children (26 percent) from whom streptococci were isolated for the first time after their throat cultures had been negative for at least 1 month, we may exclude the postinfection carrier state. The persistence of streptococci in the throats of children over a period of months may reflect either a continuing infectious process or the postinfection carrier state. Our current studies, in which we are attempting to correlate more closely the serologic with the bacteriological findings, may clarify this point.

It is significant that despite repeated recovery of beta hemolytic streptococci from their throats, none of the children in the three schools studied developed active rheumatic fever, nor was there a single case of scarlet fever.

A number of investigators (*12–16*) have implicated group A, types 12 and 4, beta hemolytic streptococcus in the pathogenesis of glomerulonephritis. None of the children, in either our pilot or present study, from whom type 12 or type 4 group A beta hemolytic streptococcus was isolated, developed clinical glomerulonephritis. The "nephritogenicity" of these strains is considered elsewhere (*4*, *17*). The predominance of type 12 in both of our studies indicates that this type was common in the schools studied and did not represent an isolated "epidemic" in February through May 1953, when it was the only type recovered.

We are still investigating the significance of groups B, C, and G beta hemolytic streptococci in relationship to illness in Dade County. Groups C and G evoked at least one type of systemic response, as evidenced by the higher average antistreptolysin O titer of children harboring these groups of streptococci compared with that of children from whom no beta hemolytic streptococci or only group B streptococci were recovered.

When considered in terms of the rheumatic fever picture in Miami, Fla., our observations suggest that the low rate of the disease cannot be attributed to the following:

1. Infrequency of group A beta hemolytic streptococcus.
2. Difference in groups or types of beta hemolytic streptococci compared with those encountered in other areas.
3. Lack of immunological response of the host, as determined by antistreptolysin O titers.

The answer probably lies "in some alteration in the pattern of the etiological relationship presumed to exist between group A beta hemolytic streptococci and rheumatic fever" (*4*) other than variations in incidence, frequency, or type of organisms.

Variations in the virulence of the organism or differences in degree or pattern of the host's immunological response to the organism may be responsible for the low rheumatic fever rate in Dade County, Fla. Also to be considered in the pathogenesis of the disease is the possible role of a virus-streptococcal combination (*18*). All of these factors probably are influenced by geography and climate.

Summary

1. Throat swabs were taken monthly from October 1953 through May 1954 from 417 children in grades 1 and 2 in three schools in Miami, Fla. In all, 2,809 pairs of throat swabs were collected, representing an average of 6.7 swabs per child and 351 children per month.

2. Group A beta hemolytic streptoccoccus was isolated from the throats of 126 (35.9 percent) of the children at least once during the 8-month period.

3. Nine types of group A beta hemolytic streptococcus were isolated; in order of frequency, these were types 12, 1, 4, 3, 28, 31, 33, 23, and 44.

4. One hundred eighty-nine children who participated in a pilot study (February through May 1953) were carried over into the present program. Of these, 29 had harbored beta hemolytic streptococci in the pilot study. Twenty-one (72 percent) continued to carry streptococci in their throats; 14 (48 percent) had the same group of beta hemolytic streptococcus or the same type of group A organism.

5. Sixty children harbored group A beta hemolytic streptococcus in their throats on more than one occasion during the 8-month study. Twenty-six of these children had participated in the pilot study; 8 had been positive for group A organisms; an additional child had carried a nongroupable organism.

6. The percentage of positive isolates was approximately the same in the first graders as in the second graders.

7. Antistreptolysin O titers of children with groups A, C, and G beta hemolytic streptococcus were higher than those of children from whom no beta hemolytic streptococci or only group B were recovered.

8. The findings are discussed from the standpoint of several possible types of host-organism relationship.

9. None of the children from whom group A beta hemolytic streptococcus was isolated developed active rheumatic fever or scarlet fever, nor was clinical glomerulonephritis noted among any of the children, including those from whom a strain of type 12 or type 4 group A beta hemolytic streptococcus was isolated.

10. The low rheumatic fever rate in Miami, Fla., is discussed in view of these findings.

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Departmental Announcement

Edmund Baxter has been appointed as the regional director of Region III, Department of Health, Education, and Welfare, Charlottesville, Va.

Mr. Baxter has approximately 20 years of Government service, mostly with the Department of Health, Education, and Welfare and its predecessor agency. He has served for the past 3 years as consultant for special institutions in the Office of the Secretary. Prior to that, he was in charge of the program under which allotments of critical materials were made to schools, colleges, hospitals, and welfare institutions.

Mr. Baxter is a graduate in public administration of the University of Louisville. He served during World War II as a naval officer in the Pacific.