STREPTOCOCCAL THROAT CARRIAGE IN SCHOOL CHILDREN WITH SPECIAL REFERENCE TO SEASONAL INCIDENCE

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Abstract. A number of studies on throat carriage of beta hemolytic streptococci (BHS) carried out during the years 1972-90 in urban and rural school children from low socioeconomic groups in the age group of 5-15 years in and around Delhi showed an overall carriage rate of BHS varying from 12.2%-64.3% depending upon the season and number of swabs taken. Group A was found to be the most predominant serological group (31.1%-62.6%). The T-typability was found to be 98.2%. The most prevalent T-patterns observed during 1972-78 study were 3/13/B_{3264} followed by 5/11/12/27/44. A significant difference was observed in the prevalence of T-patterns during the study of 2,034 children from 1979-83 and 3,094 children from 1984-90. When the most prevalent T-patterns were found to be 5/11/12/27/44 followed by 3/13/B_{3264}. The study of the school children from 1972-90 showed the isolation of BHS as well as significant predominance of GAS ($p < 0.001$) in winter months than summer months. There was no difference in the distribution of carriage of BHS and GAS amongst rural or urban school children. Since RF/RHD are illnesses which were often encountered in school children among socially and economically disadvantaged populations stronger support for streptococcal surveillance programs should be encouraged.

INTRODUCTION

Streptococcal infections have been described as occupational diseases of school children (Kaplan, 1980). The prevalence of streptococcal carriage varies widely depending on the population (El Kholy *et al,* 1978; Quinn and Martin, 1961; El Kholy *et al,* 1973), season (El Kholy *et al,* 1973; Krause *et al,* 1962; Mozziconacci *et al,* 1961; Davies *et al,* 1968; Lazarov and Bergner-Rabinowitz, 1968; Saslaw and Streitfeld, 1956; Rotta *et al,* 1968; Padmavati *et al,* 1983) and socioeconomic conditions (Kuttner and Krumweide, 1944; Holmes and Williams, 1954; Quinn, 1965; Quinn and Lowery, 1970; Coburn and Pauli, 1932; Mote and Jones, 1941; Riley *et al,* 1956; Holmes and Rubbo, 1953). Isolation of beta hemolytic streptococcus (BHS) from an asymptomatic patient is usually interpreted as a reflection of the carrier status or persistence of the organism after antecedent infection. Many workers have reported BHS carriage from 40-50% in the throat of normal children (El Kholy, 1978; Quinn and Martin, 1961; Holmes and Williams, 1954; Quinn, 1965; Prakash *et al,* 1967; Koshy *et al,* 1967; Meyers and Koshy, 1961; Sharma and Bhatia, 1966; Padmavati, 1978; Shiokawa, 1979; WHO, 1983). Such children remain a potential danger to the community and run risk themselves of infection. Although group C and G streptococci can cause pharyngitis and may provoke an immune response, only group A streptococcal infections of the upper respiratory tract results in non-suppurative sequelae like rheumatic fever (RF), rheumatic heart disease (RHD), and acute glomerulonephritis (AGN).

There are few detailed reports on the throat carriage of BHS and the prevalence of serotypes of Group A BHS in relation to seasonal variations which is very much needed as seasonal prophylaxis is the recent concept for the control of RF/RHD. In this light a number of studies were undertaken to find out the carriage rate of BHS especially Group A *Streptococci* (GAS) and its serotypes, especially seasonal variations if any from 1972-90. The information will be helpful in the control of rheumatic fever and rheumatic heart disease by launching seasonal prophylaxis.

MATERIALS AND METHOD

The WHO Collaborating Centre for Reference and Training in Streptococcal Diseases, New Delhi carried out a series of studies from 1972-90

in the school children in the age group of 5-15 years in and around Delhi in different seasons to find out the prevalence throat carriage of BHS, especially GAS. The strains of GAS were further subjected to T-typing in order to investigate if there was any seasonal variation in serotype distribution.

Population and plan of study

Group I (1972-73): 400 school children in the age group 5-15 years from low socioeconomic groups were screened for the carriage of BHS. The children were swabbed every month for one year except during vacations (May, June, December and January when the school was closed.

Group II (1973-75): 1,830 school children in the same age group and economic status as above were swabbed only once at any time of the year for BHS carriage.

Group III (1977-78): 500 school children in the age group 5-15 years in a village community (about 80 km from Delhi) where overcrowding was comparatively less were selected for similar study. The children were swabbed twice during summer (March-June) and winter (November-January) months.

Group IV (1979-83): 2,034 urban school children from low socioeconomic groups were under survey for streptococcal load from 1979-83. The throat swabs were collected during every summer and winter month from all the 2,034 children during the 5 year period of study.

Group V (1983): In the year 1983 a total of 450 school children were swabbed only once during winter.

Group VI (1984-90): A total of 3,094 urban school children from low socioeconomic group were swabbed once in summer and winter months for throat carriage from 1984-90. They include 424 children in the year 1984, 430 in 1985, 440 in 1986 and 450 each in the years 1987, 1988, 1989 and 1990.

Processing of throat swabs

The throat swabs were plated on 7% sheep blood agar plates within 3 hours of collection and read for the presence of BHS after overnight incubation at 37°C. The BHS were serologically grouped (Fuller, 1938; Prakash *et al,* 1972; Rotta, 1976) using hyperimmune A, B, C and G grouping sera produced locally at WHO Collaborating Centre for Streptococcus at Lady Hardinge Medical College. The GAS isolates were T-typed by agglutination reaction (Rotta, 1976; Griffith, 1934). The grouping and T-typing sera were raised as described in the Manual of Reference Procedures in Streptococcal Bacteriology and Serology (Rotta, 1976).

RESULTS

The study of the 400 school children in the year 1972-73 when the children were swabbed 8 times showed a carriage rate of 28.8% in their throats (Table 1). The study of 2,034 children (1979-83) who were swabbed 8 times (twice in both summer and winter months) and followed for a period of 5 years showed that the carriage of BHS was (54.4%). The study of the 500 rural children (1977-78) and 3,094 children (1984-90) who were all swabbed twice both in winter and summer months every year showed that the carriage of BHS was 27.2% and 24.3%, respectively but the study of 1,830 children who were swabbed only once during the two year period (1973-75) showed that only 21% of them carried BHS in their throats.

On further analysis of the seasonal carriage it was observed that winter carriage of BHS and GAS was significantly higher throughout as compared to summer months ($p < 0.001$) (Table 1, Fig 1, 2). It was observed that there was no difference in the carriage load of BHS or GAS in children from village (1977-78) studies and overall urban communities (Table 1). All the studies showed the predominance of GAS irrespective of the seasons ranging from 31.0-63.5% (Table 1).

All the isolates of GAS were serotyped for their T-patterns. The T-typability was found to be 98.2%. It was observed that the studies carried out from 1972-78 showed the predominance of T-pattern 3/13/B_{3264} followed by 5/11/12/27/44 (Table 2). However a change in the prevalence of T-patterns was observed during the study of the 2,034 children for 5 years from 1979-83 and the 3,094 children for 7 years from 1984-90 ie the T-pattern 5/11/12/27/44 was found to be predominant followed by 3/13/B_{3264}. However, 8/25/Imp 19 and 4/28 became the third most common pattern

Table 1

Carriage of beta hemolytic streptococci (BHS) in school children (1972-90).

No. of children studied	Year of study	No. of times swabbed	No. isolated (%)		Other Groups		
			BHS	GAS	B	C	G
400	1972-73	8	115 (28.8)	72 (62.6)	2 (1.7)	15 (13.0)	26 (22.6)
1,830	1973-75	1	384 (21.0)	163 (42.4)	9 (2.3)	99 (25.8)	111 (28.9)
500*	1977-78	2	136 (27.2)	51 (37.5)	5 (3.6)	37 (27.2)	43 (31.6)
Winter			75 (15.0)	32 (42.3)	2 (2.6)	18 (24.0)	22 (29.3)
Summer			61 (12.2)	19 (31.1)	2 (3.3)	18 (29.5)	21 (34.4)
2,034	1979-83	8	1,107 (54.4)	584 (52.8)	23 (2.0)	200 (18.0)	298 (26.9)
Winter			746 (36.8)	384 (51.5)	10 (1.3)	134 (17.9)	218 (29.2)
Summer			361 (17.8)	150 (41.6)	13 (3.6)	47 (13.0)	80 (22.2)
450	1983	1	242 (53.7)	100 (41.0)	3 (1.2)	47 (19.2)	90 (36.7)
Winter							
3,094	1984-90	2	784 (25.31)	450 (57.2)	24 (3.06)	76 (9.7)	234 (29.8)
Winter			504 (64.3)	320 (63.5)	12 (2.4)	34 (6.7)	138 (27.4)
Summer			280 (35.7)	130 (46.4)	12 (4.3)	42 (15.0)	96 (34.3)

* Children from village community

Table 2

Predominant T-patterns of GAS seen during 1972-90 in the throat of school children.

Predominant T-patterns	Year GAS	1972-73 64	1973-75 124	1977-78 41	1979-83 496	1984-90 450
3/13/B_{3264}		27 (42.2)	50 (40.3)	16 (39.0)	114 (23.0)	90 (20.0)
5/11/12/27/44		16 (25.0)	32 (25.8)	13 (31.7)	235 (47.4)	226 (50.2)
8/25/Imp 19		10 (15.6)	25 (20.2)	6 (14.6)	64 (12.9)	50 (11.1)
4/28		6 (9.4)	10 (6.1)	6 (14.6)	80 (16.1)	80 (17.7)
NT		5 (7.8)	7 (5.6)	-	3 (0.6)	4 (0.9)

T-typability was 98.2%
The T-patterns falling below 5% are not indicated.
The figures in parenthesis show percentage.

during 1972-73 and 1977-78 study. But in 1979-83 and from 1984-90, 4/28 acquired the third common pattern status followed by 8/25/Imp 19. The T-patterns of the strains of GAS falling below 5% are not shown in Table 2. There was no seasonal difference in the prevalence of T-patterns.

Thus the study showed that the carriage of BHS as well as GAS were significantly higher in winter months ($p < 0.001$) than in summer.

DISCUSSION

Streptococcal diseases represent an important health and economic problem, especially in tropical and subtropical countries of the world. In the present study the BHS isolation rate in the age group of 5-15 years varied from 12.2-64.3% depending upon a number of times they were swabbed and the season. Similar diversity in the incidence

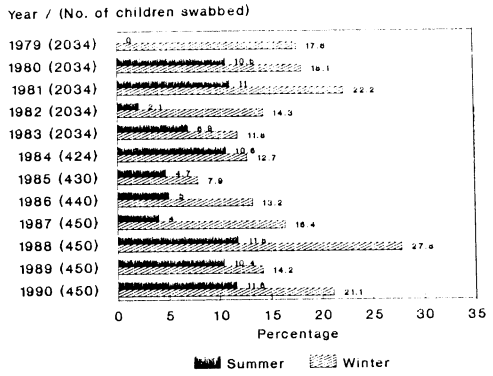

Fig 1—Seasonal incidence of BHS carriage in school children (1979-90). The same 2,034 children were studied from 1979 till 1983.

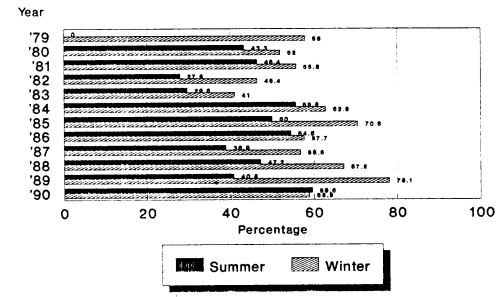

Fig 2—Seasonal incidence of GAS carriage in school children (1979-90).

of BHS has been reported in the literature depending upon the age group (Wannamaker, 1954; Anonymous, 1980; Wannamaker, 1972; El Kholy *et al,* 1973; Krause *et al,* 1962; Mozziconacci *et al,* 1961; Davies *et al,* 1968; Lazarov and Bergner - Rabinowitz, 1968; Saslaw and Streitfeld, 1956; Padmavati *et al,* 1983; Cornfeld and Hubbard, 1961; Quinn, 1965), the season of the study (El Kholy *et al,* 1973; Krause *et al,* 1962; Mozziconacci *et al,* 1961; Davies *et al,* 1968; Lazarov and Bergner - Rabinowitz, 1968; Saslaw and Streitfeld, 1956; Padmavati *et al,* 1983; Wannamaker, 1972; Cornfeld and Hubbard, 1961), socioeconomic status (Kuttner and Krumweide, 1944; Holmes and Williams, 1954; Quinn, 1965; Quinn and Lowery, 1970; Coburn and Pauli Ruth, 1932; Mote and Jones, 1941; Riley *et al,* 1956; Holmes and Rubbo, 1953) and the number of times swabbed during the period of study (Pike and Fauhene, 1946; El Kholy *et al,* 1978; Quinn, 1961). Thus the results of the study indicate that BHS has a year round incidence with peak periods occurring during winter followed by summer months. El Kholy *et al* (1973) reported that the highest monthly carrier rate occurred during the autumn and early winter, and the lowest during the summer months.

The results of the first and second international surveys on the distribution of T-patterns of GAS indicated 5/11/12/27/44 to be the most prevalent T-complex (Parker, 1967; Kohler, 1974). However, at the same time it was observed that most prevalent T-pattern amongst school children was $3/13/B_{3264}$ (Prakash *et al,* 1977; Koshy, 1976). In the present study it was observed that amongst the GAS isolated from 1972-78 the most common T-pattern was $3/13/B_{3264}$ followed by 5/11/12/27/44. However, the study carried out for five years from 1979-83 and for seven years from 1984-90 showed a predominance of T-pattern 5/11/12/27/44 followed by $3/13/B_{3264}$ was noticed. A variation in the T-type distribution as observed in the present study has been observed by other workers also (Quinn and Martin, 1961; Quinn, 1965; Griffith, 1934). Dunlop and Harvey (1964) stressed that individual susceptibility factors play a large part in the acquisition BHS and individuals are prone to acquire different groups and types in successive months. There was no seasonal difference in the distribution of T-patterns in the present study.

The higher incidence of GAS in low socioeconomic groups of children in winter months suggests the potential value of a seasonal prophylaxis for the control of streptococcal infections and their sequelae. This is further supported by the observations made by Padmavati *et al,* (1983) who have reported a significant drop in GAS isolation after Penicillin V 130 mg given in a dose of 4 tablets per day for a week. Since RF/RHD are illnesses which are concentrated among socially and economically disadvantaged populations, stronger support for streptococcal surveillance programs should be encouraged for schools serving this population group.

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