RISK FACTORS OF STREPTOCOCCAL COLONIZATION IN SCHOOL AGE CHILDREN

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Abstract. We studied the factors influencing the colonization of *Streptococcus* in school age children aged 6-11 years from 2 low socioeconomic schools of the Bangkok Metropolitan area. 4,055 throat swab cultures were performed. Beta hemolytic *Streptococcus* (BHS) and beta hemolytic *Streptococcus* group A (BHSA) were isolated in 1,747 (43%) and 744 (18%) respectively. 1,547 qestionnaires were returned from the children. Of these, 750 and 570 were found to have BHS and BHSA in the throat, respectively. Among the risk factors, considered, teeth brushing of one time or none per day was significant for BHS positive in the throat as compared with the BHS negative group, while personal hygiene such as sharing glass with other, playing in dirty water, poor housing sanitation and low family income was significantly associated with the BHSA positive group. With the combination of certain clinical manifestations, these factors may increase the accuracy of predicting streptococcal infection.

INTRODUCTION

Beta hemolytic streptococci (BHS) have been recognized as pathogens causing a wide variety of disease states, including pharyngitis, scarlet fever, pneumonia, bacteremia, osteomyelitis, skin and soft tissue infection and central nervous system infection (Bisno, 1990). The Group A *Streptococcus* is unique among beta-hemolytic streptococci in that, besides having the capacity to produce a variety of acute purulent infections, it also has the potential to induce serious nonsuppurative sequelae, including rheumatic fever with rheumatic carditis and glomerulonephritis (Ouie, 1991). However, the early and appropiate treatment of streptococcal pharyngitis can prevent acute rheumatic fever (Denny *et al,* 1950; Gordis, 1973; Markowitz, 1985). Streptococcal sore throat is among the most common bacterial infections of childhood with the peak incidence occurring during the first few years of school (Bisno, 1990). Although group A streptococci are responsible for the majority of throat infections, serogroups C and G may be occasionally involved. In order to control streptococcal infections in the community and thus reduce their complications, it is necessary to have data on the epidemiology of these infections. A number of studies have been done to document the extent of streptococcal infection by determining the prevalence of streptococcal carriage in the throats of asymptomatic school children. Pharyngeal carriage rates among school children vary with geographic area and season of the year. Carriage rates of 13-49% have been reported in various studies (Karoui *et al,* 1982). Breese and Diney (1966) evaluated factors influencing the spread of beta hemolytic streptococcal infections within the family group. There were no reports of factors influencing streptococcal colonization within the community. Therefore, we conducted a study in school children in order to evaluate the factors influencing the colonization of streptococci in school age children.

MATERIALS AND METHODS

Throat swabs were collected for isolation of BSH and beta hemolytic *Streptococcus* group A (BHSA) from school age children (aged 6-11 years) of two primary schools in Bangkok metropolitan area who were of low socioeconomic status during November 1988, June 1989, October 1989. In order to obtain good specimens, throat swabs were taken by vigorous rubbing of a sterile cotton-tipped wooden

applicator over both tonsil and oropharynx (Rotta and Facklan, 1983). The swabs were inoculated directly on to 5% sheep blood agar plus staphylococcus streptococcus supplement (Oxoid limited: Hamshire RG 24 OPW) which contained nalidixic-acid 7.5 mg, colistin sulfate 5.0 mg in 500 ml of medium (Ellner *et al,* 1966). Cultures were streaked and they were incubated at 37°C overnight in a candle jar. The final conclusions were based upon the presence or absence of beta hemolytic streptococci on blood agar plates after reincubation for 24 hours. One of the isolated colonies was grouped using Phadebact streptococcal reagents for groups A, B, C, F and G (Phamacia, Uppsala, Sweden).

Each child had the throat swab done once to three times throughout the study.

Questionaires were distributed to each child and their parents were requested to answer the questions concerning personal hygiene, environmental factors, parents' education levels, family income. The data were analysed only once for each individual. Statistical assessement used univariate calculated adjusted odds ratio of each significant risk factor with a 95% confidence interval.

RESULTS

A total of 4,055 throat swabs were done; BHS and BHSA were isolated in 1,747 (43%) and 744 (18%) respectively. 2,782 questionnaires were sent out and 1,547 questionnaires were returned from individual children. Of the total examined, 750 and 570 were found to have BHS and BHSA in the throat, respectively.

Univariate analysis

Among the risk factors considered (Tables 1, 2, 3, 4) teeth brushing of one time versus none per day

Table 1

Presence of personal hygiene factors in BHS positive and negative group (N = 1,547).

Risk factors	β – strept		p value	Relative risk	95% CI
	+ ve (n = 750)	–ve (n = 797)			
Personal Hygiene					
Share spoon with others	488/739 (66.0%)	396/624 (63.5%)	0.401	1.11	0.89 – 1.40
No handwashing before eating	490/745 (65.7%)	396/627 (63.2%)	0.259	1.12	0.89 – 1.40
Share glass with others	440/740 (59.4%)	348/623 (55.9%)	0.175	1.15	0.92 – 1.44
Drink unboiled water	313/750 (41.7%)	256/628 (40.8%)	0.615	1.04	0.83 – 1.29
Teeth brushing ≤ 1/day	198/729 (27.1%)	156/620 (25.2%)	0.035*	1.36	1.05 – 1.76
Bathing ≤ 1/day	86/732 (11.7%)	70/613 (11.4%)	0.425	1.10	0.86 – 1.42
Play in dirty water	74/737 (10.0%)	48/620 (7.7%)	0.145	1.33	0.89 – 1.97
Play in dirty sands	167/731 (22.8%)	154/622 (24.8%)	0.497	0.89	0.69 – 1.16
Thumb sucking	68/734 (9.2%)	44/620 (7.1%)	0.151	1.33	0.88 – 2.02
+ ve intestinal parasite	292/511 (57.1%)	248/434 (57.1%)	1.00	1.0	0.76 – 1.30
Don't cover mouth when coughing/sneezing	466/737 (63.1)	365/624 (58.5%)	0.180	1.22	0.97 – 1.52

Table 2

Presence of environmental factors in BHS positive and negative groups.

Risk factors	β-strept		p value	Relative risk	95% CI
	+ ve (n = 750)	–ve (n = 797)			
Environmental factors					
Stagnant water underneath the house	269/745 (36.1%)	198/616 (32.1%)	0.125	1.19	0.94 – 1.50
+ ve mosquitos	728/745 (97.7%)	603/621 (97.1%)	0.472	1.27	0.62 – 2.62
Nearby garbage	288/742 (38.8%)	236/609 (38.8%)	0.981	1.00	0.79 – 1.25
Nearby factory	124/737 (16.8%)	117/609 (19.2%)	0.229	0.85	0.63 – 1.13
Persons in the same house > 5	367/712 (51.5%)	296/605 (48.9%)	0.458	1.11	0.88 – 1.38
Children in the same house > 3	165/667 (24.7%)	120/555 (21.6%)	0.346	1.19	0.90 – 1.57
Presence of sick person in family ≥ 1	337/385 (87.5%)	277/316 (87.7%)	0.959	0.98	0.61 – 1.58
Presence of person with pyoderma in family	148/206 (71.8%)	102/148 (68.9%)	0.584	1.15	0.70 – 1.87
People sleeping in the same room > 3	248/587 (42.2%)	195/491 (39.7%)	0.497	1.11	0.86 – 1.42
Extended family	352/749 (46.9%)	295/631 (46.8%)	0.429	1.00	0.81 – 1.25
Cigarette smoking					
Father	379/717 (52.9%)	332/604 (55.0%)	0.444	0.91	0.73 – 1.14
Mother	68/688 (9.9%)	53/582 (9.1%)	0.384	1.09	0.78 – 1.62
Others	298/668 (44.6%)	235/568 (41.4%)	0.339	1.14	0.90 – 1.44
Presence of persons with chronic cough in family	77/709 (10.8%)	66/590 (11.2%)	0.648	0.96	0.67 – 1.39

was significant for BHS positivity in the throat as compared with the BHS negative group (Table 1).

When comparing between BHSA positive and BHSA negative groups (Tables 5, 6, 7, 8) personal hygiene of sharing glasses with other, playing in dirty water and poor housing sanitation (stagnant water underneath the house) were significantly associated with the BHSA positive group. When considering economic factors, family income of less than or equal to 4,000 baht per month was significantly associated with BHSA positive group.

DISCUSSION

In this study, the prevalence of BHS and BHSA in throat of school children were comparable to the studies reported from South India and Kuwait (Karoui *et al,* 1982). However, when compared with previous studies in Thailand, in which BHSA were found in about 9.09% of 1,089 healthy school children (Dharmasakti *et al,* 1985), our study demonstrated a higher prevalance of streptococcal carriage in the throats of school children; this can be explained by the

Table 3

Presence of parents' education levels factors in BHS positive and negative groups.

Risk factors	β-strept		p value	Relative risk	95% CI
	+ ve (n = 750)	–ve (n = 797)			
Education levels					
Father					
≤ Lower primary school	387/677 (57.1%)	343/562 (61.0%)	0.186	1.17	0.92 – 1.48
≤ Upper primary school	499/677	405/562	0.559	0.92	0.70 – 1.19
≤ Secondary school	577/677 (85.2%)	472/562 (83.9%)	0.599	0.90	0.65 – 1.25
Mother					
≤ Lower primary school	499/683 (73.0%)	432/573 (75.3%)	0.381	1.12	0.868 – 1.468
≤ Upper primary school	590/683 (86.3%)	490/573 (85.5%)	0.718	0.93	0.66 – 1.29
≤ Secondary school	633/683 (92.5%)	535/573 (93.3%)	0.642	1.13	0.71 – 1.71

Table 4

Presence of family income factors in BHS positive and negative groups.

Risk factors	β-strept		p value	Relative risk	95% CI
	+ ve (n = 750)	–ve (n = 797)			
Family income					
≤ 4,000 baht/mo (US $ 160)	384/661 (58.0%)	303/563 (53.8%)	0.148	1.18	0.94 – 1.5

lower socioeconomic status of our study population, while some children may have active but subclinical infections. Generally, the streptococcus that predominates in the oral cavity is *Streptococcus viridans;* many circumstances such as antimicrobials, viral infection, and stress can alter normal microbial flora in the mouth (Cooperstock, 1992). Out study showed that teeth brushing of one time or no times per day was significant for the BHS positive group as compared with the BHS negative group. This finding suggests that poor oral hygiene may have some influence in altering the condition which will favor the colonization of BHS. This is not true for BHSA colonization in the study population. The higher percentage of sharing glasses with others in the BHSA positive group compared with the BHSA negative group supports the concept of spreading of streptococcus infection by droplets or nasopharygeal secretion. Interestingly, sharing spoons was not significant for BHSA positivity in the throat as compared with the BHSA negative group. This may be explained by less contamination of nasopharyngeal secretions via sharing spoons compared to sharing glasses with others.

Table 5

Presence of personal hygiene factors in BHSA positive and negative groups (N = 1,547).

Risk factors	Group A strept		p value	Relative risk	95% CI
	+ ve (n = 570)	–ve (n = 977)			
Personal Hygiene					
Share spoon with others	372/562 (66.1%)	512/801 (63.9%)	0.337	1.10	0.87-1.39
No handwashing before eating	377/567 (66.4%)	509/805 (58.6%)	0.112	1.15	0.91-1.45
Share glass with others	346/562 (61.5%)	442/801 (58.7%)	0.015*	1.30	1.03-1.63
Drink unboiled water	242/570 (42.4%)	327/808 (40.5%)	0.375	1.08	0.86-1.35
Teeth brushing ≤ 1/day	152/550 (27.6%)	202/799 (25.3%)	0.303	1.12	0.87-1.45
Bathing ≤ 1/day	68/560 (12.1%)	88/785 (11.2%)	0.214	1.09	0.77-1.55
Play in dirty water	62/561 (11.0%)	60/796 (7.5%)	0.020*	1.52	1.03-2.24
Play in dirty sands	132/555 (23.7%)	189/798 (23.7%)	0.411	1.00	0.77-1.30
Thumb sucking	51/559 (9.1%)	61/795 (7.7%)	0.153	1.20	0.80-1.81
+ve intestinal parasite	216/385 (56.1%)	324/560 (57.9%)	0.592	0.93	0.71-1.22
Don't cover mouth when coughing/sneezing	358/560 (63.9%)	473/801 (59.1%)	0.104	1.22	0.97-1.54

Prapphal *et al* (1992) reported that poor housing sanitation in terms of dirty water underneath the house was associated with higher risk for acute respiratory tract infection. Our results confirmed that poor housing sanitation and low family income were associated with higher risk of colonization with BHSA which are important bacteria causing upper respitory tract infection in children (Cauwenberge and Mijnsbrugge, 1991). Overcrowded living conditions (> 10 people in the home) have been previously reported to increase the incidence of upper respiratory tract infection. (Cauwenberge and Mijnsbrugge, 1991). Acquisition of streptococci generally is associated with crowding in the home, shcool or other institution (Kliegman and Feigin, 1992). Our results failed to support this risk factor of BHSA colonization. This may be explained by different criteria of definding overcrowed living conditions or different study populations.

Although individuals with active but subclinical infection may also contribute to the spread of infection, the role of throat carriers is less certain. Most secondary spread occurs during the first two weeks after acquisition and decreases during the colonization stage (Wannamaker, 1954). Diagnosis of streptococcal pharyngitis requires a combination of the clinical manifestations, epidemiological findings and throat cultures to confirm the probability of streptococcal infection. Breese (1977) evaluated a nine-factor scoring system for prediction of streptococcal pharyngitis and found that those factors correlated well with streptococcal pharyngitis with accuracy of 77.6%. Prapphal *et al* (1994) studied the significance and accuracy of clinical symptoms and signs in predicting streptococcal pharyngitis in school children and found that the combinations of certain symptoms and signs including sore throat, cough, nasal congestion, tonsillar exudate, pyoderma

Table 6

Presence of environmental factors in BHSA positive and negative groups.

Risk factors	Group A strept		p value	Relative risk	95% CI
	+ ve (n = 570)	–ve (n = 977)			
Environmental factors					
Stangnant water underneath the house	215/569 (37.8%)	252/792 (33.1%)	0.022*	1.30	1.03-1.64
+ve mosquitos	555/569 (97.5%)	776/797 (97.4%)	0.840	1.07	0.51-2.24
Nearby garbage	223/566 (39.4%)	301.785 (38.3%)	0.736	1.04	0.83-1.31
Nearby factory	96/562 (17.0%)	145/784 (18.5%)	0.199	0.907	0.67-1.21
Persons in the same house > 5	290/546 (53.1%)	373/771 (48.4%)	0.128	1.20	0.96-1.51
Children in the same house ≥ 3	130/512 (25.4%)	155/710 (21.8%)	0.181	1.21	0.92-1.60
Presence of sick person in family > 1	263/299 (88.0%)	351/402 (87.3%)	0.797	1.06	0.65-1.71
Presence of person with pyoderma in family	116/157 (73.9%)	134/197 (68.0%)	0.325	1.33	0.81-2.17
People sleeping in the same room > 3	191/447 (42.7%)	252/631 (39.9%)	0.300	1.12	0.87-1.44
Extended family	275/569 (48.3%)	372/811 (45.9%)	0.160	1.10	0.88-1.37
Cigarette smoking					
– Father	291/545 (53.4%)	420/776 (54.1%)	0.793	0.97	0.77-1.21
– Mother	55/525 (10.4%)	66/745 (8.9%)	0.152	1.20	0.81-1.78
– Others	231/508 (45.4%)	302/728 (41.5%)	0.185	1.17	0.92-1.48
Presence of persons with chronic cough in family	60/540 (11.1%)	83/759 (10.9%)	0.493	1.01	0.02-1.46

and positive physician's impression could predict GABHS pharyngitis with 42.9% sensitivity, 64.8% specificity and 60.8% accuracy. Our study showed that certain factors, including personal hygiene, sharing glass with others, playing in dirty water, poor housing sanitation and low family income might be useful in predicting BHSA infection, when used with the combination of clinical manifestations, prior to availability of culture results. Early diagnosis and appropriate antibiotic treatment can have a significant impact on the clinical course of the illness and can reduce the risk of transmission of the infection (Gerber, 1989).

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Table 7

Presence of parents' education levels factors in BHSA positive and negative groups.

Risk factors	Group A strept		p value	Relative risk	95% CI
	+ ve (n = 570)	–ve (n = 977)			
Education levels					
Father					
≤ Lower primary school	291/509 (57.1%)	439/730 (60.1%)	0.32	1.13	0.89-1.43
≤ Upper primary school	372/509 (73.1%)	532/730 (72.8%)	0.989	1.01	0.76-1.28
≤ Secondary school	434/509 (85.3%)	615/730 (84.2%)	0.682	0.92	0.66-1.28
Mother					
≤ Lowe primary school	381/513 (74.2%)	550/743 (74.0%)	0.974	0.987	0.75-1.28
≤ Upper primary school	443/513 (86.3%)	637/743 (85.7%)	0.818	0.94	0.67-1.33
≤ Secondary school	472/513 (92.0%)	695/743 (93.5%)	0.35	1.25	0.71-1.98

Table 8

Presence of family income factors in BHSA positive and negative groups.

Risk factors	Group A strept		p value	Relative risk	95% CI
	+ ve (n = 570)	–ve (n = 977)			
Family income					
≤ 4,000 baht/mo (US $ 160)	311/502 (61.9%)	376/722 (52.1%)	0.0007	1.49*	1.18-1.90

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