

The Prevalence of Group A Beta-hemolytic *Streptococcus* in Healthy Turkish Children in Day-care Centers in Ankara

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Background: To investigate the carrier rates of group A beta-hemolytic *Streptococci* (GAS) in various seasons of the year in the upper respiratory tract of healthy children in day-care centers.

Methods: In this descriptive study, a total of 1893 throat swabs obtained from healthy children 1-6 years old in 13 day-care centers were screened for beta-hemolytic *Streptococci* in Ankara, Turkey, between October 2003 and July 2005. Standard microbiological techniques were used for screening.

Results: In this study, a total of 61 isolates of beta-hemolytic *Streptococci* were obtained. Of the isolates 75.4% were GAS. The rate of isolation was 1.03% in spring, 1.2% in summer, 2.26% in winter, and 4.08% in autumn.

Conclusion: The GAS carrier rate was the highest in autumn in healthy children. A low prevalence of GAS was observed in our country. (*Chang Gung Med J* 2008;31:554-8)

Key words: group A beta-hemolytic *Streptococci*, carriage, prevalence, day-care centers

Upper respiratory tract infections are the most common infectious disease in childhood.⁽¹⁻³⁾ The most common etiologic agent of bacterial tonsillopharyngitis is group A beta-hemolytic *Streptococci* (GAS).⁽⁴⁻¹¹⁾ Streptococcal pharyngitis is quite common in children in day-care centers. Transmission occurs with close contact via inhalation of organisms in large droplets or by direct contact with respiratory secretions.⁽⁹⁻¹²⁾ The incubation period for streptococcal pharyngitis is short (2 to 5 days). The physical findings include erythema, edema, and swelling of the pharynx.⁽¹¹⁻¹⁶⁾ The tonsils are enlarged, and a grayish-white exudate may be present. Patients may develop chills and fever, and erythema and swelling commonly occur over the face.^(4,10,12,16) If the patients are untreated, the transmission rate of GAS is approximately 35% in the family or school.^(10,16)

Delayed or inadequate treatment of streptococcal pharyngitis can cause serious subsequent complications, such as acute rheumatic fever and acute glomerulonephritis.^(12,14,16) GAS may remain part of the resident oropharyngeal flora resulting in chronic colonization, with the patient becoming a chronic carrier. The carriers of GAS (*Streptococcus pyogenes*) can spread the bacteria to other children via aerosol transmission.^(4,12,16) Crowded living conditions increase the transmission of GAS and it can also cause outbreaks under these conditions. Throat culture has always been considered the "gold standard" for diagnosing group A *Streptococci*.^(7,16) On the other hand, a positive culture does not differentiate acute infection from an asymptomatic carrier state. Although the degree of positivity of the throat culture and clinical symptoms may assist in making

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this differentiation, carriers do not have any symptoms or serological signs of streptococcal pharyngitis.^(4,12)

In this study, we investigated the carrier rate of GAS in various seasons of the year in the upper respiratory tract of healthy children in day-care centers.

METHODS

With Institutional Review Board approval, a total of 1893 throat swabs obtained from healthy children 1-6 years old in 13 day-care centers were cultured for isolation of GAS at the Umut Medical Imaging and Laboratory Groups, Service of Microbiology, Ankara, Turkey, between October 2003 and July 2005. A total of 921 samples were taken from boys and 972 samples were taken from girls. The children were questioned about clinical symptoms such as sore throat, fever, chills, and malaise, and examined for signs such as erythema and swelling of the pharyngeal mucosa. Those who had such symptoms or signs were excluded. Patients who were taking antibiotics or had taken them during the previous week were excluded. Informed consent statements were obtained from families before enrollment. Each day-care center was sampled 4 times a year and the samples came in randomly from the 13 centers. Samples were collected continuously during the time period of the study. The day-care center communities were of mixed similar socioeconomic levels. The number of the specimens varied because of elimination of symptomatic patients and problems with sampling permission by families or center administrations. All samplings were performed by either one Otolaryngology-Head and Neck Surgery resident physician or one medical microbiologist. Specimens were preserved during transport by one trained medical microbiologist.

We collected a pharyngeal specimen with a cotton swab and Stuart medium (Diomed, Istanbul, Turkey). Under direct visualization with good illumination, the swab was rubbed over both tonsils, tonsillar fossae, oropharynx, and nasopharynx posterior to the uvula. Care was taken to avoid touching the tongue and buccal mucosa. The samples were transported to the laboratory. The throat swabs were inoculated on 5% sheep blood agar. After incubation at 35-37°C for 18-24 hours, cultures were evaluated. Beta-hemolytic colonies on the blood agar plate were

identified with a bacitracin disk and a latex agglutination reagent (Slidex Strepto-Kit, BioMerieux, France). The degree of growth was expressed as 1+ to 4+ according to the number of colony forming units (CFU) as follows: 1+: ≤ 10 CFU; 2+: 11-50 CFU, 3+: > 50 CFU; 4+: predominant growth or pure culture.⁽¹⁵⁾ We provided 95% confidence intervals for all the estimates.

For statistical analysis the chi-square test was used.

RESULTS

The average age of the study population was 3.9 ± 1.25 years. The number of students per classroom was 13-19 (mean 16). In the study, a total of 61 isolates of beta-hemolytic *Streptococci* were obtained from healthy children. Of the isolates, 75.4% (46 of 61 isolates) were group A, 3.3% (2 isolates) were group B, 4.9% (3 isolates) were group C, 9.8% (6 isolates) were group G, and 6.6% (4 isolates) were non-A,B,C,G. The degree of growth in GAS positive cases were 1+: 34.8%, 2+: 28.3%, 3+: 21.7% and 4+: 15.2% as described in Table 1. The rate of isolation was 6/581 (1.03%) in spring, 2/166 (1.2%) in summer, 11/485 (2.26%) in winter, and 27/661 (4.08%) in autumn (Table 2). There were significant differences in frequencies between the seasons ($p < 0.01$). Additionally, there were significant differences in frequencies between years ($p < 0.01$).

GAS was isolated from 22 of 921 (2.39%) boys' samples and from 24 of 972 (2.46%) girls' samples ($p > 0.05$). We didn't detect GAS in any of the center staff with same method. They were tested at all sites

Table 1. Degree of Growth of GAS

Group	Autumn No.	Winter No.	Spring No.	Summer No.	Total No.	%
1+ (≤ 10 CFU)	10	3	2	1	16	34.8
2+ (11-50 CFU)	7	3	2	1	13	28.3
3+ (> 50 CFU)	6	3	1	0	10	21.7
4+ (predominant growth or pure culture)	4	2	1	0	7	15.2
Total	27	11	6	2	46	100.0

Abbreviation: CFU: colony forming unit.

Table 2. The Distribution of GAS Isolates by Year and Season

Season	2003			2004			2005			Overall		
	% (+)	No. (+)	No. Swab	% (+)	No. (+)	No. Swab	% (+)	No. (+)	No. Swab	% (+)	No. (+)	No. Swab
Autumn	4.66	7	150	3.91	511	20	-	-	-	4.81	27	661
Winter	0.69	1	145	2.94	340	10	-	-	-	2.26	11	485
Spring	-	-	-	1.85	108	2	0.85	473	4	1.03	6	581
Summer	-	-	-	0	42	0	1.61	124	2	1.2	2	166
Total	2.71	8	295	3.19	1001	32	1	597	6	2.43	46	1893

and in all seasons.

DISCUSSION

GAS-associated diseases and sequelae continue to have devastating effects on public health and national economies as they mainly affect children and young adults.^(10,12,14,16) GAS has remained a significant human pathogen for centuries and is still the most frequent cause of bacterial pharyngotonsillitis in children in day-care centers.^(12,16)

In Baquero *et al.*'s⁽²⁾ study between May 1996 and April 1997 in Spain, culture of pharyngeal swabs obtained a total of 914 isolates of beta-hemolytic *Streptococci*, of which 86% were group A, 8.4% were group C, 4.5% were group G, and 1.1% were group F. In that study fewer group A isolates were obtained in summer (11.6%) than in other seasons, for which the frequency ranged from 28 to 30%.⁽²⁾

The presence of persistently but weakly positive throat cultures after repeated courses of antibiotic therapy in otherwise asymptomatic patients is not a cause for alarm. These persons are streptococcal carriers who are not at inordinate risk of developing rheumatic fever or of spreading infection to others. The most frequent problem is anxiety produced by multiple medical consultations and procedures associated with streptococcal colonization.^(2,7,15)

Throat culture is recommended because physical examination may not accurately distinguish the etiology in pharyngotonsillitis.⁽¹⁶⁻¹⁹⁾ Besides, it may be difficult to interpret the result of a throat culture under some conditions.⁽⁹⁾ In this study, throat cultures were taken to investigate the carrier rate of GAS in

healthy children. The degree of growth was expressed as 1+ to 4+ according to the number of CFU, as described in Table 1. The majority of our cases were 1+ or 2+. Bell *et al.*⁽³⁾ reported that in patients with pharyngitis, 71% of the isolates were heavy, whereas a heavy culture was obtained in only 1-7% of healthy children. Breese *et al.*⁽⁵⁾ also emphasized the value of quantitative assessment of colonies on culture to differentiate those with true infections from carriers. In our study, 34.8% of the carriers of GAS had 1+ culture positivity (Table 1). Many of the carriers with a low number of colonies possibly suffered have asymptomatic infection. Of course, an accurate throat swab technique is also mandatory to retrieve precise results from a throat culture.

Gunnarsson *et al.*⁽⁹⁾ implied that the prevalence of GAS in healthy individuals was highest in the 3-15 year age group (5.0-21.2%). We found that the prevalence of an upper respiratory tract GAS carrier state in children at 13 day-care centers was 2.43% in Ankara. Christenson *et al.*⁽⁶⁾ reported it was 2% in Stockholm, Sweden. Yagupsky *et al.*⁽²⁰⁾ determined the prevalence of *S. pyogenes* as 2.7% in infants and 8.4% in toddlers in day-care facilities in Israel, reaching 8.5% and 17.8% in the two groups, respectively by midwinter. Smith *et al.*⁽¹⁷⁾ detected GAS in 36% of children in day-care centers in the U.S.A..

The number of students per classroom may be an important risk factor for the transmission of GAS.⁽¹⁰⁾ We didn't evaluate this issue because the number of students per classroom was approximately equal in our study groups.

Group A streptococcal outbreaks can occur in day-care centers in some periods despite strict

hygiene and appropriate antibiotic treatment of all culture-positive individuals irrespective of the importance of the symptoms.^(11,13,18) Furthermore, patients left untreated are at risk of developing acute rheumatic fever. Penicillin remains the treatment of choice and resistance to penicillin has not been detected during the past 70 years. For penicillin-allergic individuals, macrolides are accepted as an alternative.⁽¹⁶⁾

In our study, there were significant differences in frequency between seasons. The prevalence was the highest in the autumn. This may be due to first opening time because schools open in Turkey at this time. Thus, the children may first contaminate each other at this time. The specimen numbers decreased in summer because of summer vacation. Therefore, the sample number in summer in our study was too small to have enough positive isolates for comparison. Additionally, there were significant differences in the frequency between years. There was no difference in the carrier rates between boys (2.39%) and girls (2.46%), statistically. Seasonal variations have been previously described in Spain, and lower isolation rates in summer were also noted. In Baquero *et al.*'s⁽²⁾ study fewer group A isolates were obtained in summer than in other seasons. Ameen *et al.*⁽¹⁾ reported the isolation rate of GAS as 10% in healthy school children during the winter of 1994-95 in children 5-7 years old at nine schools in the United Arab Emirates.

The carrier rate of GAS varies from one population to another. Differences in prevalence may be due to socioeconomic conditions, the regions, the seasons, and other factors.^(6,17) GAS-associated upper respiratory tract infections may be an important health problem. The infection occurs widely throughout the world with highly variable prevalences. The frequency of chronic carriers varies between 2 and 25 percent.^(1,8,9,13) Carriers all over the world are significant reservoirs of GAS.

In conclusion, the carrier rate of GAS was the highest in the autumn in healthy children in day-care centers in Ankara, Turkey.

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