

## ORIGINAL ARTICLE

# CARRIERS OF GROUP A $\beta$ -HEMOLYTIC *STREPTOCOCCUS* AMONG AN ADOLESCENT POPULATION IN TEHRAN

Nikdokht Taghavi MD\*, Hossein Sarmadian MD\*\*

\*Department of Infectious Disease, Shaheed Beheshti University of Medical Sciences, Tehran,

\*\*Department of Infectious Disease, Arak University of Medical Sciences, Arak, Iran

**Background**– Streptococcal pharyngitis is not prevalent among individuals above 15 years of age and as a result, there is little research conducted on this age group. Hence, the aim of this study was to detect the prevalence of group A  $\beta$ -hemolytic *Streptococcus* (GABHS) among healthy individuals between 15 to 18 years of age.

**Methods**– Using cluster sampling methods, 546 individuals aged from 15 to 18 years were randomly selected from a population of high school students in District 3 of Education Organization (Tehran, Iran). The results of throat cultures, demographic data, contents of tonsillar enlargement, cryptic tonsillitis and the level of education of individuals' parents were evaluated.

**Results**– Of the total of 546 students, 49 (9%) had GABHS in their pharynxes. Seventeen (60%) of the 28 students in which asymptomatic pharyngitis and/or cryptic tonsillitis was documented had GABHS in their pharynxes. Tonsillar enlargement was not a significant risk factor for being a carrier of GABHS. Lower level of parents' education was associated with a positive rate of GABHS.

**Conclusion**– Compared to developed countries, the higher prevalence of GABHS carriers in our study probably indicates that there is a significant number of children with untreated or partially-treated streptococcal pharyngitis. With the recent removal of legal restrictions in the prescription of injectable penicillins for children, a complete course of antibiotic treatment is highly recommended.

**Keywords** • exudative pharyngitis • GABHS • streptococcal pharyngitis

### Introduction

Group A  $\beta$ -hemolytic streptococcus (GABHS) accounts for nearly one-third of all pharyngitis cases each year during spring and winter.<sup>1–3</sup> The prevalence of carriers of this organism varies according to geographical area, season of the year, socioeconomic status and age group. In school age children, the prevalence is reported to be between 15% to 20%.<sup>1,2</sup> Overcrowding and a high population density are said to be important in the bacterial transmission from one person to another, so the infection spreads easily in crowded

populations such as in schools and military camps.<sup>2–4</sup>

Rheumatic fever, the serious complication of this infection is seen in all ages except infancy, however, it is most prevalent between the ages of 5 to 15 years, the ages where streptococcal pharyngitis is most prevalent.<sup>1,2,5</sup>

Epidemiologic studies have revealed that only certain serotypes of the bacteria are rheumatogenic and therefore dangerous.

As a result of certain serotypes of GABHS developing from the mucoid type, there was an increase in incidence of rheumatic fever in the mid 1980s.

Pharyngitis cases have a large quantity of the microorganism in their nose and throat. If the condition is left untreated, the bacteria may reside

•Correspondence: N. Taghavi MD, Department of Infectious Disease, Bou Ali Hospital, Shaheed Beheshti University of Medical Sciences, Tehran Iran. Fax: + 98–21–3786182.

there for weeks, and even months, after all the symptoms have disappeared. The microbial load in carriers decreases with time and the organisms eventually disappear from the nasal discharges. In addition, mucoid protein (protein M) is no longer detectable and as a result, the virulence of the bacteria substantially decreases. Hence, this suggests that streptococcal pharyngitis is mainly transmitted by those with the acute condition rather than carriers.<sup>1-3,6</sup>

We performed a small-scale study after considering the limitations imposed by complications of the infection and the availability of conclusive data on the prevalence of carriers in the over-15-years age group.

### Patients and Methods

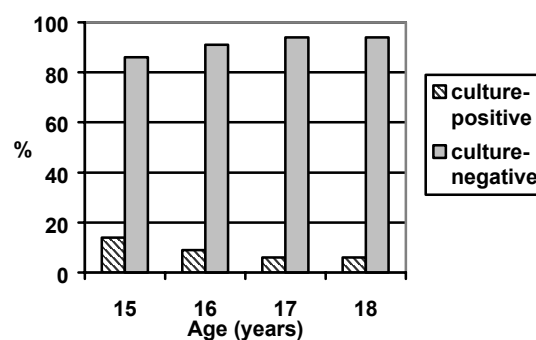
The target population were students in high schools from District 3, Education Organization, Tehran, Iran. Using a two-stage sampling method, 546 students (273 males, 273 females) from the 15-to 18-year-old age group were selected during the last three months of the year 2001. The high schools were initially clustered and after estimating the sample size, selection was made at random from the clusters. The prevalence of the event, confidence limit and effect size were set at 15%, 95% and 3%, respectively in order to determine the sample size.

After a brief history and a targeted physical examination, students with any signs or symptoms of acute viral/bacterial pharyngitis including those with tender cervical lymphadenopathy, fever and rhinorrhea, were excluded from the study. Any history of cardiovascular or other relevant disease was also considered as exclusion criteria.

Under good lighting conditions, a cotton swab was rubbed on the tonsillar pillars and pharynx and the swab plated on sheep blood agar (SBA). All culture media were incubated at 37°C for 24 hours and then studied under direct light.  $\beta$ -hemolysis colonies were replated on another SBA, with a bacitracin disk (0.04 units/disk Padtan-Teb, Iran) placed on the center.

The new media were reincubated at 37°C and the inhibition zones were measured. Zones greater than 15 mm were considered positive.

ASO titer in serum was measured in culture positive students after 3-4 weeks. After each swabbing, a questionnaire with the following data was completed; demographics, education level of

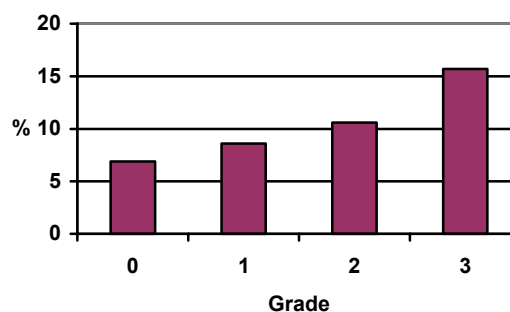


**Figure 1.** Distribution of culture-positive and negative cases according to age.

the students' parents, absence or presence of tonsils and cleft palate, the presence of any exudates and the degree of tonsillar enlargement. Tonsillar enlargement was graded based on the existence and position of the tonsillar surface in relation to the pillars. Tonsillectomy patients were categorized as group zero. If the surface of the tonsils was at the level of anterior pillars, it was considered as grade 1; grade 2 tonsils were those with a surface above the anterior pillars; and finally, if two tonsils approached each other, the condition was considered as grade 3. Informed consent was obtained from all the participants' parents.

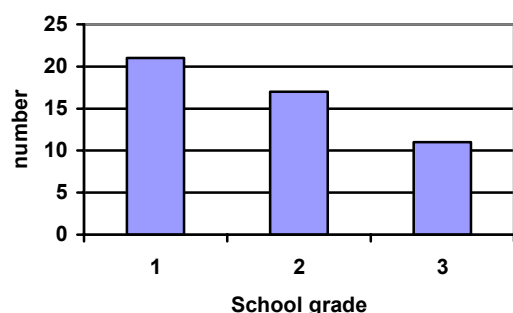
### Results

Of the 546 students, 49 (9%) had a positive culture and normal ASO titer. The male to female ratio among culture-positive cases was four to three. The number of culture-positive cases showed a converse relation to the age of the students in the study (Figure 1). None of the students had a history of cleft palate operation.



**Figure 2.** Frequency of GABHS positivity in terms of tonsillar enlargement.

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**Figure 3.** Number of positive cultures according to high school grade (each grade constituted of 182 students).

In terms of tonsillar grading, the majority (439) of the students belonged to the grade 1 group of whom 38 (8.6%) had GABHS-positive cultures. Of 41 individuals who had the history of tonsillectomy, GABHS-positive culture was only found in three cases (Figure 2). Twenty-eight of the 546 students had cryptic tonsillitis or a non-exudative pharyngitis without any systemic symptoms, seventeen of which were GABHS positive. However, of the 518 cases with no pharyngitis and / or cryptic tonsillitis only 32 cases had positive cultures. Considering the equal number of students in each grade of high school, the rate of culture-positive cases was inversely proportional to the grade of education (Figure 3). Among students belonging to parents with university degrees, only 37 out of 484 (7.6%) were culture positive; while in those with parents under high school diploma education, 12 from 77 (15.6%) were culture positive.

### Discussion

GABHS is among the most prevalent bacterial childhood infections and constitutes 20% to 40% of all cases of exudative pharyngitis.<sup>1</sup> The condition is most prevalent in the age group of 5 to 15 years; <sup>1-3</sup> the highest prevalence occurring in 7-year-old children and rarely occurring in those under 3 years of age. <sup>2,7</sup>

Males are equally affected by GABHS as females.<sup>1</sup> GABHS frequently colonizes the pharynx of asymptomatic individuals, as 15% to 20% of school-age children are asymptomatic carriers.<sup>1,2</sup>

The main goal of the present survey was to determine prevalence of carriers in a sample of Iranian adolescents. According to the results of

other investigators, this figure is 5% among the adult population.<sup>1,2</sup> If the prevalence of carriers is reduced with age,<sup>1-3,8</sup> the high rate observed in our study (9%) is probably due to the exclusion of cases over 18 years of age. The prevalence of carriers among primary school children in Isfahan, in the central part of Iran, was reported to be 4.9% by Tavakkoli et al.<sup>8</sup> Another study from Russia reported a figure of 29.8% in preschool children and students in the early years of primary school.<sup>9</sup> Bogovac et al reported a 6% prevalence in all age groups and 11.7% prevalence in 6 to 13-year-old children from Croatia.<sup>10</sup> Also, Ghaemi and the colleagues showed a similar prevalence among 6 to 13-year-old children from Gorgan, northern Iran.<sup>11</sup> The present study was performed on a population of relatively high socioeconomic status (SES) and probably underestimated the prevalence of carriers in Iranian society. However, when one includes the population with higher ages, the prevalence drops accordingly.

Spread of the infection increases in closed environments such as military camps and daycare centers. In a study from India, it has been shown that up to 35% of children in daycare centers became carriers at the time of streptococcal infection outbreaks.<sup>12</sup>

In one-fifth of cases, streptococcal pharyngitis may present with no signs or symptoms. Also one in every five mild cases is missed in general.<sup>13-15</sup> In tonsillectomized patients, the clinical syndrome is milder.<sup>1-3</sup>

As mentioned in the result section, 60% of the students with cryptic tonsils and non-exudative pharyngitis without systemic signs (fever and cervical lymphadenopathy) had a positive culture for GABHS. The study by Falck et al achieved similar results.<sup>16</sup> This might emphasize the greater proportion of carriers in individuals with cryptic tonsils, a matter which requires further investigation. Although we found more carriers among males, other studies do not support sex as a factor for being a carrier.<sup>1,2,13</sup>

After a course of antimicrobial treatment both carriers and patients with the acute condition responded reasonably and the microorganism remained in only a minority (5% to 30%) of cases.<sup>1,2,9,13</sup> In the study of Falck et al on 31 children from a daycare center with only an erythema in the pharynx, 19 cases had a positive culture for GABHS, of whom only 30% remained carrier after treatment.<sup>16</sup> Poor patient compliance, reinfection, antimicrobial resistance and  $\beta$ -lactamase produc-

tion by normal pharyngeal flora are the potential causes of remaining a carrier after antimicrobial therapy.<sup>1-3,5</sup> This group of patients often carry the *Streptococcus* in their pharynx with no apparent signs of acute infection. As the risk of acquiring rheumatic fever is low, routine throat cultures are unnecessary; the only exception being a patient with a family history of acute rheumatic fever.<sup>2,5,17,18</sup>

Differentiation between streptococcal pharyngitis and non streptococcal/ viral pharyngitis is difficult. Furthermore, fever, exudative accumulation and tender lymphadenopathy in anterior cervical region is found only in 15% of GABHS infections.<sup>4,14</sup> As such, a rapid antigen detection test (rapid Strep test) or throat culture is necessary for correct diagnosis.<sup>6, 14,15, 19</sup>

Throat cultures are recommended in patients with strong clinical evidence of infection despite a negative result of rapid test. According to Pitteti et al, the sensitivity and specificity of optical immunoassay rapid test is 79.5% and 96.9%, respectively.<sup>19</sup> Considering the real probability of false-negative results of rapid tests, it is better to perform cultures in those with the negative result; appropriate therapy should immediately be given to patients with a positive result of the rapid test. Throat culture remains the gold standard test in the diagnosis of streptococcal pharyngitis.<sup>19,20</sup>

Rheumatic fever is prevalent in crowded populations. Population density is an independent factor which facilitates the spread of the infection. A poor income population also acquires the disease more frequently.<sup>5,13</sup>

In the present study the level of the parents' education was related to the rate of positive results in throat cultures for GABHS. It must be noted that this study was performed in an area of Tehran with relatively high SES and educated population. With respect to the relationship between SES and the level of the parents' education, and the rate of acquiring the infection, our results are consistent with other studies in this field.<sup>5,13</sup>

With regard to the shortcomings of this study, we suggest a more comprehensive survey with a reasonable coverage of the population for a more accurate estimate of carrier prevalence. Health economic indices should also be included in the design of future studies.

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