

Group A streptococcal sore throat in a periurban population of northern India: a one-year prospective study

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Objective To estimate the incidence and risk factors of group A streptococcus (GAS) sore throat among school-aged children living in a periurban slum area of Chandigarh, North India.

Methods A total of 536 children aged 5–15 years from 261 families identified by a systematic random selection method were enrolled in the study. Episodes of sore throat were recorded through fortnightly home visits over a one-year period. The local vernacular (Hindi) terms *gala kharab* (bad throat) and *khansi jukam* (cough and cold) were used to identify symptoms of sore throat, and throat swab specimens were collected from children who had these symptoms on the day of the home visit. Bacterial culture was carried out and the isolation of GAS was confirmed using group-A-specific antiserum.

Findings The incidences of sore throat and GAS sore throat were, respectively, 7.05 and 0.95 episodes per child-year. The incidence was higher in the following situations: among 11-year-olds, during the winter (November to January) and rainy (August) months (a bimodal peak), among children living in houses where there was no separate room for the kitchen, and in homes that included a tobacco smoker.

Conclusion The results show that the incidence of GAS sore throat was related to age, season, and indoor air pollution.

Keywords Pharyngitis/microbiology; Streptococcus pyogenes/pathogenicity; Child; Smoke/adverse effects; Poverty areas; Socioeconomic factors; Cohort studies; India (*source: MeSH*).

Mots clés Pharyngite/microbiologie; Streptococcus pyogènes/pathogénicité; Enfant; Fumée/effets indésirables; Zone pauvreté; Facteur socio-économique; Etude cohorte; Inde (*source: INSERM*).

Palabras clave Faringitis/microbiología; Streptococcus pyogenes/patogenicidad; Niño; Humos/efectos adversos; Areas de pobreza; Factores socioeconómicos; Estudios de cohortes; India (*fuentes: BIREME*).

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Introduction

Sore throat is one of the commonest symptoms that primary health care physicians have to deal with. More than 225 pathogens, including about 200 viruses, are responsible for upper respiratory

tract infections (1, 2). *Streptococcus pyogenes*, or Lancefield group A β -haemolytic streptococcus (GAS), is one of the commonest bacterial pathogens that causes acute pharyngitis among school-aged children living in lower socioeconomic conditions (3–5). These Gram-positive cocci are distributed worldwide and have been associated with a variety of sequelae such as impetigo, otitis media, necrotizing fasciitis, glomerulonephritis, acute rheumatic fever/rheumatic heart disease (RF/RHD) (6, 7). It has been estimated that there may be 30 million children with RHD in developing countries, compared with only 1.5 million in developed countries (8).

In India isolation rates of GAS in children with pharyngitis have ranged from 4.2% to 13.7% (9, 10), which is comparable to the rates reported from developed countries. However, in closed and crowded communities the rates of isolation and spread of GAS infection may be much higher. The prevalence of asymptomatic carriage of GAS in different parts of India has been reported to lie in the range of 11.2–34% (11). However, prospective

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studies of the seasonal occurrence of GAS sore throat, as well as its distribution in different age, sex, and socioeconomic groups, are scanty. The present study was therefore conducted to estimate the incidence and risk factors of GAS sore throat among school-aged children in northern India.

Patients and methods

Study area

The study was based on a house-to-house survey in a periurban slum community near Chandigarh, northern India, with a population of approximately 10 000. Most families migrated to this slum area from different parts of India. The majority were engaged as daily wage labourers in the government or private sectors and lived in unhygienic and overcrowded conditions.

Sampling and sample size

Out of the 1376 households in the community, 261 (19%) were chosen for the study using a systematic random selection method, i.e. the first survey household was selected at random from the first five households of the community and thereafter every fifth household was sampled. Demographic, socioeconomic as well as environmental data, obtained by interviewing the head of each household, were recorded on a structured proforma. A total of 536 children aged 5–15 years from these families were enrolled in the study. Of these, 18 children could not be followed up for the entire period of 12 months. One child died from non-streptococcal disease.

Data collection

All the children were visited in their homes every fortnight by an investigator who had been trained specially for this purpose for six months in the Department of Community Medicine, PGIMER, Chandigarh. The occurrence of a case of sore throat during the previous 15 days and on the day of the visit was recorded on a pre-tested structured schedule. The vernacular (Hindi) terms *gala kharab* (bad throat) and *kbansi jukam* (cough and cold) were used to ask about symptoms of sore throat. Data were collected for a period of one year from April 1995 to March 1996, thus covering all seasons, i.e. dry summer months from April to June, wet summer months from July to September, and winter months from October to March. If the child had symptoms of sore throat on the day of the visit, a throat swab specimen was collected, after obtaining informed consent, and processed for the isolation and identification of group A β -haemolytic streptococci.

Laboratory investigation

The collected throat swabs were inoculated on blood agar media containing 5–7% defibrinated sheep blood and incubated for 24 h at 37 °C under an atmosphere containing 5–10% CO₂. The bacitracin

sensitivity test (0.04 units/disc) was carried out on isolates of β -haemolytic streptococci. Bacitracin-sensitive isolates were further examined for Lancefield grouping with antigen prepared using Fuller's formamide method (12). The numbers of colonies were counted and children with less than 20 colonies were considered to be carriers. The group-A-specific antiserum was raised in rabbits against group A standard strain J 17A4 (available from WHO Collaborating Centre for Reference and Research on Streptococci, Prague, Czech Republic). The antiserum was absorbed with other groups of streptococci (13). Rabbit antiserum raised against the standard strain of group A (J 17A4) did not show any cross-reaction with the other groups of streptococci. Formamide-extracted group-specific antigen was confirmed as group A streptococcus by the Ouchterlony double-diffusion test (14), using group-A-specific antiserum raised in rabbits.

Statistical analysis

The total number of follow-up days and episodes of sore throat were compiled for each child and the incidence was estimated per child-day by dividing the total number of episodes by the total number of child follow-up days. The incidence per child-year was estimated by multiplying the incidence per child-day by 365.25 days. The monthly incidence (per child-month) was calculated by dividing the number of episodes per month by the total number of child-days of follow-up in that month and multiplying the answer by 30 days. The total number of episodes due to GAS infections was estimated by assuming that the proportion of sore throat due to GAS during the 14 days prior to the visit would be the same as on the day of the follow-up visit for children from whom throat swabs were collected. The incidences of sore throat and GAS sore throat were estimated according to age, sex, season, crowding, indoor environment, and socioeconomic status (SES) classified according to the modified Kuppaswamy scale (15). Occupation, education and income were scored and ranked to classify the SES. Statistical significance was tested by the χ^2 -test for categorical variables, and the χ^2 -test for trend for ordered categorical variables such as age.

Results

Table 1 shows the sociodemographic data of the study population. The housing conditions of the community were very poor. Only 15% were living in a *pukka* (higher quality) house, and separate kitchen facilities were available in only 31% of houses. Most families lived in overcrowded homes, with an average of 3.7 persons per room. Most of the families belonged to the upper end of the lower socioeconomic scale and the lower end of the middle socioeconomic scale. There were no upper class families in the community.

Table 1. Socioeconomic and environmental characteristics of the 261 study households

Characteristic	Frequency or mean amount
Socioeconomic status	
Lower	37.2%
Lower middle	39.1%
Upper middle	23.7%
Per capita income per month (in Rs ^a)	429.2 ± 201.9 ^b
Pukka (i.e. higher quality) house	15.0%
No. of rooms in the house	1.7 ± 0.8 ^b
Area of the house (m ²)	17.0 ± 6.83 ^b
Toilet in the house	10.0%
Separate kitchen in the house	31.0%
Nuclear families	84.7%
At least one tobacco smoker in the family	75.1%
No. of persons per room	3.7 ± 1.5 ^b

^a US\$ 1 = Rs 43.28 in July 1999.

^b Mean ± S.D.

Table 2. Incidence of sore throat and of group A streptococcal (GAS) sore throat among the study children, by sex

	Males	Females	Total
No. of children	312	224	536
No. of follow-up days	84 889	60 557	145 446
No. of sore throat episodes			
In the previous 14 days	762	521	1283
On the day of the visit	882	641	1523
No. of throat swabs collected	530	380	910
No. of swabs with >20 colonies	77	46	123
Incidence per child-year			
Sore throat	7.07	7.01	7.05
GAS sore throat	1.03	0.85	0.95

Table 3. Incidence of sore throat and of group A streptococcal (GAS) sore throat among the study children, by age

Age (years)	No. of children		No. of follow-up days	No. of sore throat episodes	Incidence per child-year ^a	
	Male	Female			Sore throat	GAS sore throat
5	29	27	14 646	321	8.01	1.01
6	35	28	17 125	372	7.93	1.11
7	32	19	13 763	309	8.20	0.82
8	46	28	20 420	407	7.28	1.03
9	20	16	10 449	194	6.78	0.72
10	45	28	19 884	270	6.80	0.86
11	25	17	11 557	224	7.08	1.77
12	37	27	18 023	289	5.86	0.83
13	18	09	7 246	128	6.45	0.90
14	21	18	9 952	159	5.84	0.47
15	04	07	2 381	33	5.06	0.56

^a χ^2 -test for trend: $P < 0.01$.

Among the 536 children studied from April 1995 to March 1996, a total of 145 446 child-days of follow-up (mean, 271 days; standard deviation, 59;

range, 0–317 days) and 2806 episodes of sore throat were recorded (Table 2). A total of 1523 episodes were recorded as being present on the day of the visit, the rest having occurred during the previous 14 days. Of the 910 throat swabs collected from children with a sore throat on the day of the visit, 123 were culture-positive for group A streptococcus (> 20 colonies).

Of the 536 children studied, 0.4% had group A streptococcal infections three times, 1.5% twice, 18.8% once, and 79.3% had no such infection during the study period. The GAS infection rate was not significantly different among children belonging to families having one, two, three, four or five children.

There was no significant difference in the incidence of sore throat or GAS sore throat between males and females (see Table 2). The incidence of sore throat varied according to age ($P < 0.01$), being higher among the 5–8-years age group (Table 3). In contrast, the incidence of GAS sore throat was significantly higher among 11-year-olds ($P < 0.01$). Fig. 1 shows the incidence of sore throat as well as GAS sore throat during the one-year study period. The incidence was significantly higher during the winter and rainy months ($P < 0.01$).

Table 4 shows the incidence of GAS sore throat by socioeconomic status and environmental factors. Households with environmental factors present, e.g. indoor air pollution arising from not having separate kitchen facilities and from there being a tobacco smoker in the family, exhibited a significantly higher incidence of GAS sore throat ($P < 0.01$). In contrast, other factors, such as socioeconomic status and the household space (floor area) per person, had no significant influence on the incidence of sore throat or GAS sore throat.

Discussion

The average incidence of group A streptococcal sore throat in this study was estimated to be one episode per child per year among 5–15-year-olds. Since the term "sore throat" may not have been properly understood by the interviewees owing to differences in describing its symptoms in local cultures, we used the Hindi terms *gala kharab* (bad throat) and *kbansi jukam* (cough and cold) to describe the symptoms and to identify children for collection of throat swab specimens. The identification of children with GAS sore throat could, therefore, vary according to the terminology used for inquiring about the symptoms of sore throat, the criteria employed to define GAS infection, the age group studied, and the season when the survey was carried out. In rural Egypt the infection rate of GAS among 6–12-year-old school-children was estimated to be 6 episodes per 1000 per week, i.e. 0.3 episode per child-year (16); in this Egyptian study, the attack rate of GAS infection was defined as a positive throat culture with a concomitant rise in antistreptolysin O titre. In our study, sore throat cases were considered to be due to GAS only if culture produced more than 20 colonies of

streptococci. A study in Europe in 1984 estimated the incidence of streptococcal pharyngitis to be 7.2 per 100 general population per year over a 10-week period (17); on the basis of cases reported to health centres, however, the incidence was found to be 3.9 per 100 general population per year (18). The point prevalence of β -haemolytic streptococcal sore throat was 13.6% in a rural area of Varanasi, India (19). In our study, 13.5% of the sore throat cases were caused by GAS. In southern India, 12% of all pharyngitis cases were caused by GAS (10). In school-aged children in Delhi, the prevalence of GAS pharyngitis was 13.7% (11).

The incidence of GAS sore throat exhibited a bimodal peak, being higher in the wet summer months and during the winter. During the rainy season and in winter, children mostly live indoors in crowded conditions, which may increase the transmission of infection. In rural Egypt, the highest streptococcal carrier rate was observed in late autumn and early winter and the lowest rate in the summer months (17). In an Indian community near Varanasi the highest point prevalence was seen in winter (19), and in Europe the highest incidence was found in autumn (18).

Age has been reported to be an important factor in the microbiological etiology of pharyngitis, the peak incidence of GAS pharyngitis occurring in children aged 5–10 years (6). In our study the incidence of GAS pharyngitis was slightly higher among 11-year-olds, a finding that was also observed in a previous study (20). The occurrence of the peak incidence at 11 years may have been because at this age children move from primary school to high school, thus being exposed to infection from other strains of streptococci. Besides the spread of infection in classrooms, the intrafamilial transmission of streptococci has also been emphasized. In our study, the infection rate among single-child families was not significantly different from that among families with two, three, four, or five children.

The incidence of sore throat as well as GAS sore throat was not significantly different between males and females. While some studies have reported that the prevalence of β -haemolytic streptococcal pharyngitis was higher among females than among males in Delhi and other places in India (13, 21), others have reported that GAS pharyngitis did not vary according to sex (19).

In the present study, while socioeconomic status had no influence on the incidence of sore throat as well as GAS infection, environmental factors such as tobacco smoking in the family and the absence of separate kitchen facilities had an influence on GAS infection. Our study was conducted in a slum community where there was no major difference in socioeconomic status between the households. There were no families belonging to the upper socioeconomic class and only 23.7% of the families were in the upper end of the middle class. Most children in the study population were living in overcrowded conditions, with an average of 3.7 persons per room. Indoor air pollution due to tobacco smoking and cooking in the

Fig. 1. Monthly incidence of sore throat and group A streptococcal (GAS) sore throat over the 1-year study period

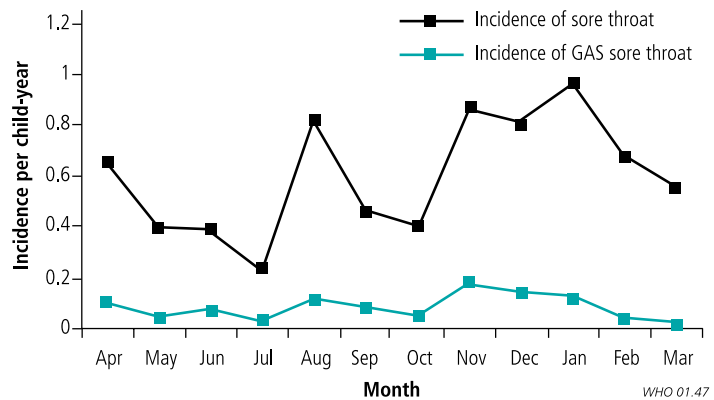


Table 4. Incidence of sore throat and of group A streptococcal (GAS) sore throat according to socioeconomic and environmental factors

Socioeconomic and environmental parameters	No. of follow-up days	No. of sore throats	Incidence per child-year	
			Sore throat	GAS sore throat
Kitchen				
Yes	50 228	1006	7.32	0.87 ^a
No	95 218	1800	6.90	0.99
Tobacco smoking in the house				
Yes	113 894	2196	7.04	1.02 ^a
No	31 552	610	7.6	0.71
Area per person (m²)				
<2.32	45 064	846	6.86	0.94
2.32 to <3.09	46 247	901	7.12	0.97
3.1 to <3.72	24 418	488	7.30	0.80
>3.72	29 717	571	7.02	1.10
Socioeconomic status				
Lower	49 887	945	6.92	0.98
Lower middle	57 061	1113	7.12	0.91
Upper middle	38 498	748	7.10	0.97

^a $P < 0.01$.

living room was found to be associated with a higher incidence of GAS infection. Most of the families in the present study cooked their food using bio-mass fuel, resulting in a considerable amount of smoke in the living room. We believe that improvement in the indoor environment could reduce the incidence of GAS infection in these poor communities. ■

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Conflicts of interest: none declared.

Résumé

Angine à streptocoque du groupe A dans une population périurbaine du nord de l'Inde : étude prospective d'un an

Objectif Estimer l'incidence et les facteurs de risque de l'angine à streptocoque du groupe A chez des écoliers d'un quartier pauvre de la périphérie de Chandigarh, dans le nord de l'Inde.

Méthodes L'étude a porté sur 536 enfants de 5 à 15 ans appartenant à 261 familles sélectionnées par tirage au sort selon une méthode systématique. Les épisodes d'angine ont été consignés lors de visites à domicile effectuées toutes les deux semaines pendant un an. Les termes de la langue vernaculaire locale (hindi) *gala kharab* (mal de gorge) et *khansi jukam* (toux et rhume) ont été utilisés pour identifier les symptômes d'angine, et des écouvillonnages de gorge ont été prélevés le jour de la visite à domicile chez les enfants qui présentaient ces symptômes. Une culture bactériolo-

gique a été effectuée et l'isolement des streptocoques du groupe A a été confirmé au moyen d'un immunsérum spécifique du groupe A.

Résultats L'incidence de l'angine était de 7,05 épisodes par enfant-année et celle de l'angine streptococcique (groupe A) de 0,95 épisode par enfant-année. Elle était plus élevée : chez les enfants de 11 ans ; pendant les mois d'hiver (novembre à janvier) et la saison des pluies (août), avec une répartition bimodale ; chez les enfants vivant dans une habitation sans cuisine séparée ; et dans les familles comptant au moins un fumeur.

Conclusion Les résultats montrent que l'incidence de l'angine à streptocoque du groupe A est liée à l'âge, à la saison et à la pollution de l'air à l'intérieur des habitations.

Resumen

Faringoamigdalitis por estreptococos del Grupo A en una población periurbana del norte de la India: estudio prospectivo de un año

Objetivo Estimar la incidencia y los factores de riesgo de faringoamigdalitis por estreptococos del grupo A (EGA) entre escolares de un barrio pobre periurbano de Chandigarh, en el norte de la India.

Métodos En total participaron en el estudio 536 niños de 5 a 15 años de edad de 261 familias identificadas mediante un método sistemático de selección aleatoria. A lo largo de un periodo de un año se realizaron visitas domiciliarias cada dos semanas para registrar los episodios de faringoamigdalitis. Los síntomas de la enfermedad se identificaron empleando los términos vernáculos locales del hindi *gala kharab* (dolor de garganta) y *khansi jukam* (tos y síntomas de resfriado), y se practicaron hisopados faríngeos en los niños que presentaban esos síntomas el día de la visita a domicilio. Se hicieron cultivos bacterianos,

y se utilizó antisuero específico contra el grupo A para confirmar el aislamiento de EGA.

Resultados La incidencia de faringoamigdalitis y de faringoamigdalitis por EGA fue, respectivamente, de 7,05 y 0,95 episodios por niño y año. La incidencia fue mayor en las siguientes situaciones: entre los niños de 11 años, durante los meses de invierno (de noviembre a enero) o lluviosos (agosto) (pico bimodal), entre los niños de viviendas donde la cocina no estaba separada del resto del espacio doméstico, y en los hogares en que había una persona fumadora.

Conclusión Los resultados muestran que la incidencia de faringoamigdalitis por EGA guarda relación con la edad, con la estación y con la contaminación del aire en locales cerrados.

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