

Group A Streptococcus Carriage in Adults in Southern Israel: A Prospective Study

Limor Adler MD MPH^{1,4}, Or Tzadok Zehavi MD^{1,3}, Miriam Parizade PhD², Yair Hershkovitz MD^{1,3}, Menashe Meni Amran MD^{1,3}, Robert Hoffman MD^{1,4}, Tal Hakmon Aronson MD¹, Erela Rotlevi MD¹, Bar Cohen MPH³, and Ilan Yehoshua MD^{1,3}

¹Department of Family Medicine, Maccabi Healthcare Services, Tel Aviv, Israel

²Maccabi Mega Lab, Maccabi Healthcare Services, Rehovot, Israel

³Department of Family Medicine, Faculty of Health Sciences, Ben Gurion University of the Negev, Beer Sheva, Israel

⁴Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel

ABSTRACT **Background:** The prevalence of Group A streptococcus (GAS) carriage among adults is studied less than in children. The variability of reported carriage rates is considerably large and differs among diverse geographic areas and populations. **Objectives:** To evaluate the prevalence of GAS carriage among adults in Israel.

Methods: In this prospective study, conducted in a large healthcare maintenance organization in Israel, we obtained pharyngeal cultures from adults attending the clinic without upper respiratory tract complaints or fever. Patient data included sex, age, number of children, and religious sectors.

Results: From May to December 2022, eight family physicians collected a total of 172 throat swabs (86% response rate). The median age was 37 years (range 18–65); 72.7% were females, 22.7% were ultra-Orthodox Jewish, and 69.2% had children. The prevalence of GAS carriage was 6.98%, 95% confidence interval (95%CI) 3.7%–11.9%. GAS carriers were younger (31.7 vs. 39.3 years, $P = 0.046$), and the majority were ultra-Orthodox Jews (58.3% vs. 20%, $P = 0.006$). All GAS carriers were from lower socioeconomic status. When assessing risk factors for GAS carriage using multivariate analysis, only being an ultra-Orthodox Jew was positively related to GAS carriage (adjusted odds ratio 5.6, 95%CI 1.67–18.8).

Conclusions: Being an ultra-Orthodox Jew was the single variable associated with a GAS carriage, which may be related to having many children at home and living in overcrowded areas. Primary care physicians in Israel should recognize this situation when examining patients with sore throats, mainly ultra-Orthodox Jews.

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Acute pharyngitis is a common medical condition in the ambulatory setting [1]. Patients often present with pain, swelling, dysphagia, dysphonia, and in some cases, fever, coughing, and exudate [2]. The most common cause of infectious pharyngitis is viral. Bacterial pharyngitis is less common but is often more symptomatic and can have serious systemic or local complications. *Streptococcus pyogenes*, or Group A streptococcus (GAS), is the most common bacterial pathogen linked with pharyngitis. GAS accounts for 15–30% of acute pharyngitis cases in children and 5–15% in adults [2].

Clinical diagnosis of acute GAS pharyngitis is considered reasonable but not good enough due to various pathogens that may cause the same symptoms and signs. The differentiation between streptococcal and other viral pathogens is determined by throat culture or a rapid Strep antigen test [3–5]. Chronic GAS carriage imposes a challenge on the primary care physician. GAS carriers presenting with upper respiratory tract infections (URTI) show positive throat culture or antigen tests, thus leading to unnecessary antibiotic treatment.

GAS carriage is estimated at 20% of asymptomatic school-age children [6]. Colonization may last 6 months or more and does not cause an active infection. The Infectious Diseases Society of America does not recommend antibiotic therapy for most chronic GAS carriers.

There are several cases where GAS carriage is clinically important, including patients with a history of rheumatic fever [7], rampant GAS pharyngitis outbreaks in closed or semi-closed facilities, or during a community outbreak of severe and invasive GAS complications [6]. In these cases, carriage should be eradicated.

The prevalence of adult GAS carriage is less studied compared to in children. In addition, the variability of reported carriage among adults in various studies is considerably

large. A study conducted on Royal Marines in Britain suggested a carriage rate of 0.49% [8]. Studies from Scandinavian countries report carriage rates of 0.6% to 1.6% [9-11].

However, in a Swedish study conducted by Agerhall and colleagues [12] GAS carriage prevalence among young adults (16–25 years old) was 10.1%, much higher than in other countries. In a study among students in the United States, a carriage rate of 11.5% was found [13]. Carriage prevalence varies considerably in different geographical areas, age groups, and populations. We evaluated the prevalence of GAS carriage among adults in Israel.

PATIENTS AND METHODS

STUDY DESIGN AND SETTING

We conducted a prospective study at Maccabi Healthcare Services (MHS), Israel's second-largest health maintenance organization. Eight family physicians from seven different MHS clinics in southern Israel collected tonsillar and nasopharyngeal swabs from adults (18–65 years old) who presented without any URTI symptoms or fever complaints. Physicians were instructed to collect swabs throughout the study period. The sample of physicians was a convenience sample. The physicians were specialists or residents in family medicine. All participants signed informed consent forms.

After GAS culture results were received from the laboratory, the physician contacted any positive patients to ask whether they were experiencing fever or throat pain, whether there was a patient or family history of rheumatic fever, and whether there were recurrent GAS infections in the patient's immediate environment. If one or more of the answers was affirmative, appropriate antibiotic treatment was promptly prescribed.

This study was approved by the ethics committee at MHS (0024-22-MHS). All participants provided written informed consent, which was collected and stored by each of the participating physicians in accordance with medical document storage guidelines and conventions. The documents were transferred to the head researcher.

MICROBIOLOGICAL TECHNIQUE

The swabs were collected, delivered, and handled according to meticulous guidelines and conditions to prevent contamination or tampering. The swabs were further processed in MHS's authorized laboratory. The swabs were streaked on one of two Group A Selective agar medium plates (BD Biosciences, Germany, or Hy Laboratories Ltd, Israel). These medium plates consist of agar supplemented with 5% sheep

blood and antibiotic agents meant to suppress the growth of non-Strep A bacteria (oxolinic acid, sulfamethoxazole plus trimethoprim, polymyxin B). In addition, a bacitracin 0.2 IU disc was used on each medium plate to facilitate growth identification. The cultures were incubated at 35°C under anaerobic conditions for 18 to 24 hours. After this period, cultures were inspected for characteristic growth of beta-hemolytic colonies inhibited by the bacitracin disc. When accurate identification proved challenging, results were corroborated using a GAS antigen test (Diagnostics, Israel).

VARIABLES

The physicians collected demographic details for each participating adult, including sex, age, number of children living with them, and religious sector (Arab, ultra-Orthodox Jew, or other). The socioeconomic status of each patient was based on the city where they lived. Those living in regions with socioeconomic status (SES) between 4 and 6 were considered *low SES*, and those living in regions with SES between 7 and 10 were considered *high SES*. The sample collection date and physician's name were documented.

STATISTICAL ANALYSIS

Sample size calculation was based on the assumption of a 5% prevalence of GAS carriage. The minimal sample size was 167 to achieve a 95% confidence interval (95%CI) with a power of 80%. The sample size calculation was conducted using WinPepi (Brixton Health). The prevalence of GAS carriage with 95%CI was calculated. Descriptive statistics were presented with a number and standard deviation for continuous variables and numbers and percentages for categorical variables. Continuous variables were compared with the Mann-Whitney test, and categorical variables were compared with the chi-square test (Fisher's exact test due to small numbers). Multivariate analysis was conducted through logistic regression with a forward approach. Statistical analyses were performed using IBM Statistical Package for the Social Sciences statistics software, version 28 (SPSS, IBM Corp, Armonk, NY, USA).

RESULTS

From May 2022 until December 2022, eight family physicians in southern Israel asked 200 patients to participate in the study. Of these, 186 patients agreed, and 172 were eligible according to the age inclusion criteria (18–65 years). Thus, 172 throat swabs were collected (response rate of 86%). The median age was 37 (range 18–65 years), 72.7%

were female, 22.7% were ultra-Orthodox Jewish, and 69.2% had children living with them. The distribution of swabs taken by each physician and the estimation of the percentage of ultra-Orthodox Jewish patients in each clinic is presented in Table 1. The prevalence of GAS carriage was 7%, with 95%CI 3.7–11.9. The distribution of positive swabs during the study period did not show a peak in any specific month.

UNIVARIATE AND MULTIVARIATE ANALYSIS

GAS carriers were younger than non-GAS carriers (31.7 vs. 39.3 years, $P = 0.046$). All other differences between GAS and non-GAS carriers are outlined in Figure 1. When assessing risk factors for GAS carriage in a multivariate analysis, only ultra-Orthodox background was positively related to GAS carriage (adjusted odds ratio 5.6, 95%CI 1.67–18.8).

DISCUSSION

MAIN FINDINGS

We found a GAS carriage of 7% with a 95%CI of 3.7–11.9. GAS carriage was associated with younger age and ethnic background (ultra-Orthodox Jews) in a univariate analysis. In a multivariate analysis, only ethnic background remained a significant variable.

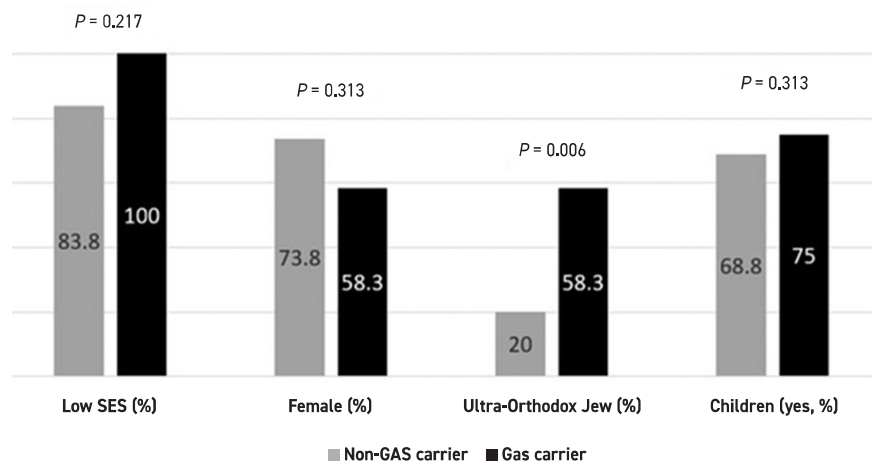
INTERPRETATION

In a meta-analysis by Oliver et al. [14], the prevalence of GAS carriage in adults was 2.8%, 95%CI of 1.5–5. In Organization for Economic Cooperation and Development (OECD) countries, the prevalence was 2%, 95%CI 0.8–5. In non-OECD countries, it was 4.6%, 95%CI 3.8–5.6. Although Israel is an OECD country, the rate found in our

Table 1. Physician distribution of patients and results

Physician number	City of clinic	Number of swabs taken	Number of positive swabs, n (%)	Estimation of the percentage of ultra-Orthodox Jewish patients in the clinic
1	Yeruham	14	2 (14.3%)	25%
2	Kiryat Gat	80	8 (10%)	25%
3	Kiryat Malachi	1	0	Almost none
4	Rehovot	3	0	Almost none
5	Ashkelon	17	0	25%
6	Ashkelon	38	2 (5.3%)	25%
7	Meitar	17	0	Almost none
8	Rehovot	2	0	Almost none
Total		172	12 (7%)	

Figure 1. Characteristics of GAS carriers vs. non-GAS carriers
 GAS = Group A streptococcus, SES = socioeconomic status



study is even higher than non-OECD countries. This finding might be explained by the ethnic background of some of these study participants: an ultra-Orthodox Jewish background. In a study conducted in north London by Spitzer and co-authors [15], the prevalence of GAS carriage among ultra-Orthodox Jews was much higher than the rest of the population living in the same geographical area (5% vs. 1%). This finding was noted in both children and adults.

Several features are unique to the ultra-Orthodox Jewish population living in Israel that can explain these findings, including living with big families with many children and learning in closed, overcrowded facilities that can increase the dissemination rate of infections.

IMPLICATIONS

When assessing throat pain complaints in adults, the family physician must consider the option that a positive throat swab may not represent a real infection but may be a carriage state. Physicians should consider the signs and symptoms that increase the likelihood ratio for GAS pharyngitis, including tonsillar or pharyngeal exudates and exposure to GAS pharyngitis in the previous 2 weeks [16,17]. In the absence of tender anterior cervical lymph nodes, tonsillar enlargement, or exudates, the chance for GAS pharyngitis is low, and the physician should consider whether to take a throat swab.

STRENGTHS AND LIMITATIONS

This study has several limitations. First, the sample of physicians who collected the throat swabs was a convenience sample. As such, the patients recruited may not represent the entire population. Second, the study period was from May to December 2022 (summer and autumn in Israel). GAS pharyngitis is most common during the winter and spring [18], which may have impacted the results. Third, our sample did not represent the Arab sub-population in Israel, which in some aspects resembles the ultra-Orthodox Jewish community in number of children and overcrowded living conditions. Still, this sector should also be evaluated. The strengths of this study are the good response rate and well-established sample size.

CONCLUSIONS

The prevalence of GAS carriage in Israel (7%) is higher than in other OECD countries. Ultra-Orthodox Jewish background was the single variable associated with a GAS carriage. This finding should be addressed by primary care physicians in Israel when examining patients with sore throats, especially ultra-Orthodox Jews.

Correspondence

Dr. L. Adler

Dept. of Family Medicine, Maccabi Healthcare Services, Tel Aviv 6812509, Israel

Phone: (972-3) 514-3947

Fax: (972-3) 795-7893

Email: limchuk@gmail.com; adler_l@mac.org.il

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