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Prevalence and Epidemiology of Group A Beta Hemolytic Streptococcus (GABHS) Among School-Age Children with Tonsillopharyngitis in Northern Palestine, A Cross-Sectional Study

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Abstract: Tonsillopharyngitis is a common diagnosis in children, and viral pathogens mainly cause it. Group A B-Hemolytic Streptococcus GABHS is the most common bacterial cause, and it is often overestimated as a causative agent because diagnosis usually relies on clinical judgment, leading to the overuse of broad-spectrum antibiotics. The study aims to investigate the prevalence of GABHS in children clinically suspected of having tonsillopharyngitis and to identify the associated risk factors and antibiotic profiles.

In this non-interventional cross-sectional study, 321 throat swab samples from children aged 5-15, clinically diagnosed with tonsillopharyngitis at 3 major healthcare centers in North Palestine from September 2022 to January 2023, were tested using throat swab cultures on blood agar and rapid antigen test for Streptococcus. A structured questionnaire was used to collect data from patients, their families, and treating physicians. A total of (99/321-30.8%) tested positive by the Rapid Antigen Test, with (75/321- 23.4%) confirmed through culture. A higher number of siblings and a history of recurrent infections were identified as significant risk factors for a positive throat swab culture. Penicillin was identified as the most effective antibiotic with a sensitivity rate of 97.3%, followed by Amoxicillin-Clavulanic Acid with a sensitivity rate of 96%, while Azithromycin was the least effective antibiotic. Among patients with tonsillopharyngitis, the prevalence of GABHS was determined to be 23.4%. If antibiotic therapy is warranted, Penicillin and Amoxicillin/Clavulanic Acid are the recommended drugs of choice

Keywords: GABHS, Pharyngitis, Tonsilitis, Antibiotic sensitivity, Amoxicillin, Penicillin, Pediatrics

Introduction

Tonsillopharyngitis is one of the most prevalent discharge diagnoses among children seeking medical care on an urgent basis. It has been proven to be caused by various pathogens, most of which are viral. Group A Beta-Hemolytic Streptococcus (GABHS) is the most common cause of bacterial-related throat infection [1]

Tonsillopharyngitis is a common cause of urgent pediatric medical visits worldwide and is primarily viral in origin [2]. However, bacterial causes—particularly GABHS—account for a significant proportion of cases, especially among school-aged children [3]. The infection affects both genders equally and demonstrates seasonal peaks in winter and early spring [4]. Transmission typically occurs through respiratory droplets or direct contact, with asymptomatic carriage being common, especially in younger children [5]. Risk factors include close contact with infected individuals in crowded environments such as schools, poor hygiene, lower socioeconomic conditions, and cold weather favoring indoor crowding. While most cases are self-limiting, early identification of GABHS is critical to prevent complications and limit unnecessary antibiotic use .[6]

GABHS pharyngitis occurs mainly in children aged 5 to 15 years, although the infection can occur at any age [7,8]. There are more than 616 million new cases of GABHS worldwide each year [1]. Seasonal variations have been reported; GABHS pharyngitis occurs most commonly in the winter and early spring .[9]

Symptoms of infection with GABHS include throat pain, fever, headaches, and chills; other possible features are abdominal pain, nausea, and vomiting [1]. The incubation period for GABHS infection is 24 to 72 hours [10]. Children are usually not contagious 24 hours after appropriate antibiotic therapy has been started .[11]

Complications of the infection can be distinguished as either suppurative or nonsuppurative. Due to the spread of GABHS to adjacent tissues, suppurative complications include cervical lymphadenitis, peritonsillar abscess, retropharyngeal abscess, otitis media, mastoiditis, and sinusitis [12]. Nonsuppurative, immune-mediated sequelae are Acute Rheumatic Fever (ARF), acute post-streptococcal glomerulonephritis, Sydenham chorea, reactive arthritis, and Pediatric Autoimmune Neuropsychiatric Disorders Associated with Streptococcus Pyogenes .[13]

It is recommended to perform a Rapid Antigen Detection Test (RADT) when GABHS pharyngitis is clinically suspected, particularly using clinical tools such as the modified CENTOR criteria [14]. A positive RADT along with a high CENTOR score supports early initiation of empiric antibiotics, reducing the contagious period and accelerating recovery [14]. Negative RADT results, especially in children, may require confirmation

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via throat culture, which remains the diagnostic gold standard [15]. RADT methods include enzyme immunoassays such as lateral flow and immunochromatographic assays, optical immunoassays, and newer molecular-based techniques like polymerase chain reaction (PCR) and fluorescence in situ hybridization (FISH) [16]. Despite diagnostic advancements, RADTs and throat cultures are underutilized in our region, and empirical treatment without laboratory confirmation remains common highlighting the need for our study .

No similar studies have been previously conducted in our geographic area .

This study aims to contribute to the limited database on the prevalence of Group A Streptococcus and uncover the pattern of antibiotic sensitivity among children clinically diagnosed with tonsillopharyngitis in the Northern West Bank .

Materials and Methods

Study Design and Setting

A non-interventional, cross-sectional study was conducted between September 2022 and January 2023 in three major healthcare centers across the northern West Bank: Jenin Governmental Hospital, Thabit Thabit Governmental Hospital in Tulkarm, and the Primary Healthcare Center in Al Makhfiyeh, Nablus. These institutions serve as primary referral centers for a large pediatric population in the region. The study population included children aged 5–15 years who presented with signs and symptoms of acute tonsillopharyngitis and received a clinical diagnosis by attending physicians.

Study Population and Eligibility Criteria

Participants were eligible for inclusion if they were aged 5–15 years, clinically diagnosed with tonsillopharyngitis during the study period, and had caregiver consent. Exclusion criteria included: [1] refusal to participate; [2] known immunodeficiencies (either primary or acquired); [3] recent use of antibiotics within seven days prior to presentation; [4] age below 5 or above 15 years; and [5] a symptomatic bleeding disorder that could complicate sample collection.

Sampling Method and Data Collection Tools

A randomized sampling technique was employed, and all eligible and consenting patients who presented during the data collection period were included. Data collection involved structured, researcher-administered interviews with patients' caregivers and treating physicians. A pre-validated, three-part questionnaire was used: Part 1 gathered demographic and background data; Part 2 captured clinical symptoms and signs; and Part 3 documented laboratory results, including both the Rapid Antigen Detection Test (RADT) and throat culture outcomes. The questionnaire was reviewed by subject experts to ensure content validity and piloted prior to use.

Laboratory Procedures

Two throat swabs were collected from each participant. The first swab was used to perform the RADT using the ABON® Strep A Rapid Test Device, a lateral flow immunochromatographic assay. Testing was conducted on-site following the manufacturer's instructions. Antigen extraction was done using reagents A and B. A positive result was indicated by two colored lines (control and test lines), while a negative result was indicated by a single control line. All tests were administered by trained personnel to ensure consistency and minimize procedural errors.

The second swab was cultured on 5% sheep blood agar and incubated at 37°C for 24 hours. Plates were inspected for beta-hemolytic colonies, which were then subcultured onto fresh blood agar to isolate pure colonies and reduce contamination. Following subculture, isolates underwent catalase testing to differentiate catalase-negative Streptococcus species from catalase-positive Staphylococcus species. Only catalase-negative colonies were included for further analysis.

Confirmed colonies were further subcultured on nutrient agar and subsequently on Mueller-Hinton agar supplemented with 5% sheep blood for antibiotic susceptibility testing. Bacitracin sensitivity was used to confirm the presence of Group A Beta-Hemolytic Streptococcus (GABHS); susceptibility was indicated by the presence of a clear inhibition zone around the Bacitracin disc. Additional antibiotic susceptibility testing was conducted using discs of Penicillin, Amoxicillin, Amoxicillin-Clavulanate, Azithromycin, and Clindamycin. All test outcomes were recorded on individual case forms and transferred to the study datasheet for statistical analysis.

Statistical Analysis

Data analysis was performed using SPSS version 25. Descriptive statistics included frequencies and percentages to summarize patient characteristics, RADT results, and culture outcomes. The Chi-square test was used to examine associations between categorical variables. Simple linear regression (SLR) was applied to explore potential predictors of positive test outcomes where appropriate. A p-value of <0.05 was considered statistically significant.

Results and Discussion

This study evaluated 321 patients with suspected tonsillopharyngitis and met the inclusion criteria. Of these patients, 99 (30.8%) tested positive on a Rapid Antigen Test; of them, only 75 (23.4%) had a confirmed diagnosis of Group A Beta-Hemolytic Streptococci (GABHS) based on culture results, yielding an overall prevalence of GAS pharyngitis at 23.4%. The gender distribution of the sample was slightly higher for males (53.3%), with an age range of 5-15 years for all participants and a median age of 8 years. Most participants (82.2%) attended school or daycare, and 95.3% reported having siblings.

As illustrated in Table 1, upon conducting a statistical analysis to examine the association between sociodemographic factors and the likelihood of a positive throat swab culture, our findings indicated a positive correlation between the number of siblings and the likelihood of a positive culture. An increased number of siblings was associated with a higher percentage of positive cultures (p-value 0.003). Secondly, we identified a relationship between reported recurrent infections and the likelihood of a positive culture. Those whose parents reported recurrent yearly infections exhibited a higher percentage of positive cultures (p-value: 0.026).

Table (1): Sociodemographic Factors and Results of Throat Swab Culture Results, (n=321).

Characteristic		Negative No. (%)	Positive No. (%)	Total No. (%)	P-value*
Sex	Male	138 (43%)	33 (10.3%)	171 (53.3%)	0.060
	Female	108 (38.6%)	42 (13.1%)	150 (46.7%)	
Age	5-8	144 (44.9%)	48 (15%)	192 (59.8%)	0.6
	9-12	75 (23.4%)	21 (6.5%)	96 (96.9%)	
	13-15	27 (8.4%)	6 (1.9%)	33 (10.3%)	
Residency	City	105 (32.7%)	30 (9.3%)	135 (42.1%)	0.700
	Village	45 (14%)	12 (3.7%)	57 (17.8%)	
	Camp	96 (29.9%)	33 (10.3%)	129 (40.2%)	
School/Daycare Attendance	Yes	204 (63.6%)	60 (18.7%)	264 (82.2%)	0.500
	No	42 (13.1%)	15 (4.7%)	57 (17.8%)	
No. of Siblings	None	12 (3.7%)	3 (0.9%)	15 (4.7%)	0.003
	1-2	96 (29.9%)	21 (6.5%)	117 (36.4%)	
	3-4	90 (28%)	45 (14%)	135 (42.1%)	
	More than 4	48 (15%)	6 (1.9%)	54 (16.8%)	
Frequency of Throat Infections per Year	1	66 (20.6%)	21 (6.5%)	87 (27.1%)	0.026
	2	117 (36.4%)	24 (7.5%)	141 (43.9%)	
	3-5	63 (19.6%)	30 (9.3%)	93 (29%)	

* Chi-square test used to test the relationship between sociodemographic factors and culture results and calculate a p-value.

Clinical characteristics

The patients in this study presented with various complaints, with cough being the most prevalent, reported by nearly half of the participants, followed by sore throat and fever. Other complaints were less common. Upon examining whether any presenting symptoms were more likely to result in a positive GABHS culture, no statistically significant association was found, as shown in Table 2. This table further reveals that 91% of patients were febrile at the time of diagnosis, as noted by their attending physicians. About one-third exhibited tonsillar exudates, and 40% had palpable anterior cervical lymph nodes. (Table 2)

Additionally, Table 3 presents the CENTOR scores based on clinical observations and patient history, however, statistical analysis showed no significant correlation between a positive throat swab culture and either the physical examination findings or higher CENTOR scores. (Table 3)

As a part of the study objectives, we examined the sensitivity of GABHS to different antibiotics commonly used in the treatment of tonsillopharyngitis. Our findings revealed that Penicillin was the most effective antibiotic, with a sensitivity rate of 97.3% and only 2.6% resistance. Amoxicillin-clavulanic acid was the second most effective, with a sensitivity rate of 96%. Azithromycin was the least effective antibiotic, with a sensitivity rate of 72% and a resistance rate of 28%. These results are valuable in guiding the selection of appropriate antibiotics for the treatment of tonsillopharyngitis caused by GABHS. More details about antibiotic sensitivity patterns are represented in Table 4 below.

Table (2): Presenting Complaints of The Patients and results of throat swab culture (n=321).

Complaint	Negative culture No. (%)	Positive culture No. (%)	Total No. (%)	P-value*
Cough	115 (35.8%)	42 (13.1%)	157 (48.9%)	0.18
Sore Throat	59 (18.4%)	15 (4.7%)	74 (23.1%)	0.53
Fever	58 (18.1%)	15 (4.7%)	73 (22.7%)	0.63
Temp. ≥ 38	225 (70.1%)	69 (21.5%)	294 (91.6%)	0.8
Tonsillar Exudate	84 (26.2%)	21 (6.5%)	105 (32.7%)	0.3
Cervical Adenopathy	96 (29.9%)	33 (10.3%)	129 (40.2%)	0.4
Others	14 (4.4%)	3 (0.9%)	17 (5.3%)	0.77

* Fisher's exact test was used to test the relationship between presenting complaints and culture results, and calculate a p-value

Table (3): CENTOR Score and results of Throat Swab Cultures, (n=321).

CENTOR Score	Negative No. (%)	Positive No. (%)	Total No. (%)	P-value
0	3 (0.9%)	3 (0.9%)	6 (1.9%)	0.2
1	96 (29.9%)	24 (7.5%)	120 (37.4%)	
2	78 (24.3%)	24 (7.5%)	102 (31.8%)	
3	51 (15.9%)	21 (6.5%)	72 (22.4%)	
4	18 (5.6%)	3 (0.9%)	21 6.5%)	

* Chi-square test used to test the relationship between the CENTOR score and culture results and calculate a p-value.

Table 4: Antibiotic sensitivity testing for positive cultured samples (n=75)

Antibiotic	Sensitive No. (%)	Intermediate No. (%)	Resistant No. (%)
Penicillin	70 (93.3%)	3 (4%)	2 (2.6%)
Amoxicillin-Clavulanic Acid	72 (96%)	0	3 (4%)
Amoxicillin	51 (68%)	9 (12%)	15 (20%)
Clindamycin	60 (80%)	0	15 (20%)
Azithromycin	39 (52%)	15 (20%)	21 (28%)

* Descriptive results.

Discussion

The prevalence of GABHS in our study was found to be 23.4%, which aligns with reported prevalence rates from other regions, including Egypt, Tunisia, Turkey, India, China, and Brazil, where figures ranged from 4% to 38% [17]. The global prevalence of GABHS is generally reported to be around 37% [3], which is higher than the rate observed in our study. The variations in prevalence can be attributed to several factors, such as the timing of data collection (seasonal differences), variations in technical methods, laboratory settings, and staff experience in culturing the samples.

While our study indicated that the prevalence of GABHS was higher in females (13.1%) compared to males (10.3%), this difference was not statistically significant (p = 0.06), which is consistent with findings from other studies that reported no significant gender-based variation in GABHS prevalence [18,19].

Sociodemographic factors were examined, and we found that two factors, the number of siblings and the annual recurrence of infection, were significantly correlated with a positive culture result (p-values 0.003 and 0.026, respectively). The positive correlation between the number of siblings and a positive culture suggests that household transmission may be a contributing factor. As the number of siblings increases, the likelihood of exposure to individuals carrying the infection may also rise, increasing the risk of contracting GABHS. This finding underscores the need for family counseling on preventing infection spread within households, such as frequent handwashing and avoiding the sharing of personal items or toys. Furthermore, the number of siblings should be considered as a risk factor when assessing the likelihood of GABHS infection.

The positive correlation between the annual recurrence of infections and the likelihood of a positive culture raises two possible hypotheses. First, there could be a chronic carrier state of GABHS with recurrent active infections, or incomplete treatment might result in persistent colonization. This highlights the importance of screening and treating chronic carriers to prevent ongoing transmission. Second, these individuals may be more susceptible to infections due to an undiagnosed immune-related condition, which warrants further investigation into immune vulnerabilities in the population.

Despite the validity of clinical assessments and the CENTOR score in diagnosing bacterial tonsillopharyngitis [18], our study calls into question the reliability of the CENTOR score as a diagnostic tool in our region. Our findings showed no significant correlation between a high CENTOR score and a positive culture result, challenging the utility of the score in predicting bacterial infections. This suggests that reliance solely on the CENTOR score and physical examination may not be appropriate for diagnosing bacterial tonsillopharyngitis in our population. Further studies are needed to assess the reliability of the CENTOR score in our specific setting.

Regarding antibiotic sensitivity, we found that 97.3% of cultured GABHS strains were sensitive to Penicillin, followed by 96% sensitivity to Amoxicillin-Clavulanic Acid. These results are comparable to other studies, one of which reported 100% sensitivity to Amoxicillin and 95% to Penicillin [20]. Our findings underscore the importance of continued research into penicillin-resistant isolates of GABHS, particularly given the ongoing concerns over antibiotic resistance.

In our study, 20% of GABHS strains were resistant to Clindamycin [19], a finding that aligns with other studies. Additionally, we observed a significant gap in the sensitivity of GABHS strains to Azithromycin, with only 72% susceptibility in our study, compared to 97.5% in other regions [21]. This discrepancy may reflect local differences in antibiotic prescribing practices and the emergence of antibiotic-resistant strains, particularly in the wake of the widespread use of Azithromycin during the COVID-19 pandemic. Moreover, incomplete antibiotic treatment and poor compliance may also contribute to the development of resistant strains, highlighting the critical need for responsible antibiotic stewardship to prevent further resistance.

These findings emphasize the importance of cautious antibiotic prescribing practices and continued efforts to monitor and address antibiotic resistance in the region.

Conclusion

In conclusion, our study provides valuable insights into the prevalence and sensitivity of Group A Streptococcus (GABHS) in patients with tonsillopharyngitis in our region. The prevalence of GABHS was found to be 23.4%. Sociodemographic factors such as the number of siblings and recurrent infections were associated with increased susceptibility. Penicillin was identified as the most effective antibiotic, followed by Amoxicillin-Clavulanic Acid. These findings contribute to optimizing antibiotic use and improving clinical outcomes in the treatment of GABHS-associated tonsillopharyngitis.

Disclosure data

- **Ethics approval and consent to participate:** The study was conducted after receiving ethical approval from the International Review Board (IRB) of An-Najah National University; Ref: Med. July 2022/29. Each child's caregiver participants or their legal guardians have been sufficiently informed of the study's purpose and the importance of their participation by the data collectors and/or the investigator. Written, Informed, voluntary, and signed consent was taken from all children's caregiver participants or legal guardians before the study commenced. Regarding the accessibility to the healthcare facilities from which the data were collected, appropriate formal permissions were granted from the Ministry of Health and the administrations of each facility
- **Consent for publication:** Not applicable
- **Availability of data and materials:** The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request
- **Author's contribution:** Conceptualization: R.S. and W.B.; Methodology: W.A., A.F., A.A., M.A., R.S., and W.B.; Formal Analysis: W.A., A.F., A.A., M.A., R.S., and W.B.; Data Curation: R.S. and W.B.; Writing—Original Draft Preparation: W.A., A.F, A.A., and M.A.; Writing—Review and Editing: R.S. and W.B.; Supervision: R.S. and W.B.; Project Administration: R.S. and W.B. All authors have reviewed and approved the final version of the manuscript.
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