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HALITOSIS AS AN ADDITIONAL CLINICAL MARKER OF STREPTOCOCCAL TONSILLITIS IN CHILDREN: OUTPATIENT OBSERVATION

The aim of the study – to evaluate the clinical significance of halitosis as a supplementary marker of streptococcal tonsillitis in children aged 3–18, including its correlation with confirmed Group A β-hemolytic streptococcal (GABHS) infection.

Materials and Methods. A total of 279 children presenting with symptoms of acute or chronic tonsillopharyngitis were assessed between January and May 2025. Clinical examination included halitosis evaluation and a rapid antigen test for GABHS. Patients with non-streptococcal or unrelated conditions were excluded.

Results and Discussion. Of 190 children with confirmed streptococcal infection, halitosis was observed in 128 (67.4 %). The symptom was most prevalent in follicular (89.3 %) and lacunar (78.5 %) tonsillitis and during exacerbations of chronic tonsillitis (81 %). Younger children (7–10 years) exhibited the highest prevalence (73.2 %). Halitosis intensity was moderate in 50.8 % and severe in 27.3 % of cases. A strong correlation was found between halitosis and positive rapid streptococcal test results (87.5 % of halitosis cases were GABHS-positive), versus 36 % among viral cases.

Conclusions. Halitosis may be a valuable, easily detectable marker for streptococcal pharyngotonsillitis in children, especially in settings with limited diagnostic tools. Its integration into clinical algorithms could improve early identification of bacterial infections and guide antibiotic prescribing, supporting efforts to reduce antibiotic resistance.

Key words: halitosis; streptococcal tonsillitis; pediatric diagnosis; group A β-hemolytic streptococcus (GABHS); oral malodor; chronic tonsillitis; rapid antigen test; bacterial pharyngitis; outpatient pediatrics; diagnostic markers.

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ГАЛІТОЗ ЯК ДОДАТКОВИЙ КЛІНІЧНИЙ МАРКЕР СТРЕПТОКОКОВОГО ТОНЗИЛІТУ В ДІТЕЙ: АМБУЛАТОРНЕ СПОСТЕРЕЖЕННЯ

Мета дослідження – оцінити клінічну значущість галітозу як додаткового маркера стрептококового тонзиліту в дітей віком від 3 до 18 років, зокрема його кореляцію з підтвердженою інфекцією, викликаною β-гемолітичним стрептококом групи А (ГБСА).

Матеріали та методи. У період із січня до травня 2025 р. було обстежено 279 дітей із симптомами гострого або хронічного тонзилофарингіту. Клінічне обстеження включало оцінку галітозу та експрес-тест на антиген ГБСА. Пацієнтів із нестрептококовими або не пов'язаними захворюваннями було виключено.

Результати дослідження та їх обговорення. Із 190 дітей із підтвердженою стрептококовою інфекцією галітоз спостерігали у 128 (67,4 %). Симптом був найбільш поширений при фолікулярному (89,3 %) та лакунарному (78,5 %) тонзиліті, а також під час загострення хронічного тонзиліту (81 %). Найвищу поширеність спостерігали у дітей віком 7–10 років (73,2 %). Інтенсивність галітозу була помірною у 50,8 % та вираженою у 27,3 % випадків. Встановлено сильну кореляцію між галітозом та позитивними результатами експрес-тесту на стрептокок (87,5 % випадків галітозу були ГБСА-позитивними) порівняно з 36 % серед вірусних випадків.

Висновки. Галітоз може бути цінним, легко виявлюваним маркером стрептококового фаринготонзиліту в дітей, особливо в умовах обмежених діагностичних ресурсів. Його інтеграція в клінічні алгоритми може покращити раннє виявлення бактеріальних інфекцій і сприяти раціональному призначенню антибіотиків, підтримуючи зусилля щодо зниження антибіотикорезистентності.

Ключові слова: галітоз; стрептококовий тонзиліт; педіатрична діагностика; β-гемолітичний стрептокок групи А (ГБСА); неприємний запах із рота; хронічний тонзиліт; експрес-тест на антиген; бактеріальний фарингіт; амбулаторна педіатрія; діагностичні маркери.

INTRODUCTION. Halitosis, or unpleasant odor from the oral cavity [1–3, 7–9], is a common phenomenon among children; however, in clinical practice, this symptom is often underestimated. In most cases, it is associated with oral hygiene disorders, gum diseases, or caries [3, 7], and therefore is not considered a potentially significant clinical marker of an infectious process. At the same time, recent studies indicate a connection between halitosis and acute infectious diseases of the oropharynx, particularly streptococcal infection – a disease that is one of the most common reasons for children's doctor visits during the cold season [1–3, 7–9].

Streptococcal infection, caused by group A β-hemolytic streptococcus [4], requires timely recognition and justified antibiotic prescription to prevent complications such as glomerulonephritis [5], rheumatic fever [6], and others. However, distinguishing bacterial infection from viral tonsillopharyngitis based solely on clinical presentation can be difficult, especially in children, where symptoms may be atypical or blurred. The use of rapid express tests or bacteriological cultures allows confirmation of the etiology, but their availability in outpatient settings is limited, and the cost is not always justified. In addition to the acute form, some children have a recurrent or chronic course of the

disease, accompanied by the constant presence of pathogenic microflora in the tonsillar crypts, formation of caseous masses, hypertrophy of the palatine arches, and changes in the lymphoid tissue of the pharyngeal ring. In such cases, halitosis becomes constant or periodic, reflecting a chronic purulent-inflammatory process in the tonsils.

In this context, the search for additional clinical signs that could serve as a guide for the physician in making a preliminary diagnosis is extremely relevant. One such sign may be halitosis – a symptom that is rarely emphasized but, as clinical observations show, often accompanies both acute streptococcal infection [1–3, 7–9] and exacerbation of chronic tonsillitis. Volatile sulfur-containing compounds produced as a result of bacterial activity in the tonsils create a characteristic unpleasant mouth odor that may serve as a clinical marker of the bacterial etiology of the process [79].

The interest of this study lies in the fact that it considers halitosis for the first time not as an isolated symptom, but as a potential diagnostic criterion of streptococcal oropharyngeal infection in children – both in acute cases and in exacerbations of chronic tonsillitis. The novelty of the work lies in comparing the presence of halitosis with the results of rapid tests for group A β-hemolytic streptococcus, which allows assessment of the diagnostic value of this symptom in the conditions of a regular outpatient visit.

The results of the study may form the basis for the development of practical recommendations for pediatricians and family doctors regarding more accurate selection of patients for antibacterial therapy, as well as contribute to the optimization of clinical diagnostic algorithms for upper respiratory tract infections in children. In addition, the inclusion of halitosis in the list of additional clinical criteria may help reduce the unjustified prescription of antibiotics, which is part of the global strategy to combat antibiotic resistance. Thus, this topic is relevant not only from the perspective of pediatric otolaryngology and infectious medicine, but also in the broader context of rational use of healthcare resources and improving the quality of medical care for children.

THE AIM OF THE STUDY – to determine the clinical role of halitosis as a marker of streptococcal oropharyngeal lesions in acute and chronic tonsillitis in children aged 3–18 years. Particular attention is paid to the association of halitosis with confirmed presence of group A β-hemolytic streptococcus (GABHS), as it is precisely the streptococcal etiology that determines the appropriateness of antibiotic therapy. The study aims to assess the frequency and diagnostic significance of halitosis – in particular of the caseous type – as a clinical phenomenon that may serve as an additional sign of bacterial inflammation during outpatient examination of a child.

MATERIALS AND METHODS. The study was conducted at the outpatient pediatric department from January to May 2025. A total of 279 children aged 3 to 18 years were examined, who presented with complaints characteristic of acute oropharyngeal diseases. Children included in the study had clinical manifestations of acute tonsillitis or tonsillopharyngitis, had not received antibacterial treatment during the last 7 days, and had no comorbidities that could influence the development of halitosis. Additionally, children with a diagnosis of chronic tonsillitis who visited the outpatient clinic during the study period were also included in the analysis. Informed parental consent for participation in the study was obtained. Patient selection was based on these inclusion criteria, while patients with non-streptococcal etiology or other chronic somatic pathology were excluded. Data collection was conducted from February to April 2025, preliminary preparation and protocol approval took place in January, and analysis of the obtained results and report preparation were carried out in May.

Clinical examination included anamnesis collection, assessment of general and local complaints, including the presence of bad breath (halitosis), physical examination, oropharyngeal inspection, and formulation of a preliminary diagnosis in accordance with approved pediatric protocols. To confirm the bacterial etiology of the disease, a rapid immunochromatographic test for the β-hemolytic group A streptococcus (Streptococcus pyogenes) antigen was used. Clinical material was collected using a sterile applicator swab from the posterior pharyngeal wall and surface of the tonsils, with subsequent application of the sample onto the Strep A Rapid Test system. A positive test result was established in 190 children (68 % of the total sample) who met the inclusion criteria. Patients with a negative result (59 children) were excluded from further analysis due to the non-streptococcal nature of the disease. The intensity of halitosis was assessed subjectively during the nasopharyngeal examination. For differential diagnosis between bacterial and viral etiology, a complete blood count was used if the rapid immunochromatographic test was negative.

A detailed analysis of the clinical picture was then conducted, examining the relationship between the presence of halitosis and other typical symptoms of streptococcal infection, such as fever, sore throat, hyperemia and plaque on the tonsils, regional lymphadenopathy, as well as features of the clinical course of chronic tonsillitis. Alongside the clinical study, a targeted literature review was conducted in international databases PubMed, Scopus, and Google Scholar from January to April 2025. The search was performed using key terms and their combinations: «halitosis», «Streptococcus pyogenes», «streptococcal pharyngitis», «chronic tonsillitis», «pediatric diagnosis», «oral malodor», «Strep A rapid antigen test», «children». Full-text publications in English or Ukrainian published no earlier than 10 years before the start of the study, containing clinical or epidemiological data relevant to the use of halitosis as a diagnostic criterion in the pediatric population, were included in the analysis. Sources related exclusively to adults or lacking primary data were not included. The literature review allowed for characterization of current scientific approaches to the pathogenesis of halitosis in oropharyngeal infections, particularly in acute and chronic inflammatory processes, and its potential diagnostic value in pediatric clinical practice.

RESULTS AND DISCUSSION. As part of the study, 190 children aged 3 to 18 years were examined at the outpatient pediatric department with complaints characteristic of acute and chronic oropharyngeal diseases, considering the stages of physiological development, immune maturity, and features of social activity that may affect the spread of oropharyngeal infections, particularly bacterial ones associated with halitosis. The obtained data are presented in Table 1.

The first group included children aged 3 to 6 years and was the largest – 60 patients (31.6 %). At this age, the high incidence of upper respiratory tract diseases was typical, explained by close interaction among children in kindergartens, playrooms, and clubs [10, 11]. The immune system at this

Table 1. **Distribution of Patients by Age Group and Clinical Relevance of Halitosis**

Age Group	Number of Patients	Percentage of Total Sample, %	Key Characteristics and Clinical Relevance
3–6 years (Preschool)	60	31.6	High incidence of URTIs due to close contact in kindergartens; immature immune system; halitosis may be an early indicator of bacterial infection.
7–10 years (Early School)	56	29.5	Increased social interaction at school; higher risk of streptococcal infections; more typical clinical symptoms facilitating diagnosis of halitosis.
11–14 years (Middle School)	50	26.3	Greater physical and social activity; participation in sports and clubs; stronger inflammatory symptoms; halitosis may indicate bacterial infection.
15–17 years (Adolescents)	15	7.9	Lower infection rates, but increased risk of complications due to delayed medical attention; halitosis may reflect more severe disease course.
18 years (Young Adults)	9	4.7	Mature immune system; better health self-monitoring; halitosis still significant in diagnosing severe bacterial tonsillitis.

Source. Prepared by the authors during this research.

stage has not yet reached functional maturity, making them more vulnerable to bacterial pathogens, especially group A β-hemolytic streptococcus [10, 11]. In this category of patients, halitosis often served as the first clinical signal of the development of bacterial oropharyngeal infection [1–3, 7–9].

The second group included early school-aged children (7–10 years) – 56 individuals (29.5 %). During this period, a new stage of socialization begins – school education, accompanied by a high level of interpersonal contact [10, 11]. At the same time, immune response development continues, and hygiene skills are not yet fully established [10, 11]. In this group, the clinical picture of oropharyngeal infections had typical manifestations, and halitosis was an early indicator of bacterial infection, especially in streptococcal pharyngitis.

The third group included middle school-aged children (11–14 years) – 50 patients (26.3 %). This age was characterized by increased physical activity and participation in school and extracurricular events, contributing to infectious contact [10, 11]. In addition, at this age, infections had pronounced clinical manifestations with a significant purulent component, directly correlating with the occurrence of halitosis. In such cases, bad breath was more often associated with the presence of purulent plaque or a significant inflammatory process in the oropharyngeal mucosa [1–3, 7–9, 13].

The fourth group included adolescents aged 15–17 years – 15 patients (7.9 %). Despite a tendency toward a decrease in the incidence of acute respiratory infections in older adolescence, there was a more frequent appearance of complicated and chronic forms of infections [10, 11]. Halitosis in this group was an indicator of prolonged or inadequately treated bacterial tonsillitis [10, 11]. Such patients often sought medical help later due to decreased parental control and overestimation of their own self-treatment capabilities [10, 11].

The fifth group included individuals aged 18 years and older – 9 patients (4.7 %). At this age, the immune system reaches full functional maturity, and hygiene skills and health monitoring are better [10, 11]. However, even in this category, halitosis indicated the presence of a purulent-inflammatory process in the oropharynx, particularly in severe bacterial tonsillitis or exacerbation of chronic pharyngitis. Subjective assessment of their own condition often led to delayed consultations, resulting in more pronounced symptoms.

Frequency of Halitosis. Among the 190 examined patients with clinically confirmed bacterial tonsillopharyngitis, halitosis was recorded in 128 individuals (67.4 %), indicating a high prevalence of this symptom in both acute and chronic oropharyngeal infections. Its occurrence appears to be associated with the form and condition of the tonsils as well as the characteristics of the local microbiota, as reflected in Tables 2, 3, and 4. The study revealed that in children aged 3–6 and 7–10 years, acute forms of tonsillitis predominated, specifically catarrhal, follicular, and lacunar types.

The *catarrhal form* (42.1 %) of tonsillitis in children aged 3–6 years was characterized by the following oropharyngeal findings: the tonsils were enlarged due to edema, and there was marked hyperemia of the tonsillar mucosa and surrounding tissues, as shown in Figure 1. The surface of the tonsils remained smooth and even, without purulent or

Figure 1. Morphological Features of the Catarrhal Form.

Notes. Enlargement and hyperemia of the tonsils without pus. Immune response preserved. *Source. Prepared by the authors during this research*.

fibrinous exudates. The pharyngeal isthmus appeared slightly narrowed due to tissue swelling, and the mucous membrane of the oropharynx was also hyperemic. Pain or discomfort during examination was typically reported in the medical history, although in many children the severity of symptoms was moderate. No signs of advanced inflammation such as purulent foci or folliculitis were observed, corresponding to the initial stage of tonsillar inflammation [14–18].

Follicular Form (89.3 %) of tonsillitis was predominant among children aged 7–10 years and, during oropharyngeal examination, was characterized by multiple purulent follicles – small, round, yellowish or whitish foci visible on the surface of enlarged tonsils, as shown in Figure 2. The mucous membrane of the tonsils was markedly hyperemic and swollen, often leading to partial narrowing of the oropharyngeal isthmus. In 73.2 % of patients in this age group, halitosis of moderate to severe intensity was observed, indicating an active inflammatory process and bacterial involvement of the tonsils. These findings reflected a pronounced infectious lesion contributing to the formation of purulent content in the follicles and an intensification of unpleasant oral odor [13–18].

Lacunar form (78.5 %) of tonsillitis was also common in children aged 7–10 years. Upon examination of the oropharynx, the tonsils were enlarged, with pronounced hyperemia and swelling of the mucous membrane. The surface of the tonsils was uneven due to the presence of purulent plugs filling the lacunae – natural depressions on the surface of the tonsils, as shown in Figure 3. These plugs were white-yellow in color and could release purulent content upon gentle pressure. Halitosis was observed in 78.5 % of patients with the lacunar form, indicating an active inflammatory process and bacterial infection in the tonsils. This form of tonsillitis was accompanied by moderate to severe intensity of unpleasant mouth odor [13–18].

Within the framework of the conducted study, among patients aged 11–17 years and adults, only the simple form of chronic tonsillitis was diagnosed according to Preobrazhensky's classification. This form is characterized by localized inflammatory changes in the tissues of the palatine tonsils without signs of systemic toxic-allergic reactions [13–18]. No systemic complications, such as rheumatic lesions of the joints, heart, or kidneys, were observed in any of the examined patients. The materials obtained during the study are illustrated in Figure 4.

In the group of children aged 11–14 years, *chronic tonsillitis* was recorded in 50 patients, of whom 68 % (34 individuals) exhibited halitosis, with 27.3 % showing severe intensity. In the 15–17-year-old group, chronic tonsillitis was identified in 15 patients, 66.7 % of whom (10 individuals) complained of persistent, foul-smelling breath that persisted between episodes of exacerbation. Among adult patients (aged 18+ years), the chronic form was found in 9 cases, and 44.4 % of them (4 individuals) also had moderate halitosis.

During oropharyngeal examination of all patients with the simple form of chronic tonsillitis, hypertrophy and softness of the palatine tonsils were observed, with an uneven surface due to the presence of deep crypts. In 84 % of cases (out of 74 patients with chronic tonsillitis), caseous masses or purulent plugs were detected [19, 20]. The obtained data are shown in Figures 4, a–f. In 79 % of patients, Preobrazhensky's symptom was positive — upon pressing the tonsils, a viscous white-yellow content with a characteristic unpleasant odor was released. Retention cysts of the tonsils were visualized in 45 % of cases (33 patients), indicating a prolonged course of the process.

Korytsky's ridges (enlargement of the submandibular lymph nodes along the sternocleidomastoid muscle) were found in 58 % of the examined patients, which is a characteristic sign of chronic prolonged inflammation in the oropharynx. In 36 % of cases, the arches were fused with the tonsils, further complicating the drainage of lacunar contents and contributing to the formation of halitosis.

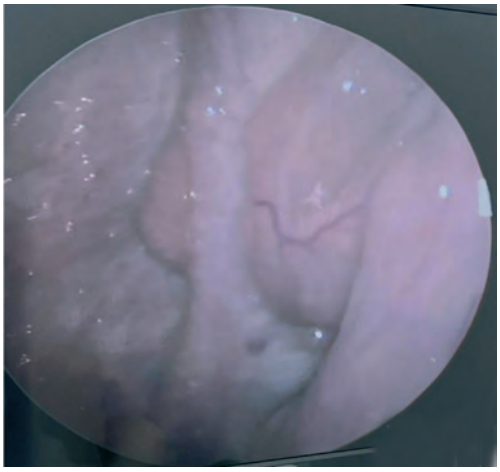

Figure 2. Morphological Features of the Follicular Form.

Notes. Enlargement of the tonsils, marked hyperemia and swelling of the mucosa. Multiple round yellowish-white follicles present on the surface of the tonsils. Signs of purulent content filling the crypts. *Source. Prepared by the authors during this research.*

Figure 3. Morphological features of the lacunar form.

Notes. Enlarged, hyperemic palatine tonsils with swelling of the oropharyngeal mucosa and the presence of whitish-yellow purulent layers in the dilated lacunae. *Source. Prepared by the authors during this research.*

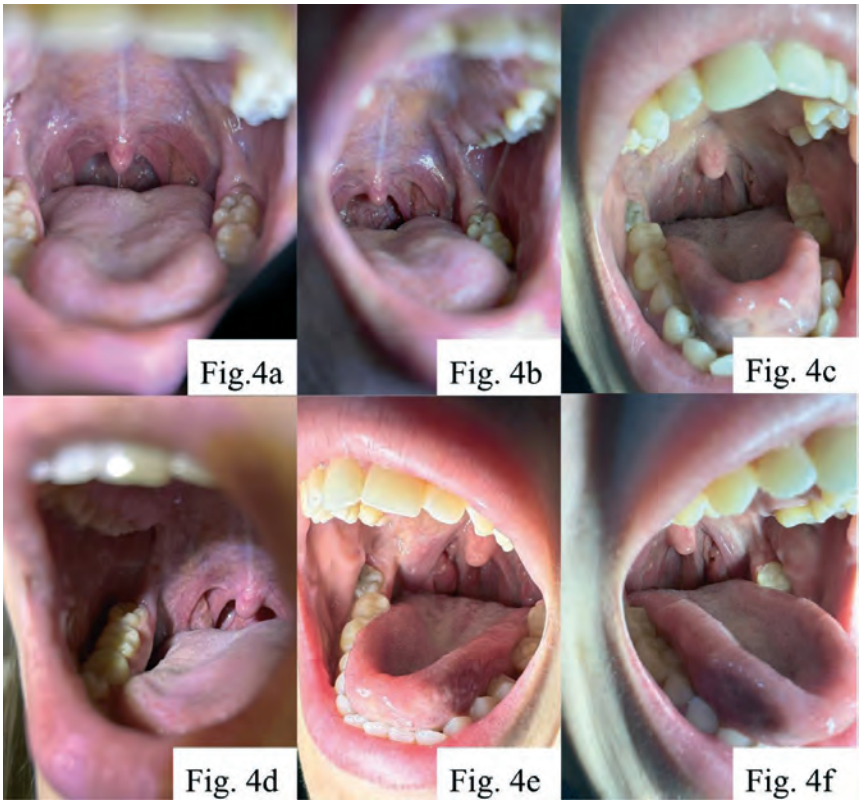

Figure 4. Chronic Tonsillitis.

Notes. a – hypertrophied, soft tonsils with deep crypts, presence of caseous masses; b – pronounced lacunarity of the tonsils, whitish plugs, moderate hyperemia; c – tonsillar hypertrophy, adhesion to the palatine arches; d – tonsils with signs of chronic inflammation, isolated caseous masses, hyperemia; e – lacunae partially filled with purulent masses, noticeable swelling of the arches, cysts; f – significant unevenness of the tonsillar surface, multiple plugs. *Source. Prepared by the authors during this research*.

Among patients of different age groups, the prevalence of halitosis varied. In the group of children aged 3–6 years, halitosis was detected in 39 out of 60 patients (65 %). In this age group, the mouth odor had moderate intensity and was often associated with the catarrhal or lacunar form of tonsillitis, with the presence of bacterial plaques on the tonsils.

In the group of children aged 7–10 years, halitosis was recorded in 41 out of 56 patients (73.2 %), which was the highest rate among all groups. At this age, the odor had moderate to severe intensity and was most often linked to the purulent (follicular or lacunar) form of tonsillitis, accompanied by fever and severe sore throat. In the group of children aged 11–14 years, halitosis was observed in 34 out of 50 patients (68 %), where the odor was mostly intense, especially in mixed forms of inflammation or in cases of prolonged tonsillitis. In the group of adolescents aged 15–17 years, the symptom was present in 10 out of 15 patients (66.7 %), with the odor being persistent and often putrid, indicating a chronic course of the disease. In the group of patients aged 18 years and older, halitosis was diagnosed in 4 out of 9 patients (44.4 %). In this category, the odor was usually of moderate intensity and occurred during exacerbations of chronic tonsillitis with the presence of purulent deposits (Table 2).

Halitosis was most commonly observed in the follicular form of tonsillitis (89.3 % of cases), in the lacunar form – in 78.5 % of cases, and in chronic tonsillitis during exacerbation – in 81 % of patients. The catarrhal form was less common, and halitosis in this group was recorded only in 42.1 % of cases, mainly among younger children (Table 3). Assessment of halitosis intensity showed that in 21.9 % of patients the odor was mild, in 50.8 % – moderate, and in 27.3 % – severe (Table 4). Severe odor was usually found in children of middle and older school age with severe clinical forms accompanied by purulent-necrotic manifestations.

Within the framework of the study examining the relationship between halitosis and bacterial infections, particularly infection with group A β-hemolytic streptococcus, it was found that among children with halitosis, in 87.5 % of cases (112 out of 128 children), the presence of group A β-hemolytic streptococcus was confirmed by nasopharyngeal swab. Diagnosis was performed using a rapid test or bacteriological throat culture, which allowed identification of the pathogen. Overall, positive rapid test results were obtained in 68 % of all examined children with symptoms of tonsillopharyngitis. This indicates a high prevalence of halitosis among children with bacterial infections of the oropharynx, especially in streptococcal tonsillopharyngitis.

When comparing the frequency of halitosis in streptococcal versus viral etiologies, it was established that halitosis occurred significantly more often in bacterial infections:

Table 2. **Prevalence of Halitosis Among Patients with Streptococcal Tonsillitis**

Age Group	Number of Patients	Number with Halitosis	Percentage with Halitosis (%)	Intensity of Halitosis	Form of Tonsillitis
3–6 years	60	39	65	Moderate	Catarrhal,
7–10 years	56	41	73.2	Moderate/Severe	Follicular, Lacunar
11–14 years	50	34	68	Severe	Mixed, Chronic
15–17 years	15	10	66.7	Foul, Persistent	Chronic (Exacerbated)
18+ years	9	4	44.4	Moderate	Chronic (Exacerbated)

Source. Prepared by the authors during this research.

Table 3. **Prevalence of Halitosis by Tonsillitis Form**

Tonsillitis Form	Number of Patients	Percentage with Halitosis (%)
Follicular	89.3% (n=84)	89.3
Lacunar	78.5% (n=78)	78.5
Chronic (Exacerbated)	81% (n=74)	81
Catarrhal	42.1% (n=19)	42.1

Source. Prepared by the authors during this research.

Table 4. **Intensity of Halitosis Among Patients with Tonsillitis**

Intensity	Percentage of Patients (%)
Weak	21.9
Moderate	50.8
Severe	27.3

Source. Prepared by the authors during this research.

among children with laboratory-confirmed streptococcal infection, the symptom was recorded in 87.5 % of cases, while among children with viral pharyngitis it was present in only 36 %. Thus, the risk of halitosis with bacterial infection was 2.4 times higher than with viral infection, highlighting its diagnostic significance. This difference is likely due to more pronounced inflammation and the presence of purulent exudate in bacterial processes, which promotes the formation of volatile sulfur compounds and the characteristic unpleasant mouth odor [7–9].

Examples of clinical symptom complexes where halitosis clearly correlates with bacterial processes include acute streptococcal pharyngitis, chronic bacterial tonsillitis, and chronic tonsillitis. In particular, acute streptococcal pharyngitis in children is usually characterized by a high body temperature above 38 °C, intense sore throat, swelling and hyperemia of the pharyngeal mucosa, purulent plaques on the tonsils, and regional lymphadenopathy. In such cases, halitosis often takes on a pronounced putrid character. In chronic bacterial tonsillitis, halitosis was a persistent symptom against the background of ongoing purulent inflammation of the tonsils, clinically accompanied by periodic exacerbations with sore throat, purulent plugs, and lymphadenopathy.

Analysis of halitosis prevalence among different age groups showed that in children aged 3–6 years, the symptom was observed in 65 % of cases (39 out of 60 patients), mostly with catarrhal or lacunar forms of tonsillitis. In children aged 7–10 years, halitosis was most frequently observed – in 73.2 % of cases (41 out of 56 patients), corresponding to purulent (follicular or lacunar) forms of tonsillitis with moderate or severe odor intensity. In the group of children aged 11–14 years, the symptom was recorded in 68 % of cases (34 out of 50 patients), where halitosis was pronounced, especially in mixed forms of infection or chronic progression. Among adolescents aged 15–17 years, halitosis was recorded in 66.7 % of cases (10 out of 15 patients), with the odor being persistent and putrid, characteristic of chronic tonsillitis. In the age group 18 years and older, halitosis was diagnosed in 44.4 % of cases (4 out of 9 patients), usually during exacerbations of chronic inflammatory processes.

Regarding different clinical forms of tonsillitis, halitosis was most common in the follicular form – in 89.3 % of cases, in the lacunar form – in 78.5 %, and during exacerbation of chronic tonsillitis – in 81 % of patients. In the catarrhal form of tonsillitis, halitosis was recorded in 42.1 % of cases. Assessment of odor intensity among patients showed that in 21.9 % of cases halitosis was mild, in 50.8 % moderate, and in 27.3 % strongly expressed. Thus, more than three-quarters of children (78.1 %) had moderate or severe halitosis intensity, making this symptom clinically noticeable without the need for special instrumental diagnostic methods.

The pathophysiological mechanisms underlying halitosis in bacterial infections of the oropharynx are primarily related to the production of volatile sulfur compounds (VSCs), mainly hydrogen sulfide, methyl mercaptan, and dimethyl sulfide [7–9, 12]. These substances are produced through the metabolism of protein substrates by anaerobic bacteria actively colonizing tonsillar crypts and the deeper layers of the pharyngeal mucosa. The gases comprising halitosis are formed due to the breakdown of peptides and glycopeptides during bacterial putrefaction in the oral cavity. During this process, peptides are hydrolyzed to amino acids, which are further metabolized into amines or polyamines [9]. The presence of purulent exudate, tissue debris, and anatomical recesses creates optimal conditions for an anaerobic environment and enhances volatile compound production [9].

It is important to note that in streptococcal infections, halitosis has a putrid, sharp character due to massive tissue destruction and active purulent processes, whereas in viral infections mouth odor is usually absent or much less pronounced due to predominant catarrhal involvement without pus formation, as investigated in this study.

Despite the significant diagnostic informativeness of the results and the clearly identified clinical association between halitosis and streptococcal oropharyngeal infection, the conducted study – as well as most outpatient observations – has several limitations that should be taken into account for a comprehensive analysis. First and foremost, the study was carried out under real clinical practice conditions, which entailed some variability in the subjective assessment of halitosis intensity. Since objective measurement methods, such as the use of a halimeter or gas analysis of volatile sulfur compounds, were not applied, the evaluation of symptom severity was based on the clinical experience of the physician and complaints from the patient or parents. However, this approach reflects the real conditions of primary care physician visits, where rapid symptom recognition occurs without specialized equipment.

It should also be noted that the study did not formally control for concomitant factors that could potentially influence the presence of halitosis: specifically, dental diseases, dietary habits, or gastroenterological pathology. At the same time, inclusion criteria limited participants to children without active chronic diseases and without signs of other somatic conditions, which substantially reduces the impact of these factors on the overall conclusions. Dynamic follow-up of patients after treatment completion was also not conducted, although clinical regression of halitosis, according to parents' reports, was observed in almost all cases following antibacterial therapy. Nevertheless, the data obtained allow for substantial conclusions regarding the role of halitosis as a clinical indicator of bacterial etiology in tonsillitis, which is important in the context of differentiating viral and bacterial infections without resorting to costly laboratory diagnostics.

From a practical standpoint, it is advisable to incorporate halitosis as one of the additional clinical criteria that can guide physicians in deciding on antibiotic prescriptions. Specifically, during outpatient examination of a child presenting with sore throat, fever, and visible changes in the oropharynx, the presence of moderate or pronounced halitosis may be considered a sign that increases the likelihood of a streptococcal process. It is recommended to use a simple three-level scale for odor intensity assessment (mild – moderate – severe), which can be applied without instruments but with consideration of clinical experience and feedback from parents.

Considering the results indicating a high prevalence of halitosis among children with streptococcal tonsillopharyngitis, it is reasonable to view this symptom not as an isolated phenomenon but as a clinical predictor of bacterial etiology in the inflammatory process. Its combination with other recognized diagnostic criteria significantly enhances the prognostic value of the symptom complex. In clinical practice, the most informative criteria for differentiating bacterial tonsillopharyngitis remain: body temperature above 38 °C, purulent or fibrinous exudative deposits on the palatine tonsils, tenderness and enlargement of cervical lymph nodes, and absence of cough as a marker of viral infection. The addition of halitosis, which, according to pathophysiological data, is caused by the formation of volatile sulfur compounds due to proteolytic activity of anaerobic microflora in the presence of purulent substrate, can considerably increase the sensitivity of clinical prediction of streptococcal infection.

To facilitate the diagnostic process and optimize treatment strategy, a clinically justified stepwise algorithm is proposed for suspected acute tonsillopharyngitis in children. The first stage involves a structured history taking with emphasis on the presence of halitosis, its onset, dynamics, and intensity evaluation via a subjective scale (e. g., 0–3 points). The second stage is the examination of the oropharynx with documentation of the following signs: hyperemia and swelling of the palatine tonsils, presence of purulent or serous coating, caseous masses in the lacunae, hypertrophy of the palatine arches, signs of retention. The third stage involves assessment of systemic manifestations: hyperthermia, regional lymphadenopathy, infection without rhinitis and cough. The fourth stage is the performance of a rapid antigen test for group A β-hemolytic streptococcus (Strep A rapid antigen test), if available. The fifth stage is clinical decision-making: in the presence of three or more of the listed signs, including halitosis, empirical systemic antibacterial therapy is recommended, considering the regional profile of Streptococcus pyogenes antibiotic resistance.

This algorithm is based on evidence-based medicine principles and adapted to resource-limited settings, particularly in outpatient pediatric practice. Halitosis, as a marker with high clinical accessibility, does not require special equipment and can be detected even during a brief consultation without laboratory verification. The assessment of this symptom should consider the possible influence of concomitant factors (poor oral hygiene, gastroesophageal reflux disease, adenoiditis), but combined with other specific symptoms of streptococcal tonsillitis, the likelihood of false-positive interpretation remains low.

For scientific validation of the proposed model, further studies are recommended with objective quantitative assessment of halitosis intensity using direct measurement devices for volatile sulfur compounds (e. g., halimetry or gas chromatography), inclusion of control groups (with viral pharyngitis and without oropharyngeal pathology), and microbiological profiling of the pathogen in patients with pronounced odor. Prospective analysis of halitosis dynamics during etiotropic treatment, alongside clinical efficacy and normalization of laboratory parameters, is especially promising. In the future, integration of halitosis into clinical scoring systems (e. g., modification of the McIsaac score) may facilitate early rec-

ognition of streptococcal infection, reduce time to therapy initiation, decrease antibiotic prescriptions for viral upper respiratory infections, and consequently reduce the development of antibiotic resistance in the population.

Prospects for further research. In view of the obtained results and the identified clinical significance of halitosis as a potential indicator of the bacterial etiology of tonsillitis, there arises a need to expand research to increase the evidential strength and formalize the clinical application of this symptom. In future scientific works, it is advisable to focus on objectifying the parameters of halitosis by using devices for quantitative analysis of volatile sulfur compounds, such as halimeters or gas chromatographs. This will eliminate variability in subjective assessment and ensure data standardization. A promising direction is the creation of control cohorts of patients with viral pharyngitis, as well as children without oropharyngeal pathology, which will allow for more precise determination of the specificity and prognostic value of halitosis as a diagnostic marker. It is also important to include in the study protocol an assessment of dental and gastroenterological status, which will ensure differentiation of the causes of halitosis beyond infectious etiology.

Special attention should be paid to microbiological analysis of oropharyngeal secretions in patients with halitosis to establish the dominant microflora and its role in symptom formation. An analysis of the correlation between the degree of odor and the quantitative load of *Streptococcus pyogenes* can deepen the understanding of the pathophysiology of the process. In addition, the dynamics of halitosis during treatment, particularly in the context of systemic antibiotic therapy, require investigation. This will allow assessment not only of the effectiveness of therapy but also the potential use of halitosis as a non-invasive indicator of clinical recovery. From a practical point of view, modifying existing clinical scales, particularly the McIsaac score, by including halitosis as a separate evaluable criterion appears promising. Conducting multicenter prospective studies with a large sample size will allow verification of the feasibility of such an approach in routine practice. Finally, the integration of halitosis into the diagnostic algorithm requires not only clinical justification but also an economic analysis, which will assess the impact of this modification on reducing unjustified antibiotic prescriptions, preventing complications, and combating antibiotic resistance. Systematic study of these aspects opens new horizons for optimizing the management of patients with acute inflammatory diseases of the oropharynx in pediatric practice.

Limitations of the study. Despite the high practical value of the conducted study, it is necessary to take into account a number of methodological limitations. First of all, the assessment of halitosis was carried out based on the clinical impression of the physician and reports from patients or their parents without the use of objective instrumental methods, in particular halimetry or gas chromatography. This creates a potential risk of subjectivity in the evaluation of symptom intensity. In addition, although children with chronic somatic diseases were excluded from the sample, a systematic differentiation of other possible etiological factors of halitosis, such as dental pathology, gastroesophageal reflux disease, or adenoid tissue hypertrophy, was not conducted. The absence of a control group (children with viral infections or without oropharyngeal pathology) limits the possibility of determining the specificity and prognostic value of halitosis as a diagnostic criterion. It should also be noted that the study had a cross-sectional design without dynamic observation, which makes it impossible to assess changes in the intensity of halitosis during treatment or to use this symptom as a marker of clinical recovery. At the same time, these limitations do not diminish the scientific significance of the obtained results, but rather outline directions for further research to objectify clinical observations and expand the evidence base.

CONCLUSIONS. The obtained results confirm that halitosis is a common and clinically significant symptom of streptococcal infection in children. The established close association between the presence of halitosis and infection with group A β-hemolytic streptococcus allows it to be considered as an additional diagnostic criterion during the initial examination. Considering the prevalence and intensity of this symptom, it is advisable to include the assessment of halitosis in clinical protocols to improve diagnostic accuracy and optimize antibacterial therapy.

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