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Temporal Changes in Pediatric Peritonsillar Abscess Diagnoses Before and During the COVID-19 Pandemic: A Multi-institutional Retrospective Database Review

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Abstract

Objective

Peritonsillar abscess (PTA) is often secondary to acute tonsillitis and is the most prevalent deep space infection within the head and neck. This study investigates whether pediatric PTA diagnosis patterns changed before and during the COVID-19 era.

Methods

Using the TriNetX US Collaborative Network, we identified pediatric patients aged ⩽17 years with eligible evaluation-and-management encounters between January 2016 and December 2022 and stratified them according to PTA diagnosis. The full study period was used to characterize longitudinal diagnosis trends and assess the correlation between monthly PTA and acute tonsillitis rates. The primary pre-/pandemic comparison was restricted to two 12-month periods, April 2019 through March 2020 and April 2020 through March 2021, to align calendar months and reduce seasonal confounding. Monthly documented diagnosis rates were calculated per 100,000 patients and compared using Welch's two-sample t-tests.

Results

Among 11,298,101 identified children, 8,548 had PTA; 4,439 (51.9%) were female, and 3,969 (46.4%) were male. Mean age at the time of PTA diagnosis was 12.20 years (SD=4.83). Compared with the non-PTA cohort, patients with PTA were more likely to have a history of acute upper respiratory infection (64.4% vs. 18.0%; $\chi^2(1) = 11{,}952.2$, $p<.001$), including acute pharyngitis and acute tonsillitis. A history of tonsillectomy was also more common among patients with PTA (2.6% vs. 0.4%; $\chi^2(1) = 1{,}063.0$, $p<.001$). The mean monthly PTA diagnosis rate was lower during the pandemic than during the pre-pandemic period (0.6 vs. 1.3 cases per 100,000; $t(15.2) = 7.6$, $p<.001$).

Conclusion

There was a significant decrease in the documented diagnoses of both acute tonsillitis and PTA during the COVID-19 pandemic compared to pre-pandemic times, and patients with PTA were more likely to have a history of tonsillitis and pharyngitis.

Categories: Otolaryngology, Emergency Medicine, Pediatrics
Keywords: covid-19, pandemic, pediatrics, peritonsillar abscess, tonsillitis

Introduction

Peritonsillar abscess (PTA) is the most prevalent deep space infection within the head and neck, defined by a collection of pus between the palatine tonsil capsule and the pharyngeal muscles [1,2]. Incidence of PTA increases throughout childhood, peaking in teenagers at 167 cases per 100,000 children annually [3]. Traditional theory describes PTA as a complication of acute tonsillitis, while an alternate theory, first introduced by Passy in 1994, postulates that abscess formation occurs as a result of infection within the supratonsillar Weber's glands [4-10]. The most commonly isolated pathogens include *Streptococcus pyogenes* and *Fusobacterium necrophorum* [11,12]. Clinical presentation of PTA typically begins with progressive unilateral throat pain and odynophagia, which may be accompanied by referred ipsilateral otalgia. Later progression may involve a "hot potato" voice and neck pain secondary to cervical lymph node inflammation. Physical examination may reveal trismus, tonsillar blanching with applied pressure, and a swollen, edematous uvula with contralateral deviation. Complications of PTA include parapharyngeal or retropharyngeal abscess, laryngeal edema, which may lead to airway compromise, and sepsis [2,11]. First-line management includes prompt drainage, either by way of incision and drainage or needle aspiration, and

broad-spectrum antibiotics, with tonsillectomy reserved for recurrent presentations [13].

In response to the COVID-19 pandemic, various public health interventions were implemented to mitigate the spread of viral infection, including masking, physical distancing, hand hygiene, contact tracing and quarantine, stay-at-home orders, workplace and school closures, and travel restrictions [14,15]. The implementation of these measures offers a unique opportunity to explore the current etiological theories of pediatric PTA. In this context, we investigated documented pediatric PTA diagnosis rates before and during the COVID-19 pandemic, hypothesizing that there would be a decrease in PTA rates during this period.

Materials And Methods

Study design

We conducted a retrospective database review using electronic health record (EHR) data from the TriNetX US Collaborative Network, which aggregates de-identified data from 78 healthcare organizations. Participating sites, primarily large academic and community health systems, contribute structured data, including diagnoses, procedures, demographics, and encounter information. All data are de-identified in accordance with Health Insurance Portability and Accountability Act standards, and analyses are conducted using aggregate datasets without access to patient-level identifiers. Race and ethnicity data were obtained from EHRs within the TriNetX database. These data were collected by participating health care organizations according to their institutional practices and were included because racial and ethnic differences may influence disease incidence, health care utilization, and clinical outcomes. Data were curated on January 3, 2024. Patients were included if they were ⩽17 years old and had an evaluation-and-management (E&M) encounter (CPT: 99202-99499) between January 2016 and December 2022. These patients were stratified into two cohorts: those who were diagnosed with PTA (ICD-10: J36) and those who were not. Demographic information, history of upper respiratory infections (URIs) (ICD-10: J00-J06), and history of tonsillectomy (CPT: 42820, 42821, 42825, 42836) prior to the index date of PTA diagnosis were collected. For patients with PTA, the index date was the date of the first documented PTA diagnosis. For non-PTA patients, the index date was the comparator E&M service date. Medical and surgical histories were assessed before the respective index date. The primary outcome was the monthly documented PTA diagnosis rate, with the monthly documented acute tonsillitis diagnosis rate evaluated as a secondary outcome, from January 2016 through December 2022. Data from January 2016 through December 2022 were used to describe longitudinal trends in monthly PTA and acute tonsillitis diagnosis rates and to evaluate the correlation between these rates. The inferential pre-/pandemic comparison was restricted to the pre-pandemic baseline period of April 2019 through March 2020 and the pandemic period of April 2020 through March 2021. These two 12-month intervals were selected to align calendar months and reduce confounding from seasonal variation. Data outside these intervals contributed to the longitudinal trend and correlation analyses but not to the two-period comparison. Monthly diagnosis rates were calculated as the number of patients with the respective diagnosis during each month divided by the number of eligible pediatric patients during that month and multiplied by 100,000. This study was determined to be exempt from full review by the University at Buffalo Institutional Review Board.

Statistical analysis

All statistical analyses were conducted in R (Version 4.4.0, R Core Team, 2024). Categorical variables were reported as frequency counts and percentages, while continuous variables were reported as means with standard deviations (SDs). Pearson's χ^2 tests were used to compare categorical variables, and Student's t-tests were used to compare continuous demographic variables. Pearson correlation was used to assess the relationship between the monthly diagnosis rates of acute tonsillitis and PTA. Welch's two-sample t-tests were used to compare monthly diagnosis rates during the pandemic period (April 2020-March 2021) with the pre-pandemic baseline period (April 2019-March 2020). Statistical significance was defined as $p<.05$.

Results

Patient demographics and history

A total of 11,298,101 pediatric patients with CPT codes for E&M were identified. Among these patients, 8,548 (0.1%) received a diagnosis of PTA, with a mean age of 12.20 years (SD=4.83). The PTA cohort included 4,439 (51.9%) female patients and 3,969 (46.4%) male patients. Pediatric patients with PTA were significantly older than those without PTA (mean age 12.20 ± 4.83 vs. 7.25 ± 5.76 years; $t(11,298,099) = 79.4$, $p<.001$). Racial distribution differed significantly between groups ($\chi^2(6) = 296.3$, $p<.001$), with Black or African American children comprising a greater proportion of the PTA group compared to the non-PTA group (21.9% vs. 17.1%). A higher percentage of patients with PTA were identified as Hispanic or Latino than patients without PTA (22.6% vs. 18.6%; $\chi^2(2) = 273.4$, $p<.001$). Comparison of the demographics of pediatric PTA and non-PTA patients between 2016 and 2022 is provided in Table *1*.

Demographic	PTA, N=8,548	Non-PTA, N=11,289,553	Test statistic (df)	p-value
Age (years), mean ± SD	12.2 ± 4.83	7.25 ± 5.76	t = 79.433 (df = 11,298,099)	<.001[a]
Sex N (%)			χ^2 = 63.634 (df = 2)	<.001[b]
Male	3,969 (46.4)	5,720,222 (50.7)		
Female	4,439 (51.9)	5,377,152 (47.6)		
Unknown	140 (1.6)	192,179 (1.7)		
Race			χ^2 = 296.343 (df = 6)	<.001[b]
American Indian or Alaska Native	32 (0.4)	36,308 (0.3)		
Asian	233 (2.7)	493,879 (4.4)		
Black or African American	1,876 (21.9)	1,925,071 (17.1)		
Native Hawaiian or Other Pacific Islander	135 (1.6)	100,128 (0.9)		
White	4,752 (55.6)	6,255,191 (55.4)		
Other Race	593 (6.9)	869,036 (7.7)		
Unknown Race	927 (10.8)	1,609,940 (14.3)		
Ethnicity			χ^2 = 273.374 (df = 2)	<.001[b]
Hispanic or Latino	1,930 (22.6)	2,096,067 (18.6)		
Not Hispanic or Latino	5,587 (65.4)	7,105,150 (62.9)		
Unknown ethnicity	1,031 (12.1)	2,088,336 (18.5)		

TABLE 1: Comparison of demographics of pediatric peritonsillar abscess (PTA) and non-PTA patients in TriNetX between 2016 and 2022.

SD: standard deviation.

[a]Student's t-test

[b]Pearson's χ^2 test

History of acute upper respiratory tract infection was significantly more common among pediatric PTA patients compared to those without PTA (64.4% vs. 18.0%; $\chi^2(1) = 11{,}952.2$, p<.001; Table *2*).

History, N (%)	ICD-10/CPT code	PTA, N=8,548	Non-PTA analysis sample, n=615,584†	Pearson χ^2 statistic (df=1)	p-value[a]
Acute upper respiratory infection	ICD-10: J00-J06	5,508 (64.4)	111,034 (18.0)	11,952.231	< .001
Acute pharyngitis	ICD-10: J02	4,317 (50.5)	51,565 (8.4)	18,353.821	< .001
Acute tonsillitis	ICD-10: J03	2,184 (25.5)	11,881 (1.9)	21,353.222	< .001
Acute upper respiratory infections of multiple and unspecified sites	ICD-10: J06	2,086 (24.4)	69,936 (11.4)	1,404.934	< .001
Acute sinusitis	ICD-10: J01	507 (5.9)	11,054 (1.8)	793.116	< .001
Acute obstructive laryngitis (croup) and epiglottitis	ICD-10: J05	302 (3.5)	10,051 (1.6)	186.622	< .001
Acute nasopharyngitis (common cold)	ICD-10: J00	213 (2.5)	5,882 (1.0)	205.774	< .001
Acute laryngitis and tracheitis	ICD-10: J04	34 (0.4)	756 (0.1)	50.415	< .001
Tonsillectomy with/without adenoidectomy	CPT: 42820, 42821, 42825, 42836	218 (2.6)	2,179 (0.4)	1,063.043	< .001
Tonsillectomy and adenoidectomy	CPT: 42820, 42821	148 (1.7)	1,982 (0.3)	492.428	< .001
Tonsillectomy, primary or secondary	CPT: 42825, 42836	70 (0.8)	197 (0.0)	1,220.868	< .001

TABLE 2: Comparison of medical and surgical histories of peritonsillar abscess (PTA) and non-PTA patients.

†615,584 out of the 11,289,553 patients in the No PTA cohort were included in these results, as TriNetX limits large cohort results in approximately 10,000 patients per healthcare organization to optimize performance.

[a]Pearson's χ^2 test

The most frequently documented URIs in the PTA cohort were acute pharyngitis (50.5%; $\chi^2(1) = 18,353.8$), acute tonsillitis (25.5%; $\chi^2(1) = 21,353.2$), and URIs of multiple or unspecified sites (24.4%; $\chi^2(1) = 1,404.9$), all of which were significantly more prevalent than in the non-PTA cohort ($p<.001$ for all comparisons). Less common infections, such as acute sinusitis (5.9% vs. 1.8%), acute obstructive laryngitis (croup) and epiglottitis (3.5% vs. 1.6%), acute nasopharyngitis (2.5% vs. 1.0%), and acute laryngitis and tracheitis (0.4% vs. 0.1%), also occurred more frequently among pediatric PTA patients. A history of tonsillectomy was also more common among PTA patients than those who did not have PTA (2.6% vs. 0.4%; $\chi^2(1) = 1,063.0$, $p<.001$).

Diagnostic trends of acute tonsillitis and PTA

The monthly diagnosis rates of acute tonsillitis and PTA between 2016 and 2022 are shown in Figure *1*.

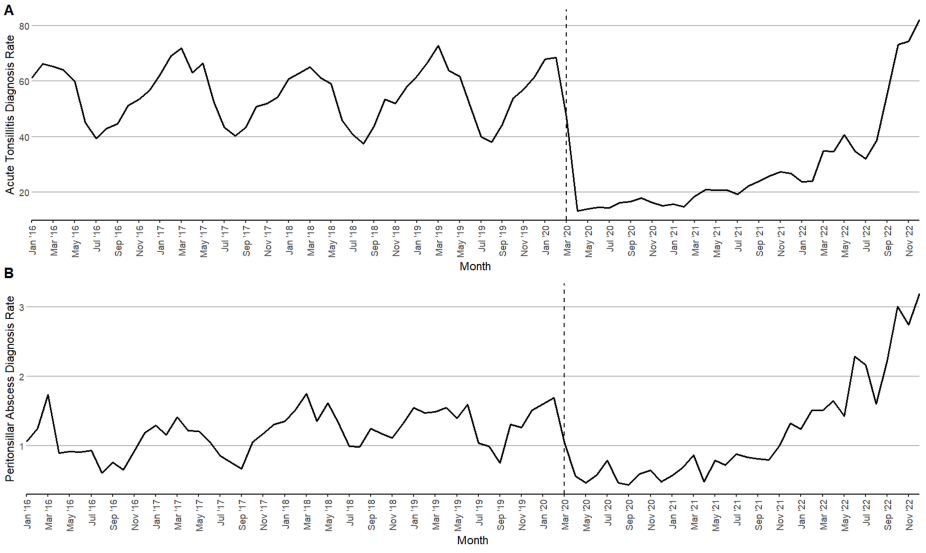


FIGURE 1: Monthly diagnosis rate (per 100,000) of acute tonsillitis (A) and peritonsillar abscess (B) between 2016 and 2022.

Before March 2020, the monthly diagnosis rates of both PTA and acute tonsillitis varied throughout the calendar year, with annual peaks in March and troughs in August. The mean monthly acute tonsillitis diagnosis rate was significantly lower during the pandemic period than during the pre-pandemic baseline period (15.6 vs. 54.6 cases per 100,000; Welch's $t(11.5) = 12.7$, $p<.001$). The mean monthly PTA diagnosis rate was also significantly lower during the pandemic period (0.6 vs. 1.3 cases per 100,000; Welch's $t(15.2) = 7.6$, $p<.001$; Figure *2*).

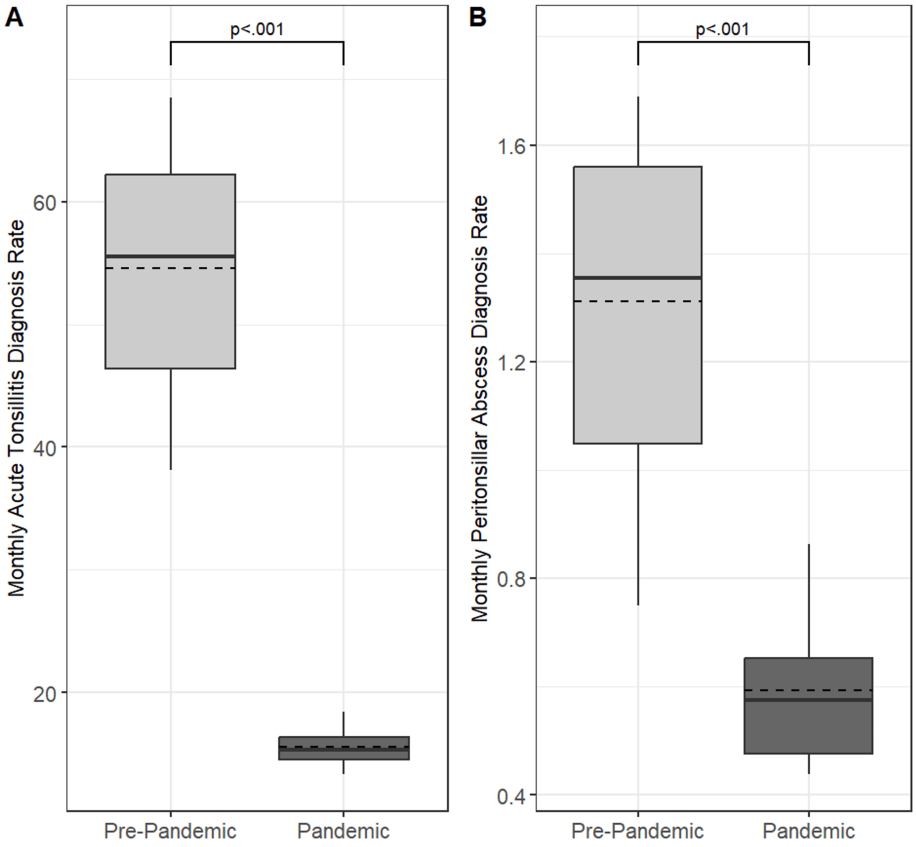


FIGURE 2: Comparison of monthly documented acute tonsillitis (A) and peritonsillar abscess (B) diagnosis rates per 100,000 patients during the pre-pandemic and pandemic periods.

Throughout the study period, the monthly documented diagnosis rates of acute tonsillitis and PTA were moderately positively correlated, r(82) = 0.62, p<.001 (Figure 3).

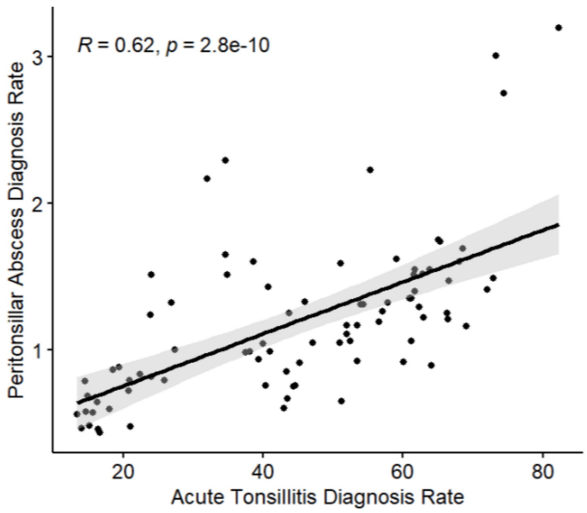


FIGURE 3: Association between monthly documented acute tonsillitis and peritonsillar abscess diagnosis rates per 100,000 patients between 2016 and 2022.

Discussion

In response to the COVID-19 pandemic, public health measures were widely adopted to reduce transmission of respiratory infections. This study is the first to investigate diagnosis rates of PTA and acute tonsillitis throughout the COVID-19 pandemic using a large, multi-institutional database. Examining these encounter-based trends enables contextualization of the effects of the pandemic on the observed epidemiology of pediatric PTA during this period, which may reflect a combination of changes in disease transmission and healthcare-seeking behavior.

Several international studies have investigated the relationship between the COVID-19 pandemic and PTA. Retrospective studies in Austria and Korea have reported significant reductions in PTA cases during the implementation of 2020 lockdowns [16,17]. A study in Japan similarly found that the incidence of both superficial and deep cervical abscesses, including PTA in children, decreased during the COVID-19 pandemic, with no notable changes in causative organisms [18]. In contrast, a case-control study performed in Israel reported minimal changes in presentation or clinical features of PTA but noted an increase in *Fusobacterium* and *Streptococcus anginosus* species isolated during the COVID-19 era [19]. A Danish study also reported decreased PTA incidence among children and adolescents from pre- to post-COVID-19 lockdowns, while observing a shift in microbiological patterns, with a significant decrease in group A Streptococcus (GAS) and Streptococcus anginosus, and an increase in Fusobacterium necrophorum species prevalence [20]. While we did not investigate the microbial etiology of PTA in our cohort, our analysis of pediatric patients aligns with prior evidence of reduced PTA incidence during the COVID-19 pandemic.

Beyond pandemic-related effects, environmental and seasonal factors may have also contributed to the variations in PTA diagnoses observed in this study. Prior studies have shown that respiratory infections vary seasonally with temperature and humidity changes [21,22]. However, seasonal trends in PTA incidence are less established. One study has shown a moderate positive correlation between PTA incidence and average monthly temperature [23], while another reported no overall seasonal variation, but noted that GAS-positive PTA cases peaked in winter and spring, and *Fusobacterium necrophorum*-positive cases trended higher in summer [3]. While we did not analyze climate variables directly in our study, we did observe a recurring pattern of decreasing documented PTA diagnosis rates from March to September and increasing rates from September to March (Figure *1*), which mirrored trends seen for acute tonsillitis. This may reflect the temperature sensitivity of tonsillitis-causing pathogens such as GAS, which has been shown to decline with each 1°C rise in temperature [22]. Further investigation into microbial patterns within the US could help explain both regional and seasonal variation in PTA incidence observed across international studies throughout the COVID-19 pandemic.

More broadly, our findings align with prior evidence showing reduced transmission of upper respiratory and cervicofacial pathogens during the COVID-19 pandemic [24-26], demonstrated by significant declines in the diagnosis rates for both PTA and acute tonsillitis. However, these reductions cannot be attributed to public health interventions alone. In a UK study, there was a 67% reduction in referrals for suspected PTA patients [27]. Changes in healthcare delivery and utilization may have influenced both outcomes and recorded incidences of PTA. A national survey also found that 41% of US respondents refused to seek medical care from March 2020 through mid-July 2020 [28], suggesting that PTA and related infections may have been underreported throughout the pandemic.

Pathogenesis of PTA

Our findings are consistent with traditional models of PTA pathogenesis [5-7], suggesting acute tonsillitis as the inciting factor, as PTA patients were more likely to have a history of acute tonsillitis, and we observed a positive correlation between monthly diagnosis trends of acute tonsillitis and PTA. The observed reduction in PTA diagnoses during periods of reduced respiratory pathogen transmission suggests that PTA may be partially preventable through upstream control of pharyngeal infections. Understanding this relationship may help anticipate seasonal or post-pandemic surges and inform anticipatory healthcare resource planning.

Our study also found that a prior tonsillectomy was more common among PTA patients than among those who did not have PTA. While counterintuitive to the theory that PTA solely arises from acute tonsillitis, this finding supports that alternative origins of PTA, such as Weber's gland involvement [4,6,8-10], are plausible, aligning more closely with a unified hypothesis of PTA pathogenesis in which bacteria initially infect tonsillar mucosa and spread via salivary ducts into the peritonsillar space as described by Klug et al. [6]. Despite the rare occurrence of PTA in the absence of tonsillar tissue, our observation may reflect individual patient characteristics not available in aggregate data such as incomplete tonsil removal, variation in removal technique (such as intracapsular tonsillectomy), congenital branchial fistulas, dental disease, and/or residual lymphoid tissue susceptible to infection. A clearer understanding of PTA pathogenesis would be beneficial for developing targeted prevention strategies and informing management decisions.

Limitations

As a retrospective analysis using TriNetX data, this study and its generalizability are limited by the accuracy

and completeness of EHRs and by potential confounding variables, which could not be controlled. TriNetX relies on EHR data and generic ICD-10-CM and CPT codes, which may vary in use across institutions. TriNetX provides only aggregate data, limiting access to patient-level data and potentially obscuring trends and outcome variability. Socioeconomic or neighborhood-level variables are not directly available within TriNetX. Because TriNetX captures data from participating healthcare systems, observed reductions in PTA likely reflect a combination of true changes in disease epidemiology and shifts in healthcare-seeking behavior during the COVID-19 pandemic. Because data were sourced from participating healthcare organizations, findings may not be fully generalizable. While we observed significant decreases in the documented diagnosis rates of PTA and acute tonsillitis during the COVID-19 pandemic, causality cannot be established. A combination of factors, including changes in disease surveillance, healthcare utilization, and antimicrobial prescribing patterns, may have contributed to observed trends. Regional and temporal variation in public health measures during the pandemic may also have influenced our findings. Reduced emergency department utilization, increased telehealth adoption, and altered referral patterns may have influenced the number of recorded PTA diagnoses. Some cases may have been managed in urgent care or outpatient settings not fully represented within the database. Therefore, these findings are interpreted as changes in documented healthcare encounters rather than definitive changes in population-level incidence.

Multivariable logistic regression modeling was not performed in this analysis. While such modeling could further assess independent associations between demographic and clinical variables and PTA diagnosis, the aggregate structure of the TriNetX dataset and the study's primary focus on temporal trends limited the feasibility and interpretability of fully adjusted patient-level analyses.

Conclusions

We observed a significant decrease in the diagnosis rate of both acute tonsillitis and PTA during the pandemic, consistent with other international studies and supporting the likely impact of public health interventions on respiratory and cervicofacial infections. A moderate positive correlation between the diagnosis rate of acute tonsillitis and PTA, along with the higher prevalence of prior tonsillitis among PTA patients, aligns with evidence for the traditional theory of PTA arising as a complication of acute tonsillitis. Our finding that a history of tonsillectomy was more common among patients with PTA supports a broader etiological framework, implicating Weber's gland obstruction as a potential concurrent mechanism. Given the observed temporal association between reductions in respiratory infections and PTA diagnoses, future studies incorporating microbiologic and antimicrobial prescribing data are needed to clarify whether transmission dynamics or healthcare utilization changes primarily drove these findings.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Supervision: Michele M. Carr

Disclosures

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