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Post-COVID-19 Otolaryngological Manifestations: The Review

Authors:

Tomasz Kandefer

Medical University of Warsaw, Żwirki i Wigury 61, 02-091 Warsaw, Poland

https://orcid.org/0009-0004-2714-8344

Tomekkandefer92@gmail.com

Maria Izabela Sroka

Medical University of Warsaw, Żwirki i Wigury 61, 02-091 Warsaw, Poland

https://orcid.org/0009-0002-8743-8963

marsrokaa@gmail.com

Radosław Jan Walkowski

Medical University of Warsaw, Żwirki i Wigury 61, 02-091 Warsaw, Poland

https://orcid.org/0009-0006-9933-6437

radwalk.med@gmail.com

Marcin Barański

Medical University of Warsaw, Żwirki i Wigury 61, 02-091 Warsaw, Poland

https://orcid.org/0009-0003-7792-5837

baranskimarcin23@gmail.com

Justyna Klonowska
Medical University of Warsaw, Żwirki i Wigury 61, 02-091 Warsaw, Poland
https://orcid.org/0009-0002-8170-9187
justynajklonowska@gmail.com
Szymon Kosek
Medical University of Warsaw, Żwirki i Wigury 61, 02-091 Warsaw, Poland
https://orcid.org/0009-0001-7350-2306
kosek.med@gmail.com
Weronika Wasiniewska
Medical University of Warsaw, Żwirki i Wigury 61, 02-091 Warsaw, Poland
https://orcid.org/0009-0001-9263-5710
wasiwer@gmail.com

Abstract

The World Health Organization defines Post-COVID-19 syndrome as the continuation or development of new symptoms occurring at least 3 months after initial SARS-CoV-2 infection, lasting for at least 2 months and unexplainable by alternative diagnoses. Meta-analyses estimate a pooled global Post-COVID-19 prevalence of 36% among COVID-19 positive individuals, with geographic variations and persistence of symptoms even at 1-2 year follow-up. The pathophysiology of otolaryngological manifestations involves multiple mechanisms: damage to non-neuronal cells in the olfactory epithelium via ACE2 and TMPRSS2 receptors for smell disorders; microvascular damage, direct viral invasion, and inflammatory responses for audiovestibular symptoms; and direct viral impact, vagus nerve neuropathy, and systemic inflammation for upper airway and voice disorders. Management strategies include olfactory training for smell disorders (57% improvement with adherence), hearing aids and vestibular rehabilitation for audiovestibular symptoms, and voice therapy and pharmaceutical interventions for dysphonia. This review synthesizes current knowledge on Post-COVID-19 otolaryngological manifestations and identifies knowledge gaps in pathophysiological mechanisms and optimal treatment approaches, highlighting the need for standardized assessment protocols, longer-term follow-up studies and establishment of evidence-based multidisciplinary care protocols through controlled clinical trials.

Key words: Post-COVID-19 Syndrome, olfaction disorders, tinnitus, hearing loss, olfactory training

Introduction:

COVID-19 pandemic emerged in December 2019. Since then, millions of people around the globe, suffer from various, long-term consequences related to the disease. These lingering effects are known as Post-COVID-19 syndrome or Long COVID. The World Health Organization (WHO) defines Post-COVID-19 condition, commonly known as Long COVID, as the continuation or development of new symptoms that occur at least 3 months after the initial SARS-CoV-2 infection, lasting for at least 2 months and cannot be explained by an alternative diagnosis[1] The clinical presentation is heterogeneous, with over 200 symptoms reported across multiple organ systems.

Among various systems, the otolarygological manifestations of Post-COVID-19 have become a concern, with the symptoms ranging from olfactory and gustory dysfunction to upper airway and voice disorders. Understanding these symptoms is crucial for future patients care and planning long-term care strategies.

This review aims to synthesize current knowledge on some of the Post-COVID-19 otolaryngological manifestations, explore their prevalence, pathophysiology, clinical presentation, and management strategies.

Prevalence:

The prevalence of otolaryngological manifestations in post-COVID-19 patients varies across different studies. However, some consistent conclusions can be made.

Meta-analysis of 429 studies estimated a pooled global long COVID prevalence of 36% among COVID-19 positive individuals[2]. Some geographical variations were observed with South America showing the highest prevalence at 51%. The symptoms does not seem to diminish over time. Studies with follow-up periods of 1 to 2 years showed a prevalence of 47%, compared to 35% for follow-up times less than 1 year.

Regarding specific otolaryngological manifestations, prevalence varies across different studies[3-7]. Regarding anosmia and dysgeusia, a meta-analysis of 2,757 recovered COVID-19

patients found that 861 (31.22%) experienced chemosensory deficit symptoms. Tinnitus prevalence rate varies across different studies from 20% to 37.7%. Hearing loss ranges from 4.8% to 50.4% - which shows significant differences in study populations. Vertigo/Dizziness prevalence ranges from 14.2% to 26%, with some studies highlighting vertigo as a frequent long-term complication. Cough prevalence ranges from 4% to 19%. Hoarseness of Voice ranges from 6,2% to 20%.

In conclusion, while the exact prevalence of Post-COVID-19 otolaryngological manifestations varies across studies, due to differences in study populations, methodologies, and the evolving nature of the virus, it is clear that a significant proportion of recovered patients experience these symptoms. The most commonly reported manifestations include olfactory and gustatory dysfunctions, audiovestibular symptoms such as tinnitus and vertigo, and upper airway symptoms like sore throat and cough. The prevalence rate can vary due to many factors, like age or severity of initial infection. Patients with more severe initial symptoms tended to have a higher prevalence of long-term otolaryngological manifestations.

Patophysiology:

Patophysiology is an important factor in understanding the disease and research on possible treatments. There is still many things we not fully understand about the exact mechanisms underlying Post-COVID-19 otolaryngological manifestations, but several hypotheses have been proposed on current research.

The primary hypothesis for olfactory dysfunction involves damage to non-neuronal cells in the olfactory epithelium. SARS-CoV-2 enters cells through the angiotensin-converting enzyme 2 (ACE2) receptor and transmembrane serine protease 2 (TMPRSS2), which are highly expressed in sustentacular cells, Bowman's glands, and stem cells of the olfactory epithelium[4,8]. This can lead to lack of repair of olfactory epithelium and disruption of olfactory neuron function without direct neuronal infection. It is accompanied by inflammation and edema in the olfactory cleft and potential damage to olfactory receptor neurons in severe cases. Gustatory dysfunction may result from similar mechanisms affecting taste buds, or it may be secondary to olfactory dysfunction, as flavor perception relies heavily on retronasal olfaction[9]. In addition, anosmia and ageusia seems to be the most persistent otolaryngological symptoms[10].

There are many hypotheses on the pathophysiology of hearing loss, tinnitus, and vertigo in Post-COVID-19. Hearing loss might be caused indirectly or directly. Indirect damage seems to be caused by microvascular damage leading to thrombosis and ischemia of auditory and vestibular organs[11]. Thrombosis prevalence is more common in moderate forms of disease[12].

The direct damage may involve direct viral invasion of inner ear structures and inflammatory responses (especially in olfactory area) affecting the cochlea and vestibular system. There are also potential autoimmune reactions triggered by the virus[3]. A 2023 study propose, that COVID-19 may activate the migraine process, leading to vestibular migraine that can cause tinnitus and vertigo. The authors hypothesize that elevated neurotransmitters triggering the trigeminovascular system (TVS) could have led to vestibular migraine in children with COVID-19, although this remains at a hypothesis stage and more studies need to be conducted[13]. Another study shows, that these symptoms can be related to ototoxic side effects by some COVID-19 therapeutics[14]. These include chloroquine and hydroxychloroquine azithromycin, lopinavir-ritonavir, interferon, ribavirin, ivermectin. This review suggests including audiologic monitoring protocols for patients receiving these COVID-19 therapeutics with known ototoxicity, especially in high-risk patient groups such as the elderly and hearing impaired. More studies need to be conducted on this topic.

A 2024 study published in Frontiers in Neurology examined the effects of COVID-19 on the vestibular system[15]. The authors noted that anxiety and stress are common during the COVID-19 pandemic and can provoke vertigo attacks. In their study, vertigo was associated with anxiety in 6.9% of COVID-19 patients, but it couldn't be confirmed and more studies need to be made on that topic. Another study published in 2023 in the Brazilian Journal of Otorhinolaryngology found that the COVID-19 pandemic has increased the rate of vertigo and exacerbated it. The study also reported that health anxiety levels are higher in vertigo patients[16].

The pathophysiology of upper airway and voice disorders in post-COVID-19 patients is multifaceted:

A 2024 study found that 25.1% of COVID-19 patients experienced dysphonia during infection, with 17.1% continuing to have voice impairment after recovery[17]. This suggests direct viral impact on the larynx and vocal cords.

A 2023 study in PLoS ONE reported that 76.3% of patients with chronic cough after COVID-19 showed pathological findings in laryngeal electromyography, indicating prolonged inflammation in the upper airways and larynx. The same study showed evidence of postviral vagus nerve neuropathy, that could explain chronic cough in post-COVID-19 syndrome - 82.8% of patients showed signs of chronic denervation[18].

Another reason to upper airway and voice disorders might be laryngeal injuries in COVID-19 patients after intubation. A 2023 study found that 47% of patients experienced severe tracheal injury, with some developing full-thickness tracheal lesions and trachea-esophageal fistulae[19].

A 2024 study in the Journal of Inflammation Research used 18F-FDG PET/CT to assess vascular inflammation in post-COVID-19 patients. They found significantly elevated FDG uptake in various aortic regions and peripheral arteries, indicating persistent systemic inflammation that could affect the upper airways[20]

Collectively, all of these studies demonstrate the complexity and multidisciplinary factors of Post-COVID-19 otolaryngological manifestations. These mechanisms can interact and contribute to the development and persistence of these symptoms. Understanding the underlying mechanisms is crucial for developing effective treatment strategies and improving long-term outcomes for affected patients, so more studies are needed to fully understand these relationships and their implications for patient care.

Diagnosis:

The diagnosis of Post-COVID-19 otolaryngological manifestations require a comprehensive approach due to the diverse nature of symptoms written in the previous paragraph, their potential long-term impact on patients quality of life and differences in patophysiology. This section will outline the key diagnostic methods and management strategies for the most common Post-COVID-19 otolaryngological manifestations.

The initial step in diagnosing those manifestations involves a thorough clinical evaluation. Some of the most recent studies, suggests, that a comprehensive approach to patients history and physical examination play a key role in examination[21]. These should include timing and severity of COVID-19 infection, onset and progression of otolaryngological symptoms and impact of these symptoms on quality of life. Some studies also underscore the importance of physical examination, with emphasis on a thorough ENT examination[4]. This examination consists of oral cavity and oropharynx inspection, nasal endoscopy, otoscopy and cranial nerve examination, particularly CN VII, IX and X. Important part of diagnosing these symptoms is understanding the prevalence and tracking symptom progression over time. Collectively these studies emphasize the need for a thorough clinical evaluation, including detailed patient history and comprehensive physical examination, to accurately diagnose and manage post-COVID-19 otolaryngological manifestations.

Various objective assessments can aid in the diagnosis of specific otolaryngological manifestations in post-COVID-19 patients:

Objective olfactory function assessment comes with the sniffin stick test-12 (SST-12). It’s a validated tool for smell assessment that provides a comprehensive evaluation of olfactory function. Sixteen small pens dispense different odorants. Each pen is presented only once and interval between different pens is at least 30 seconds, to avoid neural desensitization. The test

scores from 0-16. Normosmia is defined with a score SST-12 ≥ 11, Hyposmia: 10 > SST-12 > 6, Anosmia: SST-12 ≤ 6. A 2024 study found that while 55% of patients reported subjective smell recovery after 3 months, only 1% showed normal function on the SST-12 test[22].

The Questionnaire of Olfactory Disorders-Negative Statements (QOD-NS) is also a validated tool for assessing olfactory impairment. It consists of 17 negative statements, with scores ranging from 0 to 5.

A 2023 study demonstrated the effectiveness of remote psychophysical smell testing using the Odorized Markers Test (OMT), a six-item smell test for odor identification[23]. OMT have been proven effective during the pandemic, allowing for safe and accessible olfactory assessments.

Voice Handicap Index (VHI) has been proven useful in voice assessment. A 2023 study found that the total VHI score in COVID-19 patients was significantly higher compared to healthy subjects[24]. Another study from 2022, also reported that, the VHI scores were higher in Post-COVID-19 patients compared to controls. This study also found that, the CAPE-V (Consensus Auditory-Perceptual Evaluation of Voice) protocol, which was used to assess voice samples, proved useful. The overall severity score of dysphonia was found to be higher in the post-COVID-19 group compared to the control group.

A 2025 study found significant differences in jitter, shimmer, and harmonics-to-noise ratio (HNR) between Post-COVID-19 and control groups. Post-COVID-19 subjects showed higher jitter and shimmer values and lower HNR values[25]. The results can be used to accelerate the diagnostic process by specialists.

Laryngoscopy is one of the most important tools for otolaryngologists. A 2020 study reported that all patients who underwent laryngoscopy had abnormal findings, most commonly in the glottis and trachea[26]. The most common diagnosis was unilateral vocal fold immobility (40%), followed by posterior glottic stenosis (15%) and subglottic stenosis (10%). The results shows, that otolaryngologists should consider post-intubation laryngeal injuries in patients with voice and breathing difficulties.

While not explicitly mentioned in many studies, videolaryngostroboscopy is crucial for detailed vocal fold assessment and was likely used to report specific laryngeal findings.

Recent studies provided valuable insight into audiological and vestibular assessments in post-COVID-19 patients. A 2024 study evaluated 44 Post-COVID-19 individuals using pure tone audiometry, logoaudiometry, immitanciometry, and Brainstem Auditory Evoked Potentials (BAEP). The study found a high rate of abnormalities in both peripheral and central audiological assessments, suggesting that COVID-19 may compromise the auditory system[27].

A 2023 study assessed vestibular symptoms using the Dizziness Handicap Inventory (DHI), video Head Impulse Test (vHIT), Subjective Visual Vertical (SVV), and Vestibular Evoked Myogenic Potentials (VEMP) tests. The study found that most COVID-19 patients did not show declined semicircular or otolith function compared to healthy controls but it seems possible that it can induce acute vestibulopathy.

A 2024 review in Audiology and Neurotology reported that video-oculography (VOG) responses in COVID-19 patients showed alterations in saccades, optokinetic nystagmus, and spontaneous nystagmus. The review also noted decreased gain in the inferior semicircular canal using vHIT[28].

Studies have reported varying degrees of audiological and vestibular abnormalities in Post-COVID-19 patients. While some research suggests a high rate of abnormalities in both peripheral and central auditory pathways, other studies have found no significant decline in vestibular function compared to healthy controls. Considering the prevalence of hearing loss and vertigo being very high in some studies, these findings underscore the need for thorough audiological and vestibular assessments in Post-COVID-19 patients, particularly those reporting persistent symptoms. Further research is needed to fully understand the long-term impact of COVID-19 on the auditory and vestibular systems.

Some studies highlight the importance of imaging.

A 2023 study evaluated 110 patients with Post-COVID-19 olfactory dysfunction using MRI. The study found increased olfactory bulb dimensions and volume compared to controls, as well as olfactory cleft edema in 57.3% of patients. Radiological evidence of sinusitis was detected in only 15.5% of patients[29]. Other 2023 study examined MRI and CT findings in post-COVID-19 patients with acute invasive fungal rhinosinusitis. Common findings included periantral invasion, orbital invasion, and intracranial involvement. The study found that MRI was superior for early detection and assessing disease extent, while CT was better for identifying bony erosions[30]. A 2024 study in the British Journal of Biomedical Science analysed chest CT findings in COVID-19 ARDS survivors at 6 months post-recovery. The most common findings were ground glass opacities (94.6%), reticulations/septal thickening (96.4%), and parenchymal/atelectatic bands (92.8%)[31].

These studies collectively demonstrate value of various imaging modalities in detecting and characterizing Post-COVID-19 otolaryngological manifestations. They suggest that advanced imaging techniques may reveal abnormalities not detected by conventional methods, potentially leading to earlier diagnosis and more effective treatment of these conditions, which has a significant impact on patients outcome and quality of life.

Management:

The management of Post-COVID-19 otolaryngological manifestations requires a multidisciplinary approach tailored to specific symptoms. Recent studies have demonstrated the effectiveness of various interventions for different manifestations like olfactory training (OT), which has emerged as a cornerstone treatment for COVID-19-related olfactory dysfunction. A 2024 study found that adherence to a 4-month OT regimen yielded clinically meaningful improvements in both orthonasal and retronasal olfactory function among individuals with persistent Post-COVID-19 olfactory loss. Participants were invited to sniff, twice a day for 4 months, the 4 essential oils for 10 seconds, with a 15-second rest between odours. The study reported that 57% of adherent participants achieved a clinically significant improvement in TDI score (≥5.5 points), compared to only 22% of non-adherents[32]. Another study concluded that a three-month olfactory training is effective for improvement of COVID-19-related olfactory dysfunction, though adding daily oral vitamin A to olfactory training did not lead to better results. The most effective outcomes appear to occur when patients strictly adhere to the OT protocol and extend the duration of training to 3 months or more[33,34].

For audiovestibular symptoms, comprehensive audiometric evaluation is essential in assessing hearing acuity and detecting subtle auditory deficits. Treatment options include hearing aids, cochlear implants, or auditory rehabilitation programs based on individual needs. A 2025 narrative review recommends treating acute audiovestibular symptoms similarly to idiopathic sudden hearing loss or acute vestibular dysfunction[4]. For vestibular symptoms, a 2024 study found that while 10% of recovered patients experienced vertigo of varying severity, proper assessment and targeted vestibular rehabilitation therapy showed promising results[35]. Given the heterogeneous nature of Post-COVID-19 audiovestibular symptoms, a multidisciplinary approach involving otolaryngologists, audiologists, and vestibular rehabilitation specialists is essential for optimal outcomes.

Voice therapy is recommended for patients experiencing Post-COVID-19 dysphonia, which can persist for 5-6 months after the acute phase. A 2023 study found that COVID-related dysphonia affected 25.1% of patients during infection, with 17.1% continuing to have voice impairment after recovery[36]. Speech therapy focusing on vocal hygiene, breath support, and vocal exercises can help re-establish optimal laryngeal function. For patients with structural changes such as laryngotracheal stenosis, especially those who required intubation, surgical intervention may be necessary and has shown clinical improvement in affected individuals[37]. For severe Post-COVID-19 dysphonia, pharmaceutical interventions have proven effective. A

2022 study of six patients with isolated severe dysphonia during Post-COVID-19 syndrome underwent a treatment protocol consisting of short-term systemic steroids (Methylprednisolone starting at 32 mg per day in descending doses for two weeks), moisturizing inhalations with hyaluronic acid, and protective agents against laryngopharyngeal reflux. This resulted in improved vocal fold vibrations, decreased jitter and shimmer, and considerable enhancement in vocal function and quality across all patients[38]. The COVID-19 pandemic accelerated the adoption of telepractice in voice therapy. A 2024 pilot study investigated the effectiveness of voice therapy delivered via telepractice to patients with hyperfunctional voice disorders. Treatment was delivered using a smartphone application following initial face-to-face evaluation. All subjects showed improved voice after treatment, and patients reported satisfaction with this approach[39]. This finding aligns with clinical guidelines developed during the pandemic, which provide 65 recommendations for clinicians managing voice disorders via telepractice. The guidelines achieved 95% consensus across all topics, suggesting strong expert agreement on telepractice protocols[40].

Recent studies strongly support multidisciplinary treatment approaches for Post-COVID-19 syndrome. A 2025 randomized study found that eight-week multidisciplinary telerehabilitation showed moderate to large improvements in health and pain related parameters, particularly reducing anxiety[41]. A 2024 systematic review provided moderate certainty evidence that cognitive behavioral therapy (CBT) and combined physical and mental health rehabilitation programs improve long COVID symptoms, with an estimated 161 more patients per 1000 experiencing meaningful improvement or recovery compared to usual care[42]. The evidence suggests that early intervention with multidisciplinary approaches tailored to individual needs produces the best outcomes for Post-COVID-19 syndrome management[43].

In conclusion, management of Post-COVID-19 otolaryngological manifestations requires a tailored approach based on specific symptoms, with a focus on multidisciplinary care, targeted interventions, and regular follow-up to monitor progress and adjust treatment strategies as needed. Future research with longer follow-up periods and more standardized assessment protocols will be crucial to fully evaluate the long-term impact of COVID-19 on the audiovestibular system and to develop effective management strategies for affected individuals.

Long-term Prognosis and Follow-up:

The long-term prognosis of Post-COVID-19 otolaryngological manifestations varies considerably depending on the specific symptom and individual patient factors. For olfactory dysfunction, which represents one of the most common manifestations, studies indicate a

generally favorable prognosis with approximately 63% of patients achieving complete recovery, while about 34% remain hyposmic and 3% remain anosmic[3]. However, longer duration of initial SARS-CoV-2 infection negatively correlates with olfactory recovery. For tinnitus, the prognosis appears less favorable, with a 2024 study showing that as tinnitus severity increases, the chances of natural recovery decrease significantly, and severe tinnitus (Grade IV) is strongly associated with the risk of developing long-term hearing loss, anxiety, and emotional disorders[44]. Regular follow-up is essential, as symptoms can persist well beyond the acute phase – at 12-month assessment, a significant percentage of patients still report limitations in daily activities (43.2%) and some have not returned to work (17.6%)[45]. A multidisciplinary approach to follow-up care is recommended, with healthcare pathways established to recognize and evaluate otolaryngological symptoms. This approach should include regular monitoring of symptoms that may persist for 12 weeks or longer, with particular attention to patients with risk factors for poor prognosis, such as those with severe initial symptoms or females, who show an increased risk of persistent fatigue[4].

Conclusions:

In summary, this review highlights the significant prevalence and impact of post-COVID-19 otolaryngological manifestations, with global estimates around 36% and symptoms persisting for up to two years post-infection. The pathophysiological mechanisms underlying these manifestations are multifaceted, involving damage to non-neuronal cells in the olfactory epithelium, direct and indirect effects on the auditory system, and neurological dysfunction affecting laryngeal innervation. Treatment approaches show promising results, particularly olfactory training with proper adherence (57% improvement), voice therapy for dysphonia, and comprehensive multidisciplinary approaches.

However, significant gaps in our understanding remain, including the exact pathophysiological mechanisms, why certain individuals develop persistent symptoms while others recover completely, and the optimal treatment approaches for different manifestations. Future research should focus on developing standardized assessment protocols to enable more consistent prevalence estimates, conducting longer-term follow-up studies to assess recovery beyond two years, identifying potential biomarkers for predicting persistent symptoms, investigating the relationship between viral variants and symptom patterns, and establishing evidence-based multidisciplinary care protocols through controlled clinical trials. As our knowledge of Post-COVID-19 otolaryngological manifestations continues to evolve, ongoing collaborative research will be essential to improve the quality of life for affected individuals.

Disclosure

Author's contribution

Conceptualization: *Tomasz Kandefer*; Methodology: *Radosław Jan Walkowski*; Check: *Tomasz Kandefer*; Formal analysis: *Maria Izabela Sroka*; Investigation: *Justyna Klonowska*; Resources: *Szymon Kosek*; Data curation: *Weronika Wasiniewska*; Writing - rough preparation: *Marcin Barański*; Writing - review and editing, *Tomasz Kandefer*; Visualization: *Maria Izabela Sroka*; Supervision: *Tomasz Kandefer*; Project administration: *Radosław Jan Walkowski*;

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