

**The Role of S-LPs and Audiologists in Supporting Adults with Post COVID-19 Symptoms:
A Mapping Review**

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Coronavirus disease 2019 (COVID-19) is a multisystem infection caused by the highly pathogenic severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2; Willi et al., 2021). SARS-CoV-2 is highly contagious and is responsible for a widespread pandemic that has put significant strain on individuals and healthcare systems in Canada and throughout the world (Quinn et al., 2022; Tulenko et al., 2020). Between December 31, 2019, with the first reported cases of pneumonia in the city of Wuhan, Hubei, China, and July 26, 2023, there have been more than 768 million confirmed cases of COVID-19, including over 6.9 million deaths globally (World Health Organization [WHO], 2023). As of August 1, 2023, the Government of Canada has reported over 4.6 million confirmed cases of COVID-19 and 53,147 deaths in Canada (Public Health Agency of Canada, 2023).

Acute COVID-19 is characterized by respiratory illness, fever, and gastrointestinal signs and symptoms with varying degrees of severity (Guan et al., 2020; Zhu et al., 2020); however, patients can also present with several other manifestations including cardiovascular (Louis et al., 2022), otolaryngological (Elibol, 2021), and neurological symptoms (Harapan & Yoo, 2021). Over the course of the pandemic, it has become increasingly evident that COVID-19 infection can also lead to chronic and persistent physical, cognitive, and psychological symptoms in a proportion of individuals who recover from the acute phase of the virus (Carazo et al., 2022; Chen et al., 2022; O'Mahoney et al., 2023), independent of disease severity, age, and comorbidities (Doykov et al., 2020; Kamal et al., 2021). Several systematic reviews have reported a range of potential symptoms including fatigue, cognitive impairments, difficulty breathing, loss of smell and taste, muscle aches and pain, and joint stiffness (Chen et al., 2022; Han et al., 2022; Michelen et al., 2021; O'Mahoney et al., 2023).

In April 2020, patients experiencing the lingering symptoms of COVID-19 began referring to themselves as 'long-haulers' and coined the term 'Long COVID' (Callard & Perego, 2021).

Early recognition and advocacy by the patient community, and their efforts to organize, brought widespread visibility to this condition in scientific literature, media, clinical, policy, and governmental spaces (Callard & Perego, 2021; Perego et al., 2020). These long-term impacts of COVID-19 are collectively known as ‘post COVID-19 condition’ (PCC) in the literature, though, it has also been labeled as ‘Long COVID,’ ‘long-haul COVID,’ post-acute COVID-19,’ ‘chronic COVID syndrome,’ ‘post-acute sequelae of SARS CoV-2 infection (PASC),’ and ‘late sequelae of COVID-19’ (WHO, 2021). In October of 2021, the World Health Organization (WHO) developed a clinical case definition of PCC to capture this phenomenon, characterizing it as follows:

Post COVID-19 condition occurs in individuals with a history of probable or confirmed SARS-CoV-2 infection, usually 3 months from the onset of COVID-19 with symptoms that last for at least 2 months and cannot be explained by an alternative diagnosis. Common symptoms include fatigue, shortness of breath, cognitive dysfunction but also others and generally have an impact on everyday functioning. Symptoms may be new onset following initial recovery from an acute COVID-19 episode or persist from the initial illness. Symptoms may also fluctuate or relapse over time. (p. 1)

In Canada alone, approximately 17% of adults reported experiencing longer-term symptoms more than three months following a COVID-19 infection with 21% of those noting that these symptoms often or always limit the activities in their daily life (Public Health Agency of Canada et al., 2023). Older age per decade above 40 years, and female sex are associated with greater risk of persistence of PCC (Jensen et al., 2022; Perlis et al., 2022). Severe initial COVID-19 symptoms (i.e., hospitalization), pre-existing co-morbidities, disability, obesity, smoking, and unvaccinated status are additional risk factors associated with severity and prevalence of PCC symptoms (O’Mahoney et al., 2023; Public Health Agency of Canada et al., 2023; Tsampasian et al., 2023).

The assessment, rehabilitation, and management of PCC represent key areas of concern for patients, public health policymakers, and healthcare professions (Quinn et al., 2022). Given

the broad spectrum of sequelae experienced by patients with PCC, there is a need for an interprofessional approach to assessing, managing, and treating these symptoms.

Speech-language pathologists (S-LP) and audiologists are important members of interprofessional teams and contribute to a holistic healthcare approach. Though several symptoms of PCC fall within their respective scopes of practice, the roles of S-LPs and audiologists in supporting adults with PCC have not yet been defined (Ramage, 2020).

Literature Review

Scopes of Practice

Speech-Language and Audiology Canada (SAC) is a national organization that supports and promotes the professions of S-LP and audiology within Canada. SAC defines S-LPs as “health professionals who identify, diagnose and treat communication and swallowing disorders across the lifespan” (2016b, p. 1). The scope of practice for S-LP includes a broad range of clinical domains including speech sound production, resonance, voice, fluency, pre-linguistic communication, language comprehension and expression, pre-literacy and literacy skills, cognitive-communication, social (pragmatic) communication, feeding and swallowing, alternative and augmentative communication, aural (re)habilitation, and accent modification. S-LPs are also engaged in managing the impacts of communication and swallowing disorders on everyday functioning, and quality of life (Speech-Language and Audiology Canada [SAC], 2016b).

Audiologists are hearing professionals who identify, diagnose and manage individuals with hearing and balance disorders, as well as other communication disorders across the lifespan (SAC, 2016a). The scope of practice for audiology includes the following clinical areas: peripheral and central hearing disorders, auditory processing disorders, tinnitus, hyperacusis, misophonia, and vestibular and balance dysfunction. Audiologists are also involved in addressing the impacts of these conditions on daily functioning and general well-being (SAC, 2016a).

In the following sections, we provide a brief overview of the PCC symptoms that are relevant to these two professions identified in a rapid review of the literature.

Communication and Swallowing Symptoms

Clinical areas of service relevant to the currently reported symptoms of PCC include disorders of feeding and swallowing, voice, and cognitive-communication. Several studies have reported the presence of impairments to voice and swallowing in individuals with PCC.

Laryngeal sequelae such as early glottic injury, vocal fold motion impairment, subglottic tracheal stenosis, dyspnea, and muscle tension dysphonia have been documented among intubated and non-intubated patients post-COVID infection (Allisan-Arrighi et al., 2022; Neevel et al., 2021).

Similarly, swallowing difficulties, also known as dysphagia, have been reported among intubated patients with PCC; however, there is currently limited data to ascertain that it is also a symptom of PCC in non-intubated patients (Grilli et al., 2022). Further research is required to establish whether voice and swallowing symptomology in the chronic stage is due to intubation history or PCC.

Cognitive difficulties relating to PCC have been described in multiple systematic reviews and appear to vary significantly across studies, encompassing a wide range of domains including attention, memory, and executive-functioning (Crivelli et al., 2022; Guo et al., 2022; Houben et al., 2022). Underlying cognitive deficits can significantly impact various dimensions of communication, resulting in *cognitive-communication disorders* (American Speech-Language-Hearing Association [ASHA], 2003). Descriptions of specific communication difficulties as they relate to PCC have received limited attention thus far, although some reported characteristics include reduced discourse informativeness (e.g., specificity of noun referents) with preservation of structural language components such as syntax and morphology (Cummings, 2022b).

Audiovestibular Symptoms

The inner ear is vulnerable to viruses, and current available evidence suggests that SARS-CoV-2 has neurotropic and neuroinvasive properties that may contribute to neurotological symptoms such as hearing loss, tinnitus, and vertigo (Fancello et al., 2022). Sensorineural hearing loss (SNHL) and tinnitus have been reported to occur during and following the SARS-CoV-2 infection (Degen et al., 2022b; Francello et al., 2022; Jafari et al., 2021; O'Mahoney et al., 2023). Tinnitus is the perception of sound (e.g., ringing) in the absence of an external source (ASHA, n.d.). However, there are conflicting reports in the literature indicating that there is currently no evidence to support the presence of inner ear damage among participants with PCC (Degen et al., 2022a).

Vestibular and balance disorders such as vertigo or dizziness have also been reported in reviews, surveys, and case reports of PCC symptomology (Cha & Baek, 2021; Chen et al., 2022; Degen et al., 2022b; Han et al., 2022; Korres et al., 2022). Dizziness is “the sensation of disturbed or impaired spatial orientation without a false or distorted sense of motion” (Bisdorff et al., 2009, p. 7). Vertigo is a type of dizziness, characterized as “the sensation of self-motion when no self-motion is occurring, or the sensation of distorted self-motion during an otherwise normal head movement” (Bisdorff et al., 2009, p. 5). It should be noted that most studies pool ‘vertigo’ with ‘dizziness’ in self-report questionnaires because differentiation could be difficult for patients to self-assess, even though these two symptoms have separate clinical definitions and may have different etiologies (Korres et al., 2022).

Roles of S-LP and Audiology in PCC

Description of the roles of S-LP and audiology professions in the management of PCC is limited. COVID-19 literature referencing S-LP involvement has primarily focused on acute care and inpatient environments with those hospitalized from the disease (Namasivayam-MacDonald & Riquelme, 2020; Ramage, 2020; Mohapatara & Mohan, 2020). Identification and management of communication difficulties in patients has been highlighted as an important component of

acute care interprofessional teams, but S-LPs are reported to have limited involvement in patient care if not advocated for (Ramage, 2020). In a similar vein, as the range of PCC symptoms becomes better understood, there is a need to clearly identify and define the role that S-LPs have when working with the PCC population. This is to facilitate appropriate involvement of the profession in the management and treatment of symptoms that fall under an S-LP's area of expertise and scope of practice, and to advocate for a more holistic interprofessional approach to therapy (Mohapatara & Mohan, 2020). This similarly applies to the profession of audiology, which has received even less investigation in how their respective scope of practice can be integrated with the PCC population. Descriptions of the audiologist's role have primarily been limited to being referral destinations should patients within acute care experience symptoms relating to hearing or balance (Greenhalgh et al., 2022). There is a persistent and growing need for the involvement and scope of both professions to be better defined within the context of PCC.

Purpose

Gaps in the Literature

Various studies have described and investigated the prevalence of PCC symptoms across different body systems. However, there has been limited work done thus far to synthesize these symptoms and their functional impacts, particularly as they relate to the scopes of S-LP and audiology practice. As a consequence, the roles and relevance of these professions in the assessment, rehabilitation, and management of this condition are yet to be defined. This may contribute to unsatisfactory patient outcomes due to insufficient identification of S-LP and audiology-related symptoms and poor availability and access of S-LP and audiology services in PCC clinics, and related settings. Therefore, this review aims to synthesize the symptomology of PCC that are relevant to S-LP and audiology scopes of practice. This paper will also explore the functional impacts that post COVID-19 symptoms have on individuals. This synthesis may provide guidance for S-LPs, audiologists, and other members of the healthcare team (e.g., interprofessional PCC clinics) to support the decision-making process regarding the assessment

and management of this condition. Furthermore, this synthesis may highlight significant implications with respect to appropriate allocation of resources, greater advocacy for interprofessional management of the condition, and increased public health knowledge on the impacts of PCC and on the roles of S-LPs and audiologists.

Objectives

To address the current gaps in the literature, we conducted a review on the physiological and psychological symptoms of PCC as they relate to the different domains of S-LP and audiology scopes of practice (i.e., voice, swallowing, cognitive-communication, central and peripheral hearing, tinnitus, and balance and vestibular function). Our aims were to:

- synthesize the described clinical symptoms of PCC that are relevant to the scopes of practice of S-LPs and audiologists;
- discuss the impacts of post COVID-19 symptoms—that are relevant to S-LP and audiology professions—on everyday functioning and quality of life;
- highlight existing literature that may be used to support evidence-informed practice for S-LP and audiology assessment, rehabilitation, and management; and
- identify outstanding knowledge gaps and reveal areas that require attention and future research efforts.

Methods

Study Design

As the objectives of this paper are extensive, a scoping review was initially chosen as a suitable methodology to systematically examine the available literature on PCC, organize the clinical symptoms as they relate to S-LP and audiology scopes of practice, provide a broad overview of the roles of these professions in supporting adults experiencing PCC, and highlight gaps in the literature and areas of future research. This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines (Tricco et al., 2018).

Eligibility Criteria

We identified several eligibility criteria for articles to be included in this review. As the focus of this review is on adults with PCC, studies included adult participants (18+) who had been infected with the SARS-CoV-2 virus (self-reported or confirmed by a PCR, antigen, or antibody test) and had reported ongoing symptoms. The symptoms must have been ongoing for a minimum of 12 weeks post-infection, which is in accordance with the WHO clinical case definition of PCC (WHO, 2021). For studies published before the development of the WHO definition, articles were included if the authors explicitly stated that symptoms persisted for a minimum of 12 weeks. If a study included participants with ongoing symptoms before the 12-week mark, it was excluded from review. For studies published after the development of the WHO definition of PCC, we assumed that participants' symptoms persisted for a minimum of 12 weeks, unless otherwise stated in the study. This ensured consistency across the extracted data. Given the recency of the research, studies published from December 31, 2019—when the Wuhan Municipal Health Commission, China, first reported a cluster of cases of pneumonia in Wuhan—to present were included (WHO, 2020). We also excluded studies not published in English to ensure feasibility of the data extraction process.

Database Selection

We performed comprehensive literature searches from the following three Ovid databases: MEDLINE, Embase, and Emcare. MEDLINE is a key source for journal articles on biomedicine and life sciences, and all four American Speech-Language-Hearing Association (ASHA) journals are indexed in this database (Wolters Kluwer, 2022c). Embase contains articles from a wide range of international journals in biomedicine and pharmacy, and conference abstracts. (Wolters Kluwer, 2022a). Emcare contains citation information and abstracts from journals in nursing and allied health professions, such as rehabilitation therapy (Wolters Kluwer, 2022b). Together these databases are main sources for medical and healthcare literature in rehabilitation, biological and physical sciences, humanities, mental health, and public health.

Search Strategy

We consulted a McMaster University Health Sciences librarian to assist with development of the search terms and formatting of the search string to ensure that the search strategy was in line with the key concept areas addressed in our research question. The structure of the search involved the combination of three primary search term categories: post COVID-19 condition *AND* consequences/impacts *AND* symptomologies of post COVID-19 condition (see Appendix A for a visual representation of this strategy). Specific search terms included synonyms of these concepts. We included search terms for PCC symptoms that have been previously reported in the literature that are relevant to S-LP and audiology scopes of practice; these include terms related to cognition, voice, dysphagia, hearing loss, tinnitus, and balance (Chen et al. 2022; Miles et al., 2022; Houben & Bonnechère, 2022; Michelen et al., 2021). A full description of the search string is available in Appendix B. Search limits aligned with the eligibility criteria, as previously described (i.e., publication dates from December 31, 2019 to present; participant age to 18 years or older; English language). We also manually searched the reference lists of the selected articles to identify other relevant references and ensure that no key articles were missed. Additionally, we regularly searched Google Scholar for any new articles published after the database search, given the extent of emerging literature on PCC.

Selection Process

On April 2, 2023, we conducted identical database searches on MEDLINE, Embase, and Emcare. We began by removing duplicate publications obtained in the search by uploading the search results and additional hand-searched articles to Covidence, an online collaborative software. The next stage involved selecting relevant articles in two steps: 1) title and abstract screening; and 2) full-text screening. Studies were selected as per inclusion and exclusion criteria.

Before conducting the full title and abstract screen, we tested our screening process on a pilot sample of articles to check for agreement, during which all reviewers independently

evaluated the titles and abstracts of the same 10 randomly-selected articles and compared results. Each reviewer anonymously voted for the inclusion or exclusion of each of the articles on Google Forms. One discrepancy was identified during the pilot test which was resolved through discussion until a consensus was reached. All articles eligible for the title and abstract screening were reviewed in duplicate on Covidence to identify relevant studies. The third reviewer was consulted to resolve any disagreements through discussion.

Prior to reviewing the full-texts of our selected articles, we further tested for inter-rater reliability with a second pilot test. All reviewers independently read and evaluated the same 10 randomly-selected articles and voted for their inclusion or exclusion using Google Forms. Agreement was 100% during this pilot test. Next, we reviewed the remaining full-texts in duplicate and selected articles following our eligibility criteria. Any differences between two reviewers was resolved by consulting the third reviewer. Inter-rater reliability among pairs of reviewers was measured using Cohen's kappa coefficient (McHugh, 2012).

Data Extraction and Analysis

The following section describes our original data extraction and analysis plan. Changes to this methodology are outlined in the Results section.

We extracted data from articles judged to have met all inclusion criteria using tables designed in Google Sheets. The data extraction tables were organized to capture information relevant to the research questions. We included summaries of the relevant reported symptoms, as well as the specific measures that were used to quantify the data. This highlighted the prominent symptoms associated with PCC that are within the relevant clinical areas of service. We also planned to extract and summarize data related to participant demographics (age and sex) and the country in which the study was conducted (JBI, 2020). We also reported any impacts on quality of life and activities of daily living that were identified within the studies. This data provided more nuance to our understanding of the implications of post COVID-19 symptomology on an individual's functioning. Additional data that we planned to extract included

the author(s) and year of publication, the aim of the study, the study design/methodology, and the number of participants involved (JBI, 2020). Further information was to be charted for grey literature sources, including the name of the issuing organization and the type of document.

To ensure appropriate use of the table and to improve inter-rater reliability, we conducted a pilot test of the tool, during which all reviewers independently extracted data from the same 3 articles, and compared results. We discussed any discrepancies until consensus had been achieved, and made modifications to the tables as needed. Once the pilot phase was complete, each reviewer used the table to extract the data from randomly assigned studies and a second reviewer was delegated to review the extracted data to ensure accuracy. We resolved any disagreements through discussion. We did not conduct individual critical appraisal of the selected sources or assess risk of bias, as this is beyond the scope of the general overview of the existing evidence that is provided by this review (Tricco et al., 2018). When discussing results, we will report source factors (e.g., study design, number of participants, etc.) to provide some indication regarding the quality of the evidence.

In the Results section we have organized, summarized, and reported the findings of our review. We mapped the relevant reported symptoms extracted from the selected sources onto the clinical areas of service identified in the SAC scope of practice guidelines for S-LP and audiology (i.e., voice, swallowing, cognitive-communication, central and peripheral hearing, tinnitus, and balance and vestibular function).

Results

Changes to Methodology

Throughout the literature review and data extraction process, we made several changes to the methodology. Initially, a systematic scoping review was selected as a suitable methodology to explore the available literature on PCC and identify the relationship between its symptoms and the scopes of practice of S-LP and audiology. Our rapid literature review in November 2022 revealed very few studies of interest, which resulted in an expanded search

strategy including all forms of literature, including grey literature (e.g., preprints, conference proceedings, government websites, PCC clinic websites, organizational reports, etc.).

Once we had refined our search strategy, we conducted the database search and screening, which revealed 302 studies suitable for inclusion in the review. In discussion with our faculty supervisor, we decided to change the methodological approach to ensure the feasibility of this project. The review type was changed to a mapping review to better synthesize the large volume of novel literature on the topic. A mapping review is characterized by a broader focus on the research topic, a greater number of included studies, and limited data extraction, as compared to a scoping review (Campbell et al., 2023). The clinical symptoms of PCC extracted from studies that passed full-text review, were then mapped onto the SAC scopes of practice of S-LP and audiology professions (SAC, 2016a; SAC, 2016b).

We added the following exclusion criteria to further specify the articles included for extraction and review: (1) studies with samples comprised solely of participants with specific co-morbid medical conditions (e.g., Parkinson's disease, fibromyalgia, diabetes, etc.); (2) studies that do not report original data (e.g., narrative reviews, correspondences, etc.); (3) unpublished studies, abstracts, and conference proceedings; and (4) intervention-based studies, since the focus of the review is regarding the nature of the symptoms. Throughout the literature review, we identified two study types that were important for inclusion to address the purpose of the mapping review: (1) articles that report on the prevalence of PCC symptoms relevant to S-LP and audiology scopes of practice (i.e., 'prevalence studies'); and (2) quantitative and qualitative studies that describe the severity and biopsychosocial impacts of relevant symptoms on individuals with PCC (i.e., 'symptom assessment/impact studies'). Included studies were sorted into either group for extraction. For symptom assessment/impact studies related to cognition and cognitive-communication, we further decided to exclude studies that used screening tools exclusively (e.g., The Montreal Cognitive Assessment), as we were seeking more in-depth examinations of the impact of PCC on cognitive-communication.

We have restructured our data extraction tables appropriately to identify data variables that are relevant for the two types of studies. Initially, we aimed to extract additional data, such as the number of participants, location/country of the study, participant demographics, outcome measurements, and follow-up methods; however these were ultimately excluded when we modified the extraction process to better align with our new methodology.

Table 1 (see Appendix C) outlines the study characteristics that were extracted from prevalence studies. Data variables identified from full-text articles included aim and study design, as well as the prevalence of each reported symptom that relates to the different domains of S-LP and audiology scopes of practice (e.g., voice, swallowing, cognition and cognitive-communication, central and peripheral hearing, tinnitus, and balance and vestibular function), and impacts on functioning and quality of life.

Table 2 (see Appendix C) outlines the data that was extracted from symptom assessment/impact studies. Symptom types were divided into domains (e.g., voice, swallowing, cognition, etc.) as well as their sub-domains (e.g., memory, processing speed, attention, etc. under 'cognition'). The sub-domains of cognition that we identified as pertinent to cognitive-communication were those outlined in MacDonald's Cognitive-Communication Competence model (2017). Statistically significant and non-statistically significant findings were recorded for each symptom type. Additionally, findings related to psychological/mental health impacts, psychosocial/quality of life, and activities of daily living (e.g., school, work, etc.) were extracted.

Search Results and Study Characteristics

Our literature search yielded a total of 3,026 results from Embase ($n = 1488$), MEDLINE ($n = 1186$), Emcare ($n = 334$), and via hand-searching ($n = 18$). Following the removal of duplicates, we screened 1,687 studies by title and abstract, producing 286 eligible studies. We further excluded 194 articles following full-text screening. Details of the study selection and reasons for exclusion are provided in Figure D1 in Appendix D. Our final mapping review

included 92 articles for extraction. Inter-rater reliability among pairs of reviewers was measured using Cohen's kappa coefficient (see Table 3 in Appendix E). The levels of agreement between pairs of reviewers were rated as moderate to almost perfect during the title and abstract screening, and moderate to substantial during the full-text screening (McHugh, 2012).

Among the 92 articles included, 50 of those reported only the prevalence of S-LP and audiology PCC symptoms (i.e., 'prevalence studies;' see Table 4 in Appendix F for prevalence ranges reported in the included studies). The remaining 42 articles included more comprehensive assessments of symptoms and their impact on daily functioning and quality of life (i.e., 'symptom assessment/impact studies'). Table 5 (see Appendix G) summarizes the distribution of evidence for each area of practice. Most papers reported PCC symptoms related to cognition and cognitive-communication ($n = 26$), then central and peripheral hearing ($n = 5$), balance and vestibular function ($n = 5$), voice ($n = 4$), tinnitus ($n = 3$), swallowing ($n = 2$), and fluency ($n = 1$). Next, we examine the symptoms mapped onto each area of practice in more detail.

Speech-Language Pathology

Voice

Several voice-related symptoms have been identified among individuals with PCC. One of the most frequently cited symptoms is hoarse vocal quality, with prevalence ranges of 13.3% to 25.9% cited in the literature (Bek et al., 2021; Peter et al., 2022). The prevalence of this symptom appears to decrease as time post-infection increases (Bek et al., 2021). The occurrence of dysphonia has also been recognised in some individuals with PCC. Wahlgren et al. (2023) found that among a cohort of individuals with PCC with a history of hospitalization, 33% of participants ($n = 54$) experienced dysphonia 24 months post-infection. Furthermore, there is some evidence to suggest the presence of severe dysphonia among a small subset of this population. The use of laryngovideostroboscopy (LVS), and High-Speed Videolaryngoscopy (HSV) to examine and evaluate vocal fold movements revealed chronic erythema and dryness of

the mucosa of the vocal folds, which resulted in abnormalities in phonatory function in participants (Jeleniewska et al., 2022).

Evidence of neuropathy resulting from COVID-19 infection has been documented in several studies. A case report by An et al. (2022) demonstrated a reduction in vocal fold tension and incomplete glottic closure in the participant, as measured through videostroboscopic examination. Furthermore, the use of laryngeal electromyography (LEMG)—which measures the electrical activity of the laryngeal muscles during contraction via electrodes—demonstrated a decrease in interference patterns of the cricothyroid and bilateral thyroarytenoid muscles, consistent with vagus nerve injury. Similarly, a study by Krasnodębska et al. (2022) revealed the presence of neuropathic abnormalities in the cricothyroid and thyroarytenoid muscles, as measured by LEMG, in individuals post COVID-19 infection.

Although there is evidence to suggest the presence of voice-related symptoms in individuals with PCC, a study by Bouldin et al. (2023) revealed scores on the Voice Handicap Index–10 (VHI-10; Rosen et al., 2004) to be within normal limits at all time points post-infection in both hospitalized and non-hospitalized groups of PCC survivors, indicating that the severity of the symptoms may not be significant.

Swallowing

Dysphagia has been identified as a symptom of PCC, with the prevalence ranging between 0.6% and 21.0% (Han et al., 2022; Kintrilis et al., 2023; Munblit et al., 2021; Wahlgren et al., 2023). Although there are few studies investigating the occurrence of specific swallowing symptoms, a study by Shah et al. (2022) outlined the prevalence of various swallowing-related symptoms among PCC survivors. Participants with no history of intubation reported COVID-related laryngeal hypersensitivity (36.4%; $n = 12$), dysphagia (33.3%; $n = 11$), laryngopharyngeal reflux (18.2%; $n = 6$), and globus sensation (12.0%; $n = 4$). Other symptoms identified among individuals with PCC include xerostomia, pharyngitis, and frequent throat clearing (Anaya et al., 2021; Goldhaber et al., 2022).

Although these findings confirm the presence of oropharyngeal dysphagia in a subset of individuals with PCC, there is evidence that may suggest that the severity of these symptoms may not be significant. A study by Bouldin et al. (2023) described the presence and severity of otolaryngologic symptoms up to 12 months post-infection. Participants that were hospitalized reported a greater severity of dysphagia symptoms, as measured by the Eating Assessment Tool–10 (EAT-10; Belafsky et al., 2008), compared to non-hospitalized participants at all time points post-infection. Although the presence of dysphagia symptoms was reported among groups, the symptoms were determined to be within normal limits at all time points post-infection in both groups.

Cognition & Cognitive-Communication

Cognitive difficulties were identified as a relatively frequent complaint of those with PCC. The prevalence of overall cognitive impairment or “brain fog” was reported with a range of 2.6 to 85.0% within the included prevalence studies (Fernandez-de-las-Penas et al., 2022a; Sivan et al., 2022). In addition, difficulties in more specific cognitive domains such as attention, memory, and mental fatigue were noted (see Table 4 in Appendix F for full details of the identified prevalence ranges in this area).

From our search, we identified a number of articles that conducted more in-depth investigations of the impacts of PCC on various cognitive functions including attention, memory, executive functioning, and processing speed. Multiple studies reported low scores on measures of attention and processing speed in patients with PCC (Abdelmagid et al., 2022; Azcue et al., 2022; Delgado-Alonso et al., 2022a; Delgado-Alonso et al., 2022b; Garcia-Sanchez et al., 2022; Llana et al., 2022; Matias-Guiu et al., 2023; Schlid et al., 2023). Researchers also found significant difficulties in tasks of working, short-term, episodic, procedural, verbal, and visual memory in those with ongoing post-infection symptoms (Abdelmagid et al., 2022; Ariza et al., 2022; Delgado-Alonso et al., 2022b; Garcia-Molina et al., 2022; Guo et al., 2022; Llana et al., 2022; Matias-Guiu et al., 2023; Schlid et al., 2023).

Several studies reported significant findings of impairment in one or more cognitive domains, although the specific areas and combinations varied across studies (Ariza et al., 2022; Ariza et al., 2023; Schild et al., 2023; Birberg Thornberg et al., 2022; Holdsworth et al., 2022; Delgado-Alonso et al., 2022b). For example, in one study by Garcia-Sanchez et al. (2022) a commonly affected cognitive domain was executive functioning. Approximately 43.0% (27/63) of the sample scored below average on the Stroop Task, which measures inhibitory control and verbal interference, and the Trail Making Tests, which measure visual attention and task switching (Bowie & Harvey, 2006; Garcia-Sanchez et al., 2022; Golden, 1994). However, only 4.8% (3/63) of the sample had impairments in executive functioning alone. Holdsworth et al. (2022) reported significant associations between cognitive scores and self-reported symptoms of poor memory, concentration, and anxiety. This appears to be consistent across a number of other studies, as many of the patient populations presented to the experiments with cognitive concerns and ongoing fatigue (Albu et al., 2021; Whiteside et al., 2022; Ariza et al., 2022; Ariza et al., 2023). Overall, cognitive difficulties appear as a heterogeneous yet significant symptom following infection from COVID-19, although the specific cognitive impairments and their relationship to other factors like fatigue are still not yet well understood.

While cognition itself is not directly within the scope of S-LP, the effects that cognitive domains have in mediating communicative processes comprise the area of cognitive-communication disorders (ASHA, n.d.). Unfortunately, there appeared to be a paucity of studies directly focusing on the impacts that impaired cognition has on communication in this population. Cummings (2022b) assessed 92 adults reporting cognitive symptoms across 12 cognitive-linguistic tasks. Tasks requiring less significant demands on cognitive domains such as memory—as in picture description—showed no difference between the post COVID-19 experimental group and a healthy control group. As these demands increased—for example, in a narrative retelling of Cinderella—the author reported significant differences in measures of discourse informativeness in that the experimental group tended to omit essential information

(e.g., reasonings of character actions), and use less specific referents when describing events (e.g., using *animals* instead of *sheep*). Cummings (2022b) noted structural elements of participants' language (e.g., syntax) appeared strong and similar to that of healthy controls, and posited that their underlying cognitive difficulties were the cause of poorer performance across various tasks. Individuals with PCC have self-reported communicative complaints of word-finding and language difficulties (Castro et al., 2022; Matias-Guiu et al., 2023; Seeble et al., 2022; Wahlgren et al., 2023). Studies also found difficulties in objective measures of phonemic and semantic word fluency and object naming (Abdelmagid et al., 2022; Matias-Guiu et al., 2023; Schlid et al., 2023). However it is currently unclear whether these are true language difficulties or if they are instead the result of cognitive-communication difficulties.

Some individuals with PCC identified newfound functional challenges relating to changes in their cognitive abilities. For example, challenges with concentration and information processing appeared to be associated with difficulties effectively performing vocational activities such as customer interactions and managing multiple tasks at once (Loft et al., 2022; Schaap et al., 2022). These and other cognitive-communication difficulties related to post-infection cognitive limitations may pose significant barriers to professional, academic, and social inclusion among this population.

Fluency

Prevalence rates of new-onset speech dysfluencies were not reported in our included articles. However, clinical case studies of two individuals who developed neurogenic stuttering along with cognitive difficulties following COVID-19 infection were presented by Furlanis and colleagues (2023). With the first patient, blocks and repetitions were evident at the beginning of words and sentences, and effortful facial grimaces were observed during stuttering moments. The reported percentage of syllables stuttered (%SS) ranged from 3.0 to 5.0% during reading activities (e.g., reading passages, nonword tasks), repetition (e.g., lists of multisyllabic words), and spontaneous speech tasks (e.g., recalling past events, description of the Cookie Theft

Picture). Stuttering severity was judged to be “moderate” as defined by the Stuttering Severity Instrument–Fourth Edition (SSI-4; Riley, 2009). This patient underwent cognitive training targeting attention, cognitive flexibility, and phonemic/semantic language. Cognitive and speech/motor difficulties improved significantly after cognitive intervention.

The second patient presented with clonic stuttering (i.e., repetitions) at the initial parts of words and sentences, and some effortful pronunciation, which resulted in a slowed speech rhythm. Disfluencies were more evident during spontaneous speech compared to reading tasks, and %SS ranged from 1.0 to 3.0%. Stuttering severity was considered “mild” or “very mild” as rated by the SSI-4 (Riley, 2009). This patient received cognitive training on attention, inhibitory control, cognitive flexibility, and phonemic/semantic language skills. Cognitive difficulties improved, although there were lingering challenges with attention and executive function. Speech/motor difficulties disappeared over the next three months (Furlanis et al., 2023).

Audiology

Peripheral & Central Hearing

Hearing difficulties have been identified as a symptom of PCC, with the prevalence of subjective hearing loss ranging between 7.5 and 19.6% (Bek et al., 2021; Mirfazeli et al., 2022). Thrane et al. (2022) conducted a survey study on audiovestibular symptoms on a cohort of PCC patients ($n = 225$) who self-reported chemosensory loss and found that 10.7% ($n = 24$) also reported hearing loss. Participants reported that the onset of hearing loss occurred, on average, 10 days after the onset of COVID-19 symptoms. Among the patients with hearing loss ($n = 17$), only 11.8% ($n = 2$) experienced full recovery, whereas 88.2% ($n = 15$) had partial or no recovery months later. Patients also provided self-assessments of how hearing loss had negatively impacted their current quality of life. The average score recorded was 43.8 (range 7 - 100) on a scale of zero to 100, where zero indicated no effect or change, and 100 represented the worst possible subjective effect (Thrane et al., 2022). In another study Alexander et al. (2022) presented a clinical case of a 31-year-old male experiencing hearing and communication

challenges after recovering from COVID-19. The patient completed the Hearing Handicap Inventory for Adults (HHIA), which evaluates the impacts of hearing loss on an individual's well-being (Newman et al., 1990). His overall score indicated significant consequences of hearing loss on his quality of life, including the following: (1) difficulty understanding speech in noisy environments (e.g., in restaurants, gatherings, during work, and while visiting friends and family); (2) anxiety, depression, irritation, and nervousness; (3) difficulties arranging and finding words/information; (4) avoiding groups of people; and (5) impacts on his social life (Alexander et al., 2022).

One study by Ludwig et al. (2022) revealed, through pure tone audiometry, that 12% of patients ($n = 6$) had mild hearing loss in a small cohort of PCC patients ($n = 50$); however, some individuals were excluded due to pre-existing hearing conditions, and in comparing audiometric results to pure tone averages, researchers did not identify any significant changes. Other studies using objective otologic examinations have found no evidence to support the presence of inner ear damage in PCC cohorts. Degen et al. (2022a) observed no differences in pure tone audiometric thresholds and otoacoustic emissions between the PCC group ($n = 127$) and the no COVID control group ($n = 28$). Similarly, results of air and bone conduction audiometry in two clinical case studies of individuals with new-onset audiovestibular symptoms revealed that tonal hearing was within the normal range (Alexander et al., 2022; Andreeva et al., 2023). In one case study, further otoscopic examination and tympanometry indicated that there were no obstructions in the external ear and normal middle ear function, respectively (Alexander et al., 2022).

While there is limited evidence for peripheral hearing loss as a persisting symptom of COVID-19, case studies have revealed auditory processing challenges in some individuals with new-onset hearing difficulties and brain fog. Alexander et al. (2022) administered the Buffalo Model Questionnaire–Revised (BMQ-R) and the Buffalo Model Central Battery Test (CBT) to evaluate central auditory processing abilities (Katz, 2007; Katz & Zalewski, 2020). BMQ-R

scores identified challenges with decoding (i.e., the ability to quickly and accurately process speech), tolerance-fading memory (i.e., poor understanding of speech in background noise and difficulty with auditory memory), and organization (i.e., the ability to organize and sequence one's thoughts). The CTB consisted of three tests: (1) the Speech-in-Noise (SN) test, which assesses speech recognition of monosyllabic words presented to each ear separately within a noisy background; (2) the Staggered Spondaic Word (SSW) test, a dichotic (competing) listening test in which the first syllable of one bisyllabic word is presented on one ear and the second syllable of another bisyllabic word is presented to the other ear simultaneously; and (3) the Phonemic Synthesis (PS) test, where separate phonemes of a word are presented, and the patient is required to formulate the target word. The male participant scored below average on the SN and SSW tests, and within normal limits on the PS task. He had considerable difficulty recognizing words in noise and demonstrated several delayed responses (Alexander et al., 2022). In another study, Andreeva et al. (2023) present the clinical case of a 41-year-old female with PCC symptoms of chronic fatigue and dizziness. Poor scores on the dichotic word listening test and gap detection test indicated central auditory processing disorders and deficits in temporal auditory analysis and difficulties processing speech information with competing signals (Andreeva et al., 2023). It has been proposed that symptoms of brain fog, or mild cognitive impairment may be related to auditory processing disorder and loss of grey matter in auditory processing areas of the brain (e.g., cingulate cortex, amygdala, hippocampus, and limbic cortical areas) associated with COVID-19 (DiSogra, 2022; Douaud et al., 2022).

Tinnitus

Self-reported prevalence rates of tinnitus ranged from 7.5 to 30.6% among individuals with ongoing symptoms (Anaya et al., 2021; Degen et al., 2022b; Mirfazeli et al., 2022). Degen et al. (2022b), conducted a survey study involving 1,082 patients with PCC symptoms. Results showed that 30.6% of participants experienced symptoms of tinnitus with a self-reported mean severity of 4.8 ± 3.0 on a scale of 1 (least severe) to 10 (most severe). Thrane et al. (2022),

surveyed PCC patients with chemosensory loss ($n = 225$) and found that 16.4% ($n = 37$) had also developed tinnitus. In a follow-up questionnaire focused on audiovestibular symptoms, severity and duration, participants ($n = 21$) reported that the onset of tinnitus occurred, on average, 30 days after the initial symptoms of COVID-19. Months later, 33.3% ($n = 7$) had full recovery, while 66.7% ($n = 14$) had partial or no recovery. Patients also provided self-assessments of how tinnitus had negatively impacted their current quality of life. The average score recorded was 49.1 (range 6 - 99) on a scale of zero to 100, where zero indicated no effect or change, and 100 represented the worst possible subjective effect (Thrane et al., 2022).

Balance & Vestibular Function

Symptoms related to balance and vestibular function have been frequently self-reported by individuals with PCC. Prevalence rates of dizziness range from 0.1 to 44.4% (Bek et al., 2021; Shivani et al., 2022). Vertigo has been reported in up to 16.7% of patients with PCC (Seeble et al., 2022). In one study, Degen et al. (2022b) investigated the prevalence and self-reported severity of neurotological symptoms in adult patients with PCC ($n = 1,082$). They reported that 59.8% of participants ($n = 647$) experienced some degree of vertigo or dizziness with a self-reported mean severity of 4.6 ± 2.7 on a scale of 1 (least severe) to 10 (most severe; Degen et al., 2022b). In one study, participants in a PCC cohort ($n = 50$) subjectively rated their perception of vertigo using the Dizziness Handicap Inventory (DHI; Jacobson & Newman, 1990). In total, 5.8% of patients (1/17) reported mild symptoms at 4-6 months after COVID-19 infection compared to 23.3% (7/30) at 1-3 months (Ludwig et al., 2022). Furthermore, women were more likely to experience symptoms of dizziness than men, and their symptoms tended to be more severe and persist for longer (Ludwig et al., 2022; Zaubitzer et al., 2023).

However, standard neurological vestibular tests (e.g., Subjective Visual Vertical (SVV), video Head Impulse Test (vHIT), and cervical and ocular Vestibular Evoked Myogenic Potentials (VEMP)) have revealed normal vestibular and cochlear function in study populations (Andreeva

et al., 2023; Ludwig et al., 2022; Zaubitzer et al., 2023). These results suggest that balance symptoms may instead be related to orthostatic intolerance or autonomic dysfunction rather than to vestibular dysfunction per se.

Discussion

This mapping review synthesizes the current evidence on PCC symptomology that relate to S-LP and audiology scope of practices. In the following section we address inconsistencies, highlight other clinical considerations when working with this population, discuss the limitations of this review, and identify several research gaps and priorities.

Prevalence Ranges

We found wide ranges in the reported prevalence of each PCC symptom that were investigated. There are likely several reasons for this inconsistency. First, the populations included across studies were heterogeneous. Populations varied across characteristics such as age, hospitalization status (e.g., hospitalized vs. non-hospitalized), location (e.g., outpatient clinic vs. home reports), vaccination status, SARS-CoV-2 infection variants, and reported pre-existing co-morbidities. Similarly, there were methodological differences in study design that may have affected reported prevalence. For example, there may be differences in data collected from self-report symptom surveys/questionnaires compared to retroactively coding symptoms from healthcare records. Despite this range in prevalence, the reported symptoms appear to be consistently represented across the available literature, indicating that involvement from S-LP and audiology is warranted.

Impacts of Fatigue

General fatigue and post-exertional malaise are the most common somatic symptoms experienced by individuals who have recovered from COVID-19 (Han et al., 2022; O'Mahoney et al., 2023). Up to 72.1% of Canadians with PCC report experiencing fatigue, tiredness, or loss of energy months after the onset of symptoms (Public Health Agency of Canada et al., 2023). The underlying cause of fatigue has yet to be fully understood in individuals with PCC; however, it

may be the result of a combination of factors, including immune system dysregulation, viral persistence, and neuroinflammation (Bansal et al., 2012; Ceban et al., 2022).

Fatigue can manifest as physical, mental, and psychosocial exhaustion, and is frequently accompanied by cognitive limitations and mental health symptoms, such as challenges with attention, executive function, and anxiety (Calabria et al., 2022; Twomey et al., 2022). Studies have shown that fatigue has a significant impact on health-related quality of life and the general health status of PCC patients (DeSire et al., 2022; Schaap et al., 2022). Post-infection fatigue has also been reported to limit work capacity and increase the need for employment adaptations (Delgado-Alonso et al., 2022a; Twomey et al., 2022). Other PCC symptoms, such as dysphagia and dysphonia may be exacerbated by fatigue as well (Chalmers et al., 2023). Similarly, the presence of self-reported brain fog and cognitive impairment has been significantly associated with high levels of fatigue (Jennings et al., 2021).

Post-COVID-19 symptoms of chronic fatigue and post-exertional symptom exacerbation have led to comparisons between PCC and other post-viral conditions such as myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS) and fibromyalgia syndrome (Haider et al., 2023; Wong & Weitzer, 2021). Currently, there is a lack of established treatments for post-infection fatigue (Ceban et al., 2022). Self-management strategies commonly employed in ME/CFS, such as activity pacing and prioritization, have been recommended to help minimize post-exertional fatigue (Schaap et al., 2022; Twomey et al., 2022). However, PCC patients report that finding and maintaining balance between activities and rest can be difficult and restrictive (Schaap et al., 2022). Prior to COVID-19, S-LPs have had limited involvement in chronic fatigue services, despite the associated communication and swallowing difficulties (Chalmers et al., 2023). Therefore, there is a need for integrated interprofessional rehabilitation services (e.g., including S-LPs, occupational therapists, physicians, social workers, etc.) in order to provide a holistic and individualized approach to managing PCC fatigue and related impacts.

Impacts on Functioning and Quality of Life

Several studies have reported the significant impact of PCC on quality of life and the performance activities of daily living. Many survivors indicate a decrease in health-related quality of life measures, which appear to persist for several months post-infection (Agergaard et al., 2022). Mental health symptoms (e.g., anxiety, depression, post-traumatic stress disorder) among this population are elevated, with prevalence rates of 0.6 to 90.0% (see Table 6 in Appendix F for details; Sivan et al., 2022; Zuschlag et al., 2022). Patients also described feelings of isolation, loneliness, and frustration due to PCC being perceived as a “hidden disability” (Loft et al., 2022).

Individuals living with PCC have identified a decreased ability to participate in the workforce and other meaningful activities of daily living. Challenges with self-care, and reduced independence were recognized among survivors (Dryden et al., 2022; Faghy et al., 2022). Difficulties with managing usual activities and loss of income due to illness have been observed among patients with persisting symptoms as well (Oliveira et al., 2022; Ziauddeen et al., 2022). Additionally, an increase in the number of absences from school and/or work was reported among PCC survivors (Goldhaber et al., 2022). A study by Moy et al. (2022) revealed that 35.3% ($n = 194$) of participants experienced changes in work performance. Among those reporting vocational impacts, 73.0% ($n = 142$) required reduced working hours, and 23.9% ($n = 46$) submitted a leave of absence or a resignation to their employer due to PCC symptoms.

These findings highlight the implications of PCC on the health and well-being of working-age adults, and on society more broadly. This emerging health challenge presents potential societal impacts including increased demands on the healthcare system and social support services (e.g., short- and long-term disability, employment insurance, social assistance, community supports, etc.). PCC is characterized as a fluctuating condition, and work responsibilities can exacerbate physical, cognitive, and emotional symptoms, triggering relapse (Tabacof et al., 2022; Ziauddeen et al., 2022). Therefore, return to school and work policies must

be flexible and include accommodations that can adapt to the unpredictable PCC recovery trajectory (Office of the Chief Science Advisor of Canada, 2022).

Medical Gaslighting

Unfortunately, many PCC patients have reported experiencing ‘medical gaslighting’ when seeking diagnosis and treatment of this condition (Au et al., 2022; Russell et al., 2022; Schaap et al., 2022; Verduzco-Gutierrez et al., 2021). This term is used to describe the experience of having one’s medical concerns dismissed by a healthcare provider due to a “lack of knowledge about the condition, or the general inability of medicine to provide effective treatments” (Sebring, 2021). Au et al. (2022) conducted an online survey of PCC patients ($n = 334$) and found that 79.0% ($n = 264$) of respondents reported negative interactions with medical professionals. Qualitative coding of short-answer responses revealed the following three major themes: (1) dismissal of PCC illness reports ($n = 114$, 34.1%); (2) prolonged diagnostic journeys ($n = 130$, 38.9%); and (3) lack of treatment options for PCC ($n = 137$, 41.0%).

In a qualitative interview study exploring the subjective experiences of PCC patients ($n = 20$), medical gaslighting was a prominent theme (Russell et al., 2022). Participants expressed frustration as healthcare professionals were often unable to diagnose or treat their condition, or provide answers to questions about their illness. Some participants described interactions with dismissive healthcare professionals, who viewed their symptoms as less critical compared to those presenting with acute COVID-19, or who labeled PCC symptoms as psychogenic or attributed to anxiety. These interactions led participants to doubt their experiences and question whether they were exaggerating their symptoms. Thus, medical gaslighting in PCC may lead to significant delays in diagnosis and treatment, poorer outcomes, and loss of trust in the healthcare system.

Several characteristics of supportive healthcare professionals were identified, including focusing on patients’ quality of life and their ability to perform social roles, listening to patients’ suggestions about assessment and symptom management, and affirming patients’ concerns

(Russell et al., 2022). Patients also reported finding validation and support from online communities, where they could share their stories, ask questions, connect with others experiencing similar symptoms, and discuss management strategies (Russell et al., 2022). Therefore, it is imperative that clinicians receive ongoing education about PCC to increase awareness of its diverse symptoms, actively listen to patients and validate their experiences, communicate openly with patients, and involve them in the decision-making process, and collaborate with various specialists to provide a comprehensive and holistic approach to treatment.

Limitations

Our mapping review has several limitations. Firstly, our search strategy was primarily symptoms-based. The search terms we used for each symptom are likely not exhaustive and so some relevant articles may have not been captured by our initial search. Since our search was limited to articles published in English, we likely excluded articles that addressed our research aims. There was also a significant disparity in the number of articles found between symptoms. For example, we only identified 2 articles discussing PCC impacts on swallowing. It is more difficult to draw conclusions on the true impact of PCC in some of these areas since it is unclear whether this disparity is a result of factors including, but not limited to, our search strategy, the relative prevalence of the symptom, or simply a paucity of available research in these areas. Additionally, the nature of our search strategy may have limited the number of articles we included that discuss the qualitative impacts and lived experiences of those with PCC. This type of information is important when considering the specific functional impacts that can occur in activities of daily living and the corresponding personal perspectives of this population as they potentially relate to the scopes of practice of S-LP and audiology.

A more broad limitation of our study relates to the state of PCC literature as a whole. At the time of our search, the WHO definition of PCC was relatively new and so many of the available studies were excluded for not meeting this criterion. We expect the number of relevant

articles to significantly increase as research in this area continues to progress and studies adopt a more standardized approach for investigating this population.

Conclusion

Post-COVID-19 condition results from lingering symptoms of an infection caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2; Willi et al., 2021). There are a plethora of PCC symptoms that have been identified in the literature, a subset of which are within the scope of practice of S-LPs and audiologists. This mapping review has synthesized and described several symptoms of PCC that are relevant to the scopes of practice of S-LPs and audiologists, such as swallowing difficulties, changes in voice, cognitive and language challenges, deviations in fluency, the presence of hearing difficulties and tinnitus, and alterations to balance function. These symptoms have a significant detrimental impact on the quality of life of individuals, including increased feelings of fatigue, difficulties completing activities of daily living, challenges with academic and professional performance, and experiences of medical gaslighting.

Future research should address the lack of research in specific practice areas (e.g., tinnitus, swallowing, cognitive-communication, etc.) and to delve deeper into characterizing and addressing the challenges patients experience in their daily activities. Further research is required to determine service provision needs and to develop clinical practice guidelines based on expert consensus regarding the specialized assessment and treatment of these PCC symptoms. Additionally, there is a need for continued advocacy for the involvement of S-LPs and audiologists in interdisciplinary teams that manage this condition. Lastly, greater participation of S-LPs and audiologists in research is required to ensure that the perspectives of these professions are well represented in the literature and to elevate the voices and experiences of this patient population.

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References

- Abdelmagid, E. R., Fahmy, E. M., Taha, S. I., & Elrewainy, R. M. (2022). Impact of fatigue on cognitive function in post-COVID19 survivors. *NeuroQuantology*, 20(8), 7868-7874.
<https://doi.org/10.14704/nq.2022.20.8.NQ44812>
- Agergaard, J., Ullahammer, W. M., Gunst, J. D., Ostergaard, L., & Schiottz-Christensen, B. (2022). Characteristics of a Danish post-COVID cohort referred for examination due to persistent symptoms six months after mild acute COVID-19. *Journal of Clinical Medicine*, 11(24). <https://doi.org/10.3390/jcm11247338>
- Akova, I., & Gedikli, M. A. (2022). Determination of ongoing symptoms, quality of life levels, and risk factors in post-COVID-19 patients. *Erciyes Medical Journal*, 44(2), 208-215.
<https://doi.org/10.14744/etd.2021.99825>
- Albu, S., Zozaya, N. R., Murillo, N., Garcia-Molina, A., Chacon, C. A. F., & Kumru, H. (2021). What's going on following acute COVID-19? Clinical characteristics of patients in an out-patient rehabilitation program. *NeuroRehabilitation*, 48(4), 469-480.
<https://doi.org/10.3233/NRE-210025>
- Alexander, A. L., DiSogra, R. M., Abbas, F., Braund, S., & Spokes, C. (2023). Case study: COVID-19 brain fog or auditory processing disorder? *The Hearing Journal*, 76(04), 18-24. <https://doi.org/10.1097/01.hj.0000927332.17564.4e>
- Allisan-Arrighi, A. E., Rapoport, S. K., Laitman, B. M., Bahethi, R., Mori, M., Woo, P., Genden, E., Courey, M., & Kirke, D. N. (2022). Long-term upper aerodigestive sequelae as a result of infection with COVID-19. *Laryngoscope Investigative Otolaryngology*, 7(2), 476-485.
<https://doi.org/10.1002/liv2.763>
- American Speech-Language-Hearing Association. (2003). *Evaluating and treating communication and cognitive disorders: approaches to referral and collaboration for speech-language pathology and clinical neuropsychology* [Technical Report]. Retrieved March 22, 2023, from <https://www.asha.org/policy/tr2003-00137/>

American Speech-Language-Hearing Association. (n.d.). *Tinnitus and Hyperacusis*. (Practice Portal). Retrieved March 22, 2023, from

www.asha.org/Practice-Portal/Clinical-Topics/Tinnitus-and-Hyperacusis/

An, Y. Y., Park, K. N., & Lee, S. W. (2022). The first case report of bilateral vagal neuropathy presenting with dysphonia following COVID-19 infection. *Ear, Nose & Throat Journal*.

<https://doi.org/10.1177/01455613221075222>

Anaya, J. M., Rojas, M., Salinas, M. L., Rodriguez, Y., Roa, G., Lozano, M., . . .

Ramirez-Santana, C. (2021). Post-COVID syndrome. A case series and comprehensive review. *Autoimmunity Reviews*, 20(11). <https://doi.org/10.1016/j.autrev.2021.102947>

Andreeva, I. G., Gvozdeva, A., Pimenova, V., Ryabkova, V., Lukashenko, M., Kamaeva, E., . . .

Shoenfeld, Y. (2023). Assessment of hearing and vestibular functions in a post-COVID-19 patient: A clinical case study. *Diagnostics*, 13(1), 122.

<https://doi.org/10.3390/diagnostics13010122>

Ariza, M., Cano, N., Segura, B., Adan, A., Bargallo, N., Caldu, X., . . . Junque, C. (2023).

COVID-19 severity is related to poor executive function in people with post-COVID conditions. *Journal of Neurology*. <https://doi.org/10.1007/s00415-023-11587-4>

Ariza, M., Cano, N., Segura, B., Adan, A., Bargallo, N., Caldu, X., . . . Garolera, M. (2022).

Neuropsychological impairment in post-COVID condition individuals with and without cognitive complaints. *Frontiers in Aging Neuroscience*.

<https://doi.org/10.3389/fnagi.2022.1029842>

Aromataris E, Munn Z (Eds.). (2020). *JBIM Manual for Evidence Synthesis*. JBI.

<https://doi.org/10.46658/JBIMES-20-01>

Asadi-Pooya, A. A., Akbari, A., Emami, A., Lotfi, M., Rostamihosseinkhani, M., Nemati, H., . . .

Shahisavandi, M. (2022). Long COVID syndrome-associated brain fog. *Journal of Medical Virology*, 94(3), 979-984. <https://doi.org/10.1002/jmv.27404>

- Au, L., Capotescu, C., Eyal, G., & Finestone, G. (2022). Long covid and medical gaslighting: Dismissal, delayed diagnosis, and deferred treatment. *SSM - Qualitative Research in Health*, 2. <https://doi.org/10.1016/j.ssmqr.2022.100167>
- Azcue, N., Gomez-Esteban, J. C., Acera, M., Tijero, B., Fernandez, T., Ayo-Mentxakatorre, N., . . . Del Pino, R. (2022). Brain fog of post-COVID-19 condition and chronic fatigue syndrome, same medical disorder? *Journal of Translational Medicine*, 20(1). <https://doi.org/10.1186/s12967-022-03764-2>
- Bansal, A. S., Bradley, A. S., Bishop, K. N., Kiani-Alikhan, S., & Ford, B. (2012). Chronic fatigue syndrome, the immune system and viral infection. *Brain, Behavior, and Immunity*, 26(1), 24–31. <https://doi.org/10.1016/j.bbi.2011.06.016>
- Becker, C., Beck, K., Zumbrunn, S., Memma, V., Herzog, N., Bissmann, B., . . . Hunziker, S. (2021). Long COVID 1 year after hospitalisation for COVID-19: A prospective bicentric cohort study. *Swiss Medical Weekly*, 151. <https://doi.org/10.4414/SMW.2021.W30091>
- Bek, L. M., Huijts, S., Vlake, J. H., van den Berg-Emons, H. J. G., van Genderen, M. E., van Bommel, J., . . . Ribbers, G. M. (2021). Symptoms persisting after hospitalization for COVID-19: 12 months interim results of the COFLOW study. *ERJ Open Research*, 8. <https://doi.org/10.1101/2021.12.11.21267652>
- Belafsky, P. C., Mouadeb, D. A., Rees, C. J., Pryor, J. C., Postma, G. N., Allen, J., & Leonard, R. J. (2008). Validity and reliability of the Eating Assessment Tool (EAT-10). *Annals of Otolaryngology, Rhinology, and Laryngology*, 117(12), 919–924. <https://doi.org/10.1177/000348940811701210>
- Bernas, S. N., Baldauf, H., Real, R., Sauter, J., Markert, J., Trost, S., . . . Schetelig, J. (2022). Post-COVID-19 condition in the German working population: A cross-sectional study of 200k registered stem cell donors. *Journal of Internal Medicine*, 293, 354-370. <https://doi.org/10.1111/joim.13587>

- Birberg Thornberg, U., Andersson, A., Lindh, M., Hellgren, L., Divanoglou, A., & Levi, R. (2022). Neurocognitive deficits in COVID-19 patients five months after discharge from hospital. *Neuropsychological Rehabilitation*. <https://doi.org/10.1080/09602011.2022.2125020>
- Bisdorff, A., Von Brevern, M., Lempert, T., & Newman-Toker, D. E. (2009). Classification of vestibular symptoms: Towards an international classification of vestibular disorders. *Journal of Vestibular Research*, 19(1–2), 1–13. <https://doi.org/10.3233/ves-2009-0343>
- Bouldin, E., Shelly, S., Gillespie, A. I., & Tkaczuk, A. (2023). Otolaryngologic symptom severity post SARS-COV-2 infection. *Journal of Voice*. <https://doi.org/10.1016/j.jvoice.2023.02.024>
- Bowie, C. R., & Harvey, P. D. (2006). Administration and interpretation of the Trail Making Test. *Nature Protocols*, 1(5), 2277–2281. <https://doi.org/10.1038/nprot.2006.390>
- Braga, L. W., Oliveira, S. B., Moreira, A. S., Pereira, M. E., Carneiro, V. S., Serio, A. S., . . . Souza, L. M. N. (2022). Neuropsychological manifestations of Long COVID in hospitalized and non-hospitalized Brazilian patients. *NeuroRehabilitation*, 50(4), 391–400. <https://doi.org/10.3233/NRE-228020>
- Calabria, M., García-Sánchez, C., Grunden, N., Pons, C., Arroyo, J. A., Gómez-Ansón, B., Del Carmen Estévez García, M., Belvís, R., Morollón, N., Igual, J. V., Mur, I., Pomar, V., & Domingo, P. (2022). Post-COVID-19 fatigue: The contribution of cognitive and neuropsychiatric symptoms. *Journal of Neurology*, 269(8), 3990–3999. <https://doi.org/10.1007/s00415-022-11141-8>
- Callard, F., & Perego, E. (2021). How and why patients made Long Covid. *Social Science & Medicine*, 268. <https://doi.org/10.1016/j.socscimed.2020.113426>
- Campbell, F., Tricco, A. C., Munn, Z., Pollock, D., Saran, A., Sutton, A., White, H., & Khalil, H. (2023). Mapping reviews, scoping reviews, and evidence and gap maps (EGMs): The same but different—The “big picture” review family. *Systematic Reviews*, 12(1), 45. <https://doi.org/10.1186/s13643-023-02178-5>

- Carazo, S., Skowronski, D. M., Laforce, R., Jr, Talbot, D., Falcone, E. L., Laliberté, D., Denis, G., Deshaies, P., Hegg-Deloye, S., & De Serres, G. (2022). Physical, psychological, and cognitive profile of post-COVID conditions in healthcare workers, Quebec, Canada. *Open Forum Infectious Diseases*, 9(8). <https://doi.org/10.1093/ofid/ofac386>
- Caspersen, I. H., Magnus, P., & Trogstad, L. (2022). Excess risk and clusters of symptoms after COVID-19 in a large Norwegian cohort. *European Journal of Epidemiology*, 37(5), 539-548. <https://doi.org/10.1007/s10654-022-00847-8>
- Castro, V. M., Rosand, J., Giacino, J. T., McCoy, T. H., & Perlis, R. H. (2022). Case-control study of neuropsychiatric symptoms in electronic health records following COVID-19 hospitalization in 2 academic health systems. *Molecular Psychiatry*, 27(9), 3898-3903. <https://doi.org/10.1038/s41380-022-01646-z>
- Cavaco, S., Sousa, G., Goncalves, A., Dias, A., Andrade, C., Pereira, D., . . . Correia, M. (2023). Predictors of cognitive dysfunction one-year post COVID-19. *Neuropsychology*. <https://doi.org/10.1037/neu0000876>
- Ceban, F., Ling, S., Lui, L. M., Lee, Y., Gill, H., Teopiz, K. M., Rodrigues, N. B., Subramaniapillai, M., Di Vincenzo, J. D., Cao, B., Lin, K., Mansur, R. B., Ho, R. C., Rosenblat, J. D., Miskowiak, K., Vinberg, M., Maletic, V., & McIntyre, R. S. (2022). Fatigue and cognitive impairment in post-COVID-19 syndrome: A systematic review and meta-analysis. *Brain Behavior and Immunity*, 101, 93–135. <https://doi.org/10.1016/j.bbi.2021.12.020>
- Cha, C., & Baek, G. (2021). Symptoms and management of Long COVID: A scoping review. *Journal of Clinical Nursing*. <https://doi.org/10.1111/jocn.16150>
- Chalmers, S., Harrall, K., Wong, S. Y., Kablan, W., & Clunie, G. (2023). A retrospective study of patients presenting with speech and language therapy needs within multidisciplinary Long COVID services: A service evaluation describing and comparing two cohorts across two NHS Trusts. *International Journal of Language & Communication Disorders*. <https://doi.org/10.1111/1460-6984.12868>

- Chen, C., Hauptert, S. R., Zimmermann, L., Shi, X., Fritsche, L. G., & Mukherjee, B. (2022). Global prevalence of post-coronavirus disease 2019 (COVID-19) condition or Long COVID: A meta-analysis and systematic review. *The Journal of Infectious Diseases*, 226(9), 1593–1607. <https://doi.org/10.1093/infdis/jiac136>
- Chudzik, M., Babicki, M., Kapusta, J., Kaluzinska-Kolat, Z., Kolat, D., Jankowski, P., & Mastalerz-Migas, A. (2022). Long-COVID clinical features and risk factors: A retrospective analysis of patients from the STOP-COVID Registry of the PoLoCOV Study. *Viruses*, 14(8), 1755. <https://doi.org/10.3390/v14081755>
- Crivelli, L., Palmer, K., Calandri, I., Guekht, A., Beghi, E., Carroll, W., Frontera, J., García-Azorín, D., Westenberg, E., Winkler, A. S., Mangialasche, F., Allegri, R. F., & Kivipelto, M. (2022). Changes in cognitive functioning after COVID-19: A systematic review and meta-analysis. *Alzheimer's & Dementia*, 18(5), 1047-1066. <https://doi.org/10.1002/alz.12644>
- Cummings, L. (2022a). Case studies of adults with COVID-19 infection. In *Covid-19 and Speech-Language Pathology* (pp. 243-268). Routledge. <https://doi.org/10.4324/9781003257318-13>
- Cummings, L. (2022b). Cognitive-linguistic difficulties in adults with Long Covid. In *Covid-19 and Speech-Language Pathology* (pp. 72-95). Routledge. <https://doi.org/10.4324/9781003257318-5>
- Cummings, L. (2022c). Cognitive-linguistic difficulties in COVID-19. In *Exploring Contextualism and Performativity* (pp. 141–161). Springer. https://doi.org/10.1007/978-3-031-12543-0_9
- Cummings, L. (2022d). Communication-related quality of life in adults with Long Covid. In *Covid-19 and Speech-Language Pathology* (pp. 96-129). Routledge. <https://doi.org/10.4324/9781003257318-6>
- Cummings, L. (2022e). Pragmatic impairment and COVID-19. *Intercultural Pragmatics*, 19(3), 271–297. <https://doi.org/10.1515/ip-2022-3001>

- da Costa e Silva, G. R., Moura, W. E. A., Dos Santos, K. C., Gomes, D. O., Bandeira, G. N., Guimaraes, R. A., . . . Teles, S. A. (2023). Long-term symptoms after mild coronavirus disease in healthy healthcare professionals: A 12-month prospective cohort study. *International Journal of Environmental Research and Public Health*, 20(2).
<https://doi.org/10.3390/ijerph20021483>
- Degen, C. V., Mikuteit, M., Niewolik, J., Joosten, T., Schroder, D., Vahldiek, K., . . . Steffens, S. (2022a). Audiological profile of adult Long COVID patients. *American Journal of Otolaryngology*, 43(5). <https://doi.org/10.1016/j.amjoto.2022.103579>
- Degen, C. V., Mikuteit, M., Niewolik, J., Schroder, D., Vahldiek, K., Mucke, U., . . . Steffens, S. (2022b). Self-reported tinnitus and vertigo or dizziness in a cohort of adult Long COVID patients. *Frontiers in Neurology*, 13. <https://doi.org/10.3389/fneur.2022.884002>
- Delgado-Alonso, C., Cuevas, C., Oliver-Mas, S., Diez-Cirarda, M., Delgado-Alvarez, A., Gil-Moreno, M. J., . . . Matias-Guiu, J. A. (2022a). Fatigue and cognitive dysfunction are associated with occupational status in post-COVID syndrome. *International Journal of Environmental Research and Public Health*, 19(20).
<https://doi.org/10.3390/ijerph192013368>
- Delgado-Alonso, C., Valles-Salgado, M., Delgado-Alvarez, A., Yus, M., Gomez-Ruiz, N., Jorquera, M., . . . Matias-Guiu, J. A. (2022b). Cognitive dysfunction associated with COVID-19: A comprehensive neuropsychological study. *Journal of Psychiatric Research*, 150, 40-46. <https://doi.org/10.1016/j.jpsychires.2022.03.033>
- Dennis, A., Cuthbertson, D. J., Wootton, D., Crooks, M., Gabbay, M., Eichert, N., . . . Banerjee, A. (2022). Multi-organ impairment and Long COVID: A 1-year prospective, longitudinal cohort study. *Journal of the Royal Society of Medicine*, 116(3), 97-112.
<https://doi.org/10.1101/2022.03.18.22272607>
- de Oliveira, J. F., de Ávila, R. E., de Oliveira, N. R., da Cunha Severino Sampaio, N., Botelho, M., Gonçalves, F. A., Neto, C. J. F., de Almeida Milagres, A. C., Gomes, T. C. C., Pereira,

- T. L., de Souza, R. P., & Molina, I. (2022). Persistent symptoms, quality of life, and risk factors in long COVID: A cross-sectional study of hospitalized patients in Brazil. *International Journal of Infectious Diseases*, 122, 1044–1051.
<https://doi.org/10.1016/j.ijid.2022.07.063>
- Desgranges, F., Tadini, E., Munting, A., Regina, J., Filippidis, P., Viala, B., . . . Boillat-Blanco, N. (2022). Post-COVID-19 syndrome in outpatients: A cohort study. *Journal of General Internal Medicine*, 37(8), 1943-1952. <https://doi.org/10.1007/s11606-021-07242-1>
- DeSire, A., Moggio, L., Marotta, N., Agostini, F., Tasselli, A., Ferrante, D. D., Curci, C., Calafiore, D., Ferraro, F., Bernetti, A., Taskiran, O. O., & Ammendolia, A. (2022). Impact of rehabilitation on fatigue in post-COVID-19 patients: A systematic review and meta-analysis. *Applied Sciences*, 12(17), 8593. <https://doi.org/10.3390/app12178593>
- DiSogra, R. (2022). Are COVID-19 “brain fog” symptoms and an auditory processing disorder related? *The Hearing Review*, 29(3), 28–38.
<https://hearingreview.com/hearing-loss/hearing-disorders/apd/covid-19-brain-fog-symptoms-auditory-processing-disorder-related#comments>
- Douaud, G., Lee, S., Alfaro-Almagro, F., Arthofer, C., Wang, C., McCarthy, P., Lange, F., Andersson, J., Griffanti, L., Duff, E., Jbabdi, S., Taschler, B., Keating, P., Winkler, A. M., Collins, R., Matthews, P. M., Allen, N. E., Miller, K. L., Nichols, T. E., & Smith, S. M. (2022). SARS-CoV-2 is associated with changes in brain structure in UK Biobank. *Nature*, 604(7907), 697–707. <https://doi.org/10.1038/s41586-022-04569-5>
- Doykov, I., Hällqvist, J., Gilmour, K. C., Grandjean, L., Mills, K., & Heywood, W. E. (2020). ‘The long tail of Covid-19’ - The detection of a prolonged inflammatory response after a SARS-CoV-2 infection in asymptomatic and mildly affected patients. *F1000Research*, 9. <https://doi.org/10.12688/f1000research.27287.2>
- Dressing, A., Bormann, T., Blazhenets, G., Schroeter, N., Walter, L. I., Thürow, J., . . . Hosp, J. A. (2022). Neuropsychological profiles and cerebral glucose metabolism in neurocognitive

Long COVID-syndrome. *Journal of Nuclear Medicine*, 63(7), 1058-1063.

<https://doi.org/10.2967/jnumed.121.262985>

Dryden, M., Mudara, C., Vika, C., Blumberg, L., Mayet, N., Cohen, C., . . . Jassat, W. (2022).

Post-COVID-19 condition 3 months after hospitalisation with SARS-CoV-2 in South Africa: A prospective cohort study. *The Lancet Global Health*, 10(9), 1247-1256.

<https://doi.org/10.1016/S2214-109X%2822%2900286-8>

Elibol, E. (2020). Otolaryngological symptoms in COVID-19. *European Archives of*

Oto-Rhino-Laryngology, 278(4), 1233–1236. <https://doi.org/10.1007/s00405-020-06319-7>

Faghy, M. A., Maden-Wilkinson, T., Arena, R., Copeland, R. J., Owen, R., Hodgkins, H., &

Willmott, A. (2022). COVID-19 patients require multi-disciplinary rehabilitation approaches to address persisting symptom profiles and restore pre-COVID quality of life. *Expert Review of Respiratory Medicine*, 16(5), 595-600.

<https://doi.org/10.1080/17476348.2022.2063843>

Fancello, V., Fancello, G., Hatzopoulos, S., Bianchini, C., Stomeo, F., Pelucchi, S., & Ciorba, A.

(2022). Sensorineural hearing loss post-COVID-19 infection: An update. *Audiology Research*, 12(3), 307–315. <https://doi.org/10.3390/audiolres12030032>

Fernandez-de-las-Penas, C., Martin-Guerrero, J. D., Cancela-Cilleruelo, I., Rodriguez-Jimenez,

J., Moro-Lopez-Menchero, P., & Pellicer-Valero, O. J. (2022a). Exploring trajectory recovery curves of post-COVID cognitive symptoms in previously hospitalized COVID-19 survivors: The LONG-COVID-EXP-CM multicenter study. *Journal of Neurology*, 269(9), 4613-4617. <https://doi.org/10.1007/s00415-022-11176-x>

Fernandez-de-las-Penas, C., Ortega-Santiago, R., Fuensalida-Novo, S., Martin-Guerrero, J. D.,

Pellicer-Valero, O. J., & Torres-Macho, J. (2022b). Differences in Long-COVID symptoms between vaccinated and non-vaccinated (BNT162b2 vaccine) hospitalized COVID-19 survivors infected with the Delta variant. *Vaccines*, 10.

<https://doi.org/10.3390/vaccines10091481>

Fernandez-de-Las-Penas, C., Rodriguez-Jimenez, J., Cancela-Cilleruelo, I., Guerrero-Peral, A., Martin-Guerrero, J. D., Garcia-Azorin, D., . . . Pellicer-Valero, O. J. (2022c).

Post-COVID-19 symptoms 2 years after SARS-CoV-2 infection among hospitalized vs nonhospitalized patients. *JAMA Network Open*, 5(11).

<https://doi.org/10.1001/jamanetworkopen.2022.42106>

Fleischer, M., Szepanowski, F., Tovar, M., Herchert, K., Dinse, H., Schweda, A., . . . Kleinschnitz, C. (2022). Post-COVID-19 syndrome is rarely associated with damage of the nervous system: Findings from a prospective observational cohort study in 171 patients.

Neurology and Therapy, 11(4), 1637-1657. <https://doi.org/10.1007/s40120-022-00395-z>

Forster, C., Colombo, M. G., Wetzel, A. J., Martus, P., & Joos, S. (2022). Persisting symptoms after COVID-19: Prevalence and risk factors in a population-based cohort. *Deutsches Arzteblatt International*, 119(10), 167-174. <https://doi.org/10.3238/arztebl.m2022.0147>

Furlanis, G., Busan, P., Formaggio, E., Menichelli, A., Lunardelli, A., Ajcevic, M., . . . Manganotti, P. (2023). Stuttering-like dysfluencies as a consequence of Long COVID-19. *Journal of Speech, Language, and Hearing Research*, 66(2), 415-430.

https://doi.org/10.1044/2022_JSLHR-22-00381

Garcia-Molina, A., Garcia-Carmona, S., Espina-Bou, M., Rodriguez-Rajo, P., Sanchez-Carrion, R., & Ensenat-Cantalops, A. (2022). Neuropsychological rehabilitation for post-COVID-19 syndrome: Results of a clinical program and six-month follow up.

Neurologia. <https://doi.org/10.1016/j.nrleng.2022.06.007>

Garcia-Sanchez, C., Calabria, M., Grunden, N., Pons, C., Arroyo, J. A., Gomez-Anson, B., . . . Domingo, P. (2022). Neuropsychological deficits in patients with cognitive complaints after COVID-19. *Brain and Behavior*, 12(3). <https://doi.org/10.1002/brb3.2508>

Golden, C. J. (1994). STROOP. *Test de Colores y Palabras – Edición Revisada* (B.

Ruiz-Fernández, T. Luque y F. Sánchez-Sánchez, adaptadores). Madrid: TEA Ediciones.

- Goldhaber, N. H., Kohn, J. N., Ogan, W. S., Sitapati, A., Longhurst, C. A., Wang, A., . . . Horton, L. E. (2022). Deep dive into the long haul: Analysis of symptom clusters and risk factors for post-acute sequelae of COVID-19 to inform clinical care. *International Journal of Environmental Research and Public Health*, 19(24).
<https://doi.org/0.3390/ijerph192416841>
- Gorelik, Y., Dror, A., Zayyad, H., Wertheim, O., Abu Jabal, K., Nazzal, S., . . . Edelstein, M. (2023). Associations between reported post-COVID-19 symptoms and subjective well-being, Israel, July 2021 - April 2022. *Epidemiology and Infection*, 151.
<https://doi.org/10.1017/S0950268822001996>
- Grach, S. L., Ganesh, R., Messina, S. A., & Hurt, R. T. (2022). Post-COVID-19 syndrome: Persistent neuroimaging changes and symptoms 9 months after initial infection. *BMJ Case Reports*, 15(4). <https://doi.org/10.1136/bcr-2021-248448>
- Greenhalgh, T., Sivan, M., Delaney, B., Evans, R., & Milne, R. (2022). Long covid-an update for primary care. *BMJ (Clinical research ed.)*, 378. <https://doi.org/10.1136/bmj-2022-072117>
- Grilli, G. M., Giancaspro, R., Del Colle, A., Quarato, C. M. I., Lacedonia, D., Foschino Barbaro, M. P., & Cassano, M. (2022). Dysphagia in non-intubated patients affected by COVID-19 infection. *European Archives of Oto-Rhino-Laryngology*, 279(1), 507–513.
<https://doi.org/10.1007/s00405-021-07062-3>
- Grisanti, S. G., Garbarino, S., Barisione, E., Aloe, T., Grosso, M., Schenone, C., . . . Benedetti, L. (2022). Neurological Long-COVID in the outpatient clinic: Two subtypes, two courses. *Journal of the Neurological Sciences*, 439.. <https://doi.org/10.1016/j.jns.2022.120315>
- Grilli, G. M., Giancaspro, R., Del Colle, A., Quarato, C. M. I., Lacedonia, D., Foschino Barbaro, M. P., & Cassano, M. (2022). Dysphagia in non-intubated patients affected by COVID-19 infection. *European Archives of Oto-Rhino-Laryngology*, 279(1), 507–513.
<https://doi.org/10.1007/s00405-021-07062-3>

- Guo, P., Benito Ballesteros, A., Yeung, S. P., Liu, R., Saha, A., Curtis, L., . . . Cheke, L. G. (2022). COVCOG 2: Cognitive and memory deficits in Long COVID: A second publication from the COVID and Cognition Study. *Frontiers in Aging Neuroscience*, 14. <https://doi.org/10.3389/fnagi.2022.804937>
- Haider, S., Janowski, A., Lesnak, J., Hayashi, K., Dailey, D. L., Chimenti, R., Frey-Law, L., Sluka, K. A., & Berardi, G. (2022). A comparison of pain, fatigue, and function between post-COVID-19 condition, fibromyalgia, and chronic fatigue syndrome: A survey study. *Pain*, 164(2), 385–401. <https://doi.org/10.1097/j.pain.0000000000002711>
- Han, Q., Zheng, B., Daines, L., & Sheikh, A. (2022). Long-term sequelae of COVID-19: A systematic review and meta-analysis of one-year follow-up studies on post-COVID symptoms. *Pathogens*, 11(2). <https://doi.org/10.3390/pathogens11020269>
- Harapan, B. N., & Yoo, H. J. (2021). Neurological symptoms, manifestations, and complications associated with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and coronavirus disease 19 (COVID-19). *Journal of Neurology*. <https://doi.org/10.1007/s00415-021-10406-y>
- Heiberg, K. E., Heggestad, A. K. T., Joranson, N., Lausund, H., Breievne, G., Myrstad, M., . . . Bruun-Olsen, V. (2022). 'Brain fog', guilt, and gratitude: Experiences of symptoms and life changes in older survivors 6 months after hospitalisation for COVID-19. *European Geriatric Medicine*, 13(3), 695-703. <https://doi.org/10.1007/s41999-022-00630-8>
- Ho, F. F., Xu, S., Kwong, T. M. H., Li, A. S. C., Ha, E. H., Hua, H., . . . Chung, V. C. H. (2023). Prevalence, patterns, and clinical severity of Long COVID among Chinese medicine telemedicine service users: Preliminary results from a cross-sectional study. *International Journal of Environmental Research and Public Health*, 20(3). <https://doi.org/10.3390/ijerph20031827>
- Holdsworth, D. A., Chamley, R., Barker-Davies, R., O'Sullivan, O., Ladlow, P., Mitchell, J. L., . . . Nicol, E. D. (2022). Comprehensive clinical assessment identifies specific neurocognitive

deficits in working-age patients with long-COVID. *PLoS ONE*, 17(6).

<https://doi.org/10.1371/journal.pone.0267392>

Houben, S., & Bonnechère, B. (2022). The impact of COVID-19 infection on cognitive function and the implication for rehabilitation: A systematic review and meta-analysis.

International Journal of Environmental Research and Public Health, 19(13).

<https://doi.org/10.3390/ijerph19137748>

Imoto, W., Yamada, K., Kawai, R., Imai, T., Kawamoto, K., Uji, M., . . . Takeya, H. (2022). A cross-sectional, multicenter survey of the prevalence and risk factors for Long COVID.

Scientific Reports, 12(1). <https://doi.org/10.1038/s41598-022-25398-6>

Jacobs, M. M., Evans, E., & Ellis, C. (2023). Racial, ethnic, and sex disparities in the incidence and cognitive symptomology of Long COVID-19. *Journal of the National Medical Association*, 115(2), 233-243.

<https://doi.org/10.1016/j.jnma.2023.01.016>

Jacobson, G. P., & Newman, C. W. (1990). The development of the Dizziness Handicap Inventory. *Archives of Otolaryngology - Head & Neck Surgery*, 116(4), 424-427.

<https://doi.org/10.1001/archotol.1990.01870040046011>

Jafari, Z., Kolb, B., & Mohajerani, M. (2022). Hearing loss, tinnitus, and dizziness in COVID-19: A systematic review and meta-analysis. *Canadian Journal of Neurological Sciences*,

49(2), 184-195. <https://doi.org/10.1017/cjn.2021.63>

Jain, V., Nabi, N., Aggarwal, S., Alam, Z., Chandra, K., Singh, D., . . . Kohli, S. (2023). Long-term health consequences of COVID-19 in survivors hospitalised at a tertiary care hospital and their correlation with acute COVID-19 severity and associated risk factors. *Journal of Clinical Nursing*.

<https://doi.org/10.1111/jocn.16652>

Jeleniewska, J., Niebudek-Bogusz, E., Malinowski, J., Morawska, J., Milkowska-Dymanowska, J., & Pietruszewska, W. (2022). Isolated severe dysphonia as a presentation of post-COVID-19 syndrome. *Diagnostics*, 12(8).

<https://doi.org/10.3390/diagnostics12081839>

- Jennings, G., Monaghan, A., Feng, X., Mockler, D., & Romero-Ortuno, R. (2021). A systematic review of persistent symptoms and residual abnormal functioning following acute COVID-19: Ongoing symptomatic phase vs. post-COVID-19 syndrome. *Journal of Clinical Medicine*, 10(24). <https://doi.org/10.3390/jcm10245913>
- Jensen, A., Castro, A. W., Ferretti, M. T., Martinkova, J., Vasilevskaya, A., Santucci Chadha, A., & Tartaglia, M. C. (2022). Sex and gender differences in the neurological and neuropsychiatric symptoms of Long COVID: A narrative review. *The Italian Journal of Gender-Specific Medicine*, 8(1), 18–28. <https://doi.org/10.1723/3769.37563>
- Kamal, M., Abo Omirah, M., Hussein, A., & Saeed, H. (2021). Assessment and characterization of Long COVID manifestations. *International Journal of Clinical Practice*, 75(3), e13746. <https://doi.org/10.1111/ijcp.13746>
- Kaplan, M., Camurcu, A. A., & Erol, S. (2022). Post-coronavirus disease-2019 syndrome in healthcare workers COVID-19. *Mediterranean Journal of Infection, Microbes and Antimicrobials*, 11. <https://doi.org/10.4274/mjima.galenos.2021.2021.16>
- Katz, J. (2007) *APD evaluation to therapy: The Buffalo Model*. Retrieved from: <https://www.audiologyonline.com/articles/apd-evaluation-to-therapy-buffalo-945>
- Katz, J., & Zalewski, T. (2020). *Buffalo Model Questionnaire – Revised Administration and Interpretation Manual*. Retrieved from <https://edaud.org/shop/>
- Kintrilis, N., Kontaxakis, A., Papalampidou, A., Manthos, P., Simeonidou, Z., Stavrianou, A., . . . Rapti, C. A. (2023). Quality of life after coronavirus disease 2019 hospitalization and rehabilitation needs. *Journal of Rehabilitation Medicine: Clinical Communications*, 6. <https://doi.org/10.2340/jrmcc.v6.5327>
- Korres, G., Kitsos, D. K., Kaski, D., Tsogka, A., Giannopoulos, S., Giannopapas, V., Sideris, G., Tyrellis, G., & Voumvourakis, K. (2022). The prevalence of dizziness and vertigo in COVID-19 patients: A systematic review. *Brain Sciences*, 12(7), 948. <https://doi.org/10.3390/brainsci12070948>

- Krasnodębska, P., Szkiełkowska, A., & Miałkiewicz, B. (2023). Laryngeal sensory neuropathy caused by COVID-19: Findings using laryngeal electromyography. *European Archives of Oto-rhino-laryngology*, 280(7), 3295–3302. <https://doi.org/10.1007/s00405-023-07895-0>
- Krishnan, K., Lin, Y., Prewitt, K.-R. M., & Potter, D. A. (2022). Multidisciplinary approach to brain fog and related persisting symptoms post COVID-19. *Journal of Health Service Psychology*, 48(1), 31-38. <https://doi.org/10.1007/s42843-022-00056-7>
- Lapa, J., Rosa, D., Mendes, J. P. L., Deusdara, R., & Romero, G. A. S. (2023). Prevalence and associated factors of post-COVID-19 syndrome in a Brazilian cohort after 3 and 6 months of hospital discharge. *International Journal of Environmental Research and Public Health*, 20. <https://doi.org/10.3390/ijerph20010848>
- Llana, T., Mendez, M., Zorzo, C., Fidalgo, C., Juan, M. C., & Mendez-Lopez, M. (2022). Anosmia in COVID-19 could be associated with long-term deficits in the consolidation of procedural and verbal declarative memories. *Frontiers in Neuroscience*, 16. <https://doi.org/10.3389/fnins.2022.1082811>
- Loft, M. I., Foged, E. M., & Koreska, M. (2022). An unexpected journey: The lived experiences of patients with long-term cognitive sequelae after recovering from COVID-19. *Qualitative Health Research*. <https://doi.org/10.1177/10497323221099467>
- Louis, D. W., Saad, M., Vijayakumar, S., Ilyas, S., Kokkiralala, A., & Aronow, H. D. (2022). The cardiovascular manifestations of COVID-19. *Cardiology Clinics*, 40(3), 277–285. <https://doi.org/10.1016/j.ccl.2022.03.001>
- Ludwig, S., Schell, A., Berkemann, M., Jungbauer, F., Zaubitzer, L., Huber, L., . . . Rotter, N. (2022). Post-COVID-19 impairment of the senses of smell, taste, hearing, and balance. *Viruses*, 14(5). <https://doi.org/10.3390/v14050849>
- MacDonald, S. (2017). Introducing the model of cognitive-communication competence: A model to guide evidence-based communication interventions after brain injury. *Brain Injury*, 31(13–14), 1760–1780. <https://doi.org/10.1080/02699052.2017.1379613>

- Matias-Guiu, J. A., Herrera, E., Gonzalez-Nosti, M., Krishnan, K., Delgado-Alonso, C., Diez-Cirarda, M., . . . Hermann, B. P. (2023). Development of criteria for cognitive dysfunction in post-COVID syndrome: The IC-CoDi-COVID approach. *Psychiatry Research*, 319. <https://doi.org/10.1016/j.psychres.2022.115006>
- McHugh, M. L. (2012). Interrater reliability: the kappa statistic. *Biochemia Medica*, 22(3), 276–282.
- Michelen, M., Manoharan, L., Elkheir, N., Cheng, V., Dagens, A., Hastie, C., O'Hara, M., Suett, J., Dahmash, D., Bugaeva, P., Rigby, I., Munblit, D., Harriss, E., Burls, A., Foote, C., Scott, J., Carson, G., Olliaro, P., Sigfrid, L., & Stavropoulou, C. (2021). Characterising Long COVID: A living systematic review. *BMJ Global Health*, 6(9). <https://doi.org/10.1136/bmjgh-2021-005427>
- Mirfazeli, F. S., Sarabi-Jamab, A., Pereira-Sanchez, V., Kordi, A., Shariati, B., Shariat, S. V., . . . Faiz, S. H. R. (2022). Chronic fatigue syndrome and cognitive deficit are associated with acute-phase neuropsychiatric manifestations of COVID-19: A 9-month follow-up study. *Neurological Sciences*, 43(4), 2231-2239. <https://doi.org/10.1007/s10072-021-05786-y>
- Mohapatra, B., & Mohan, R. (2020). Speech-language pathologists' role in the multi-disciplinary management and rehabilitation of patients with COVID-19. *Journal of Rehabilitation Medicine – Clinical Communications*, 3(1). <https://doi.org/10.2340/20030711-1000037>
- Moy, F. M., Hairi, N. N., Lim, E. R. J., & Bulgiba, A. (2022). Long COVID and its associated factors among COVID survivors in the community from a middle-income country—An online cross-sectional study. *PLoS ONE*, 17(8). <https://doi.org/10.1371/journal.pone.0273364>
- Munblit, D., Bobkova, P., Spiridonova, E., Shikhaleva, A., Gamirova, A., Blyuss, O., . . . Butnaru, D. (2021). Incidence and risk factors for persistent symptoms in adults previously hospitalized for COVID-19. *Clinical and Experimental Allergy*, 51(9), 1107-1120. <https://doi.org/10.1111/cea.13997>

- Namasivayam-MacDonald, A. M., & Riquelme, L. F. (2020). Speech-language pathology management for adults with COVID-19 in the acute hospital setting: Initial recommendations to guide clinical practice. *American Journal of Speech-Language Pathology*, 29(4), 1850–1865. https://doi.org/10.1044/2020_AJSLP-20-00096
- Neevel, A. J., Smith, J. D., Morrison, R. J., Hogikyan, N. D., Kupfer, R. A., & Stein, A. P. (2021). Postacute COVID-19 laryngeal injury and dysfunction. *OTO Open*, 5(3). <https://doi.org/10.1177/2473974X211041040>
- Nehme, M., Braillard, O., Chappuis, F., Courvoisier, D. S., Kaiser, L., Soccal, P. M., . . . Guessous, I. (2022a). One-year persistent symptoms and functional impairment in SARS-CoV-2 positive and negative individuals. *Journal of Internal Medicine*, 292(1), 103-115. <https://doi.org/10.1111/joim.13482>
- Nehme, M., Braillard, O., Chappuis, F., & Guessous, I. (2022b). The chronification of post-COVID condition associated with neurocognitive symptoms, functional impairment and increased healthcare utilization. *Scientific Reports*, 12(1). <https://doi.org/10.1038/s41598-022-18673-z>
- Newman, C. W., Weinstein, B. E., Jacobson, G. P., & Hug, G. A. (1990). The Hearing Handicap Inventory for Adults: Psychometric adequacy and audiometric correlates. *Ear And Hearing*, 11(6), 430–433. <https://doi.org/10.1097/00003446-199012000-00004>
- Norrefalk, J. R., Borg, K., & Bileviciute-Ljungar, I. (2021). Self-scored impairments in functioning and disability in post-COVID syndrome following mild COVID-19 infection. *Journal of Rehabilitation Medicine*, 53(11). <https://doi.org/10.2340/jrm.v53.188>
- Office of the Chief Science Advisor of Canada. (2022). *Post-COVID-19 condition in Canada: What we know, what we don't know, and a framework for action*. Government of Canada. <https://science.gc.ca/site/science/en/office-chief-science-advisor/initiatives-covid-19/post-covid-19-condition-canada-what-we-know-what-we-dont-know-and-framework-action>

- Oliveira, C. R., Jason, L. A., Unutmaz, D., Bateman, L., & Vernon, S. D. (2023). Improvement of Long COVID symptoms over one year. *Frontiers in Medicine*, 9. <https://doi.org/10.3389/fmed.2022.1065620>
- O'Mahoney, L., Routen, A., Gillies, C. L., Ekezie, W., Welford, A., Zhang, A. X., Karamchandani, U., Simms-Williams, N., Cassambai, S., Ardavani, A., Wilkinson, T. J., Hawthorne, G., Curtis, F., Kingsnorth, A. P., Almaqhawi, A., Ward, T., Ayoubkhani, D., Banerjee, A., Calvert, M., . . . Khunti, K. (2023). The prevalence and long-term health effects of Long Covid among hospitalised and non-hospitalised populations: A systematic review and meta-analysis. *EClinicalMedicine*, 55. <https://doi.org/10.1016/j.eclinm.2022.101762>
- Perego, E., Callard, F., Stras, L., Melville-Jóhannesson, B., Pope, R., & Alwan, N. A. (2020). Why the patient-made term “Long Covid” is needed. *Wellcome Open Research*, 5, 224. <https://doi.org/10.12688/wellcomeopenres.16307.1>
- Perez-Gonzalez, A., Araujo-Ameijeiras, A., Fernandez-Villar, A., Crespo, M., Poveda, E., Cabrera, J. J., . . . Vieitez, I. (2022). Long COVID in hospitalized and non-hospitalized patients in a large cohort in Northwest Spain, a prospective cohort study. *Scientific Reports*, 12(1). <https://doi.org/10.1038/s41598-022-07414-x>
- Perlis, R. H., Santillana, M., Ognyanova, K., Safarpour, A., Lunz Trujillo, K., Simonson, M. D., Green, J., Quintana, A., Druckman, J., Baum, M. A., & Lazer, D. (2022). Prevalence and correlates of Long COVID symptoms among US adults. *JAMA Network Open*, 5(10). <https://doi.org/10.1001/jamanetworkopen.2022.38804>
- Perna, S., Abdulsattar, S., Alalwan, T. A., Zahid, M. N., Gasparri, C., Peroni, G., . . . Rondanelli, M. (2022). A cross-sectional analysis of post-acute COVID-19 symptoms. *Annali di Igiene Medicina Preventiva e di Comunita*, 34(5), 478-489. <https://doi.org/10.7416/ai.2022.2508>

- Peter, R. S., Nieters, A., Krausslich, H. G., Brockmann, S. O., Gopel, S., Kindle, G., . . . Kern, W. V. (2022). Post-acute sequelae of covid-19 six to 12 months after infection: Population based study. *The BMJ*, 379. <https://doi.org/10.1136/bmj-2022-071050>
- Public Health Agency of Canada. (2023, August 1). *COVID-19 epidemiology update: Key updates*. Government of Canada. Retrieved August 1, 2023, from <https://health-infobase.canada.ca/covid-19/>
- Public Health Agency of Canada, Statistics Canada, & COVID-19 Immunity Task Force. (2023, March 24). *COVID-19: Longer-term symptoms among Canadian adults*. Government of Canada. Retrieved July 19, 2023, from <https://health-infobase.canada.ca/covid-19/post-covid-condition/>
- Quinn, K. L., Katz, G. M., Bobos, P., Sander, B., McNaughton, C. D., Cheung, A. M., Herridge, M. S., Atzema, C. L., Born, K. B., Chan, C., Chien, V., Kaplan, D. M., Kwong, J., Leung, S., Mishra, S., Morris, A. M., Rendely, A., Slutsky, A. S., Stalteri, R., & Razak, F. A. (2022). Understanding the post COVID-19 condition (Long COVID) in adults and the expected burden for Ontario. *Science Briefs of the Ontario COVID-19 Science Advisory Table*, 3(65). <https://doi.org/10.47326/ocsat.2022.03.65.1.0>
- Ramage A. E. (2020). Potential for cognitive communication impairment in COVID-19 survivors: A call to action for speech-language pathologists. *American Journal of Speech-Language pathology*, 29(4), 1821–1832. https://doi.org/10.1044/2020_AJSLP-20-00147
- Riley, G. (2009). The Stuttering Severity Instrument for Adults and Children—Fourth Edition (SSI-4). Pro-Ed.
- Rosen, C. A., Lee, A. S., Osborne, J., Zullo, T. G., & Murry, T. (2004). Development and validation of the Voice Handicap Index–10. *Laryngoscope*, 114(9), 1549–1556. <https://doi.org/10.1097/00005537-200409000-00009>
- Russell, D., Spence, N. J., Chase, J. D., Schwartz, T., Tumminello, C. M., & Bouldin, E. D. (2022). Support amid uncertainty: Long COVID illness experiences and the role of online

communities. *SSM - Qualitative Research in Health*, 2.

<https://doi.org/10.1016/j.ssmqr.2022.100177>

Schaap, G., Wensink, M., Doggen, C. J. M., van der Palen, J., Vonkeman, H. E., & Bode, C.

(2022). "It really is an elusive illness"—Post-COVID-19 illness perceptions and recovery strategies: A thematic analysis. *International Journal of Environmental Research and Public Health*, 19. <https://doi.org/10.3390/ijerph192013003>

Schild, A. K., Goereci, Y., Scharfenberg, D., Klein, K., Lulling, J., Meiberth, D., . . . Maier, F.

(2023). Multidomain cognitive impairment in non-hospitalized patients with the post-COVID-19 syndrome: Results from a prospective monocentric cohort. *Journal of Neurology*, 270(3), 1215-1223. <https://doi.org/10.1007/s00415-022-11444-w>

Sebring, J. C. H. (2021). Towards a sociological understanding of medical gaslighting in western health care. *Sociology of Health & Illness*, 43(9), 1951–1964.

<https://doi.org/10.1111/1467-9566.13367>

Seeble, J., Waterboer, T., Hippchen, T., Simon, J., Kirchner, M., Lim, A., . . . Merle, U. (2022).

Persistent symptoms in adult patients 1 year after coronavirus disease 2019 (COVID-19): A prospective cohort study. *Clinical Infectious Diseases*, 74(7), 1191-1198.

<https://doi.org/10.1093/cid/ciab611>

Shah, H. P., Bourdillon, A. T., Panth, N., Ihnat, J., & Kohli, N. (2023). Long-term laryngological

sequelae and patient-reported outcomes after COVID-19 infection. *American Journal of Otolaryngology*, 44(2). <https://doi.org/10.1016/j.amjoto.2022.103780>

Shanbehzadeh, S., Zanjari, N., Yassin, M., Yassin, Z., & Tavahomi, M. (2023). Association

between Long COVID, functional activity, and health-related quality of life in older adults. *BMC Geriatrics*, 23(1). <https://doi.org/10.1186/s12877-023-03757-w>

Shivani, F., Kumari, N., Bai, P., Rakesh, F., Haseeb, M., Kumar, S., . . . Rizwan, A. (2022).

Long-term symptoms of COVID-19: One-year follow-up study. *Cureus*, 14(6).

<https://doi.org/10.7759/cureus.25937>

- Sivan, M., Parkin, A., Makower, S., & Greenwood, D. C. (2022). Post-COVID syndrome symptoms, functional disability, and clinical severity phenotypes in hospitalized and nonhospitalized individuals: A cross-sectional evaluation from a community COVID rehabilitation service. *Journal of Medical Virology*, 94(4), 1419-1427.
<https://doi.org/10.1002/jmv.27456>
- Soh, H. S., & Cho, B. (2022). Long COVID-19 and health-related quality of life of mild cases in Korea: 3-months follow-up of a single community treatment center. *Journal of Korean Medical Science*, 37(46),. <https://doi.org/10.3346/jkms.2022.37.e326>
- Speech-Language and Audiology Canada. (2016a, February 29). *Scope of practice for audiology*. Retrieved January 3, 2023, from
https://www.sac-oac.ca/wp-content/uploads/2023/01/scope_of_practice_audiology_en-2.pdf
- Speech-Language and Audiology Canada. (2016b, February 29). *Scope of practice for speech-language pathology*. Retrieved January 3, 2023, from
https://sac-oac.ca/sites/default/files/resources/scope_of_practice_speech-language_pathology_en.pdf
- Staudt, A., Jorres, R. A., Hinterberger, T., Lehnen, N., Loew, T., & Budweiser, S. (2022). Associations of post-acute COVID syndrome with physiological and clinical measures 10 months after hospitalization in patients of the first wave. *European Journal of Internal Medicine*, 95, 50-60. <https://doi.org/10.1016/j.ejim.2021.10.031>
- Tabacof, L., Tosto-Mancuso, J., Wood, J., Cortes, M., Kontorovich, A., McCarthy, D., Rizk, D., Rozanski, G. M., Breyman, E., Nasr, L., Kellner, C. P., Herrera, J. E., & Putrino, D. (2022). Post-acute COVID-19 syndrome negatively impacts physical function, cognitive function, health-related quality of life, and participation. *American Journal of Physical Medicine & Rehabilitation*, 101(1), 48–52.
<https://doi.org/10.1097/phm.0000000000001910>

- Tawfik, H. M., Shaaban, H. M., & Tawfik, A. M. (2021). Post-covid-19 syndrome in Egyptian healthcare staff: Highlighting the carers sufferings. *Electronic Journal of General Medicine*, 18(3). <https://doi.org/10.29333/ejgm/10838>
- Thrane, J. F., Britze, A., & Fjaeldstad, A. W. (2022). Incidence and duration of self-reported hearing loss and tinnitus in a cohort of COVID-19 patients with sudden chemosensory loss: A STROBE observational study. *European Annals of Otorhinolaryngology, Head and Neck Diseases*, 139(3), 125–128. <https://doi.org/10.1016/j.anorl.2021.07.012>
- Threats, T. T. (2010). The ICF and speech-language pathology: Aspiring to a fuller realization of ethical and moral issues. *International Journal of Speech-Language Pathology*, 12(2), 87–93. <https://doi.org/10.3109/17549500903568476>
- Tricco, A. C., Lillie, E., Zarin, W., O'Brien, K. K., Colquhoun, H., Levac, D., Moher, D., Peters, M. D., Horsley, T., Weeks, L., Hempel, S., Akl, E. A., Chang, C., McGowan, J., Stewart, L., Hartling, L., Aldcroft, A., Wilson, M. G., Garritty, C., . . . Straus, S. E. (2018). PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Annals of Internal Medicine*, 169(7), 467–473. <https://doi.org/10.7326/m18-0850>
- Tsampasian, V., Elghazaly, H., Chattopadhyay, R., Debski, M., Naing, T. K. P., Garg, P., Clark, A., Ntatsaki, E., & Vassiliou, V. S. (2023). Risk factors associated with post-COVID-19 condition. *JAMA Internal Medicine*. <https://doi.org/10.1001/jamainternmed.2023.0750>
- Tulenko, K., & Vervoort, D. (2020). Cracks in the system: The effects of the coronavirus pandemic on public health systems. *The American Review of Public Administration*, 50(6–7), 455–466. <https://doi.org/10.1177/0275074020941667>
- Twomey, R., DeMars, J. M., Franklin, K., Culos-Reed, S. N., Weatherald, J., & Wrightson, J. (2022). Chronic fatigue and postexertional malaise in people living with long COVID: An observational study. *Physical Therapy*, 102(4). <https://doi.org/10.1093/ptj/pzac005>

- Verduzco-Gutierrez, M., Rydberg, L., Sullivan, M. N., & Mukherjee, D. (2021). In this for the long haul: Ethics, COVID - 19, and rehabilitation. *Physical Medicine & Rehabilitation*, 13(3), 325–332. <https://doi.org/10.1002/pmrj.12554>
- Wahlgren, C., Forsberg, G., Divanoglou, A., Ostholm Balkhed, A., Niward, K., Berg, S., & Levi, R. (2023). Two-year follow-up of patients with post-COVID-19 condition in Sweden: A prospective cohort study. *The Lancet Regional Health - Europe*, 28. <https://doi.org/10.1016/j.lanepe.2023.100595>
- Whiteside, D. M., Basso, M. R., Naini, S. M., Porter, J., Holker, E., Waldron, E. J., . . . Taylor, S. E. (2022). Outcomes in post-acute sequelae of COVID-19 (PASC) at 6 months post-infection Part 1: Cognitive functioning. *Clinical Neuropsychologist*, 36(4), 806-828. <https://doi.org/10.1080/13854046.2022.2030412>
- Willi, S., Lüthold, R., Hunt, A., Hänggi, N. V., Sejdiu, D., Scaff, C., Bender, N., Staub, K., & Schlagenhauf, P. (2021). COVID-19 sequelae in adults aged less than 50 years: A systematic review. *Travel Medicine and Infectious Disease*, 40. <https://doi.org/10.1016/j.tmaid.2021.101995>
- Wolters Kluwer. (2022a). *Embase*. Retrieved December 16, 2022, from <https://www.wolterskluwer.com/en/solutions/ovid/embase-903>
- Wolters Kluwer. (2022b). *Ovid Emcare*. Retrieved January 8, 2023, from <https://www.wolterskluwer.com/en/solutions/ovid/ovid-emcare-14007>
- Wolters Kluwer. (2022c). *Ovid MEDLINE*. Retrieved December 16, 2022, from <https://www.wolterskluwer.com/en/solutions/ovid/ovid-medline-901>
- Wong, T. L., & Weitzer, D. (2021). Long COVID and myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS)—A systemic review and comparison of clinical presentation and symptomatology. *Medicina*, 57(5), 418. <https://doi.org/10.3390/medicina57050418>
- World Health Organization. (2021, October 6). *A clinical case definition of post COVID-19 condition by a Delphi consensus, 6 October 2021*. Retrieved November 20, 2022, from

https://www.who.int/publications/i/item/WHO-2019-nCoV-Post_COVID-19_condition-Clinical_case_definition-2021.1

World Health Organization. (2020, January 5). *COVID-19 - China*. Retrieved January 8, 2023, from <https://www.who.int/emergencies/disease-outbreak-news/item/2020-DON229>

World Health Organization. (2023, July 26). *WHO coronavirus (COVID-19) dashboard*. Retrieved August 1, 2023, from https://covid19.who.int/?adgroupsurvey=%7badgroupsurvey%7d&qclid=CjwKCAiA76-dBhByEiwAA0_s9eTAIC3Sz1mj8HCNXeOvfSelUYxKKpmmJ7jhMX0P7l6WC3WudowcjxoCZCQQA_vD_BwE

Zaubitzer, L., Ludwig, S., Berkemann, M., Walter, B., Jungbauer, F., Held, V., Hegemann, S., Rotter, N., & Schell, A. (2023). The effects of COVID-19 on the vestibular system. *Frontiers in Neurology*, 14. <https://doi.org/10.3389/fneur.2023.1134540>

Ziauddeen, N., Gurdasani, D., O'Hara, M. E., Hastie, C., Roderick, P., Yao, G., & Alwan, N. A. (2022). Characteristics and impact of Long Covid: Findings from an online survey. *PLOS ONE*, 17(3). <https://doi.org/10.1371/journal.pone.0264331>

Zhu, J., Ji, P., Pang, J., Zhong, Z., Li, H., He, C., Zhang, J., & Zhao, C. (2020). Clinical characteristics of 3062 COVID-19 patients: A meta-analysis. *Journal of Medical Virology*, 92(10). 1902-1914. <https://doi.org/10.1002/jmv.25884>

Zuschlag, D., Grandt, D., Custodis, F., Braun, C., & Hauser, W. (2022). Spontaneously reported persistent symptoms related to coronavirus disease 2019 one year after hospital discharge: A retrospective cohort single-center study. *Schmerz*, 36(5), 315-325. <https://doi.org/10.1007/s00482-022-00626-0>

Appendix A

Search Concept Map

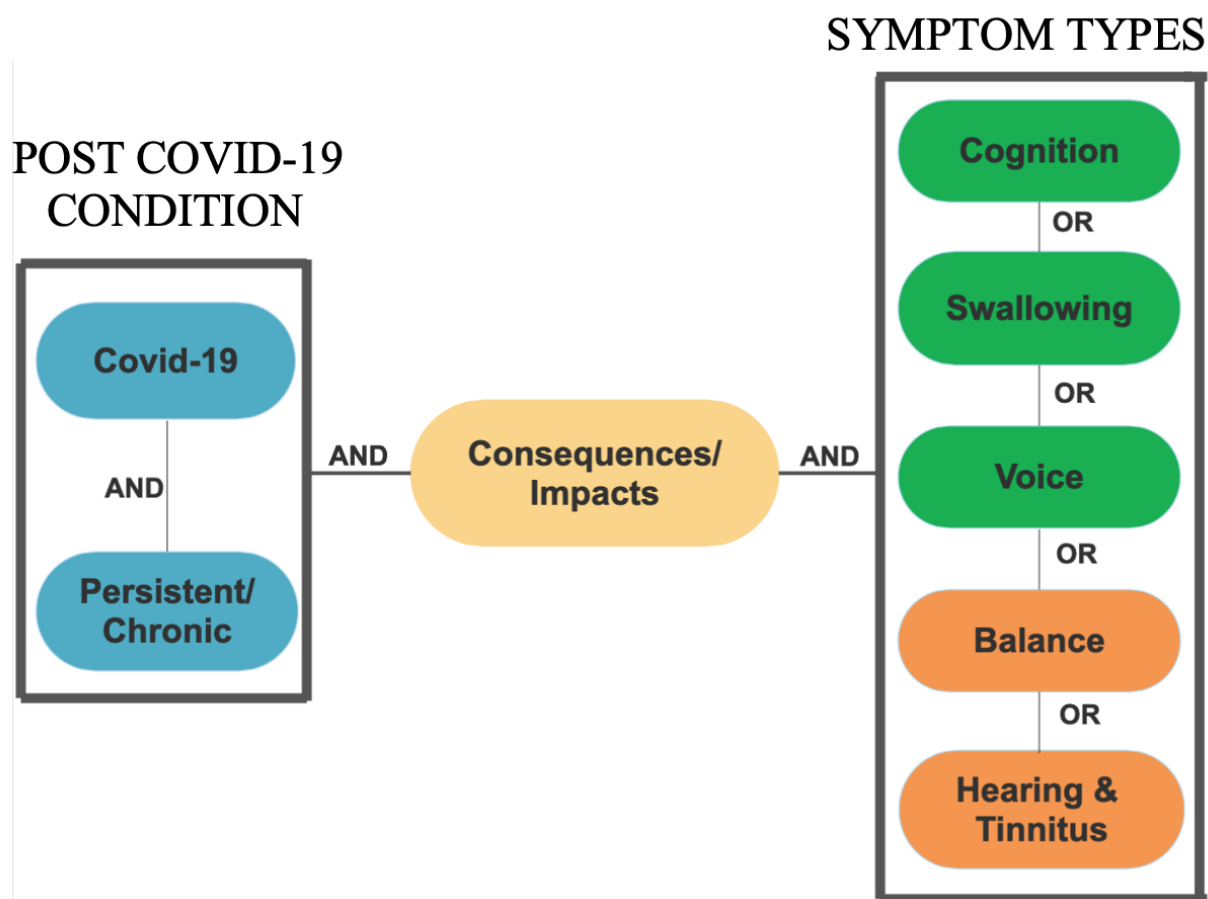


Figure A1. Search concept map.

Appendix B

Search Strategy

Databases

MEDLINE
Embase
Emcare

Filters

Publication year: December 31, 2019 to present
Publication language: English
Population: Adults (ages 18+)

Search Blocks

1. COVID-19:
"COVID-19.tw" OR "COVID.tw" OR "SARS-CoV-2.tw" OR severe acute respiratory syndrome coronavirus.tw" OR "coronavirus.tw"
2. Persistent/chronic:
"long*.tw" OR "post.tw" OR "persist*.tw" OR "chronic.tw" OR "long-term.tw" OR "post-acute.tw" OR "long-haul*.tw" OR "long-post.tw" OR "ongoing.tw"
3. Consequences/impacts:
"impact*.tw" OR "dysfunction*.tw" OR "sequela*.tw" OR "impair*.tw" OR "consequen*.tw" OR "disorder*.tw" OR "symptom*.tw" OR "syndrom*.tw" OR "deficit*.tw" OR "effect*.tw" OR "condition.tw" OR "complication*.tw" OR "disease.tw" OR "difficult*.tw"
4. Cognition:
"cognit*.tw" OR "executive funct*.tw" OR "memory.tw" OR "attention.tw" OR "planning.tw" OR "brain fog.tw" OR "forgetful*.tw" OR "concentrat*.tw"
5. Swallowing:
"swallow*.tw" OR "dysphagia.tw" OR "oropharyngeal.tw" OR aspirat*.tw" OR deglut*.tw"
6. Voice:
"voice.tw" OR "dysphonia.tw" OR "hoarse.tw" OR "upper aero*.tw" OR "airway.tw" OR "laryn*.tw" OR "vocal*.tw"
7. Balance:
"vertigo.tw" OR "dizz*.tw" OR "balanc*.tw" OR "otolog*.tw" OR "vestibul*.tw" OR "cochlea*.tw"
8. Hearing & tinnitus:
"hear.tw" OR "hearing.tw" OR "tinnitus.tw" OR "auditory.tw" OR "audition.tw" OR "aural.tw" OR "ear.tw" OR "ears.tw"

1 AND 2 AND 3 AND [4 OR 5 OR 6 OR 7 OR 8]

Appendix C

Data Extraction Tables

Table 1

Prevalence studies extraction.

		Prevalence							Quality of Life and Functional Impacts
Author(s), year	Background (Aim, Study Design)	Voice/ Speech	Swallowing	Cognitive	Language	Hearing	Tinnitus	Balance	

Table 2

Symptom assessment/impact studies extraction.

Domain	Sub-Domain(s)	Significant Results	Non-Significant Results
<i>Speech-Language Pathology</i>			
Fluency disorders, including stuttering	—		
Voice and resonance disorders	—		
Swallowing disorders	—		
Cognitive-communication/linguistic disorders, including social communication skills, reasoning, problem-solving, and executive functions	General cognitive ability		
	Self-regulation/control functions (i.e., executive functions)		
	Processing speed		
	Attention		
	Working memory		
	General memory performance		
	Reasoning		
	Social cognition (e.g., face and emotion perception, attribution, Theory of Mind, empathy)		
	Verbal fluency		

Language	Word-finding		
<i>Audiology</i>			
Hearing disorders, involving both peripheral and central pathways of hearing	—		
Tinnitus	—		
Balance/vestibular disorders, including dizziness or vertigo (related term: vestibular neuritis)	—		
<i>Psychosocial and Functional Impacts</i>			
Psychological/ mental health impacts	—		
Psychosocial/ Quality of Life	—		
Activities of Daily Living (e.g., school, work, etc.)	—		

Appendix D

PRISMA Flow Diagram

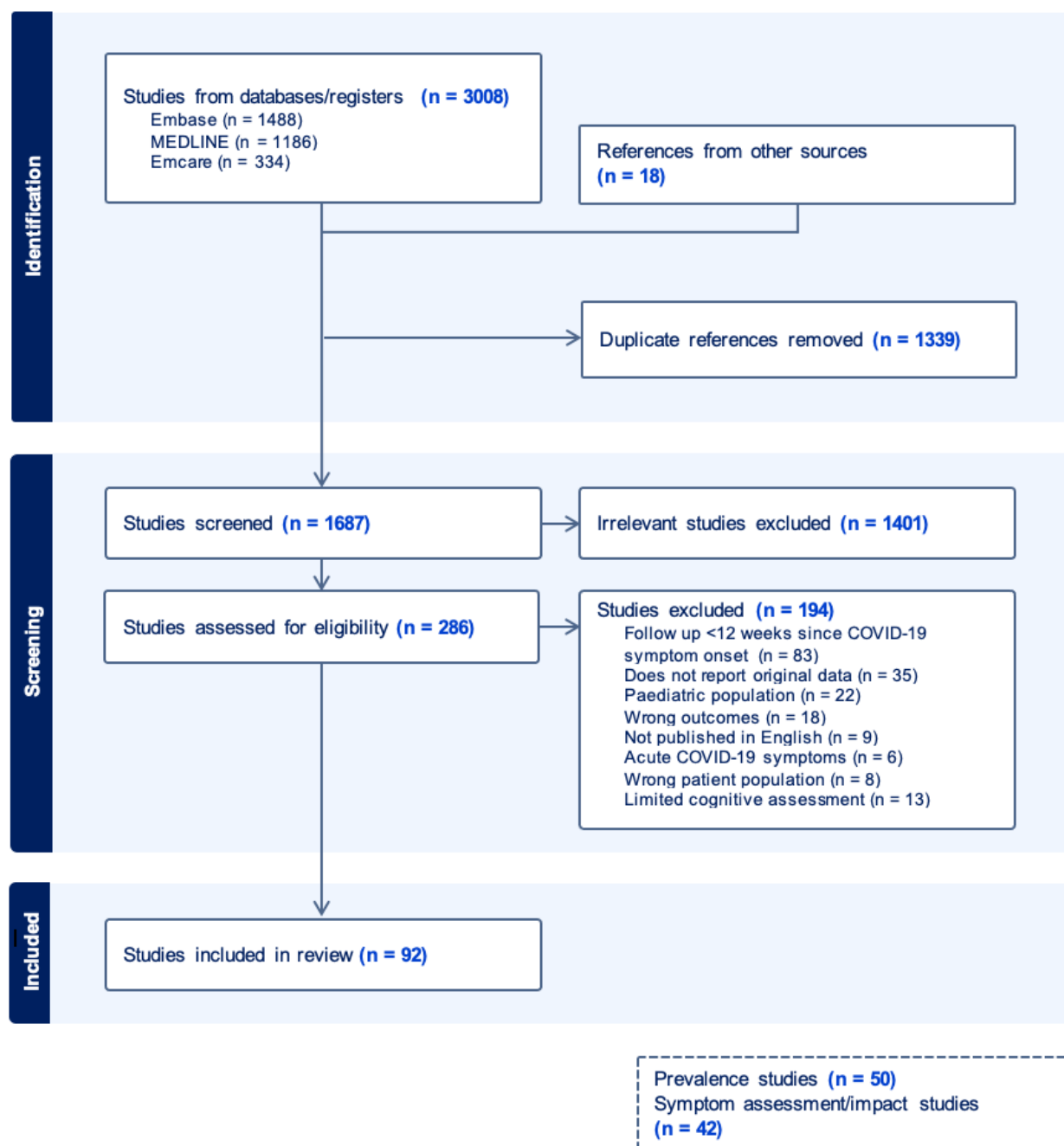


Figure D1. PRISMA flow diagram.

Appendix E

Inter-rater Reliability

Table 3

Cohen's kappa coefficient and interpretation at each stage of the study screening process.

Pair of Reviewers	Cohen's Kappa Coefficient	Interpretation (McHugh et al., 2012)
<i>Title and Abstract Screen</i>		
Reviewers A & B	0.55	moderate
Reviewers B & C	0.56	moderate
Reviewers A & C	0.90	almost perfect
<i>Full-text Screen</i>		
Reviewers A & B	0.61	substantial
Reviewers B & C	0.50	moderate
Reviewers A & C	0.75	substantial

Appendix F

Symptom Prevalence

Table 4

Prevalence ranges of S-LP and audiology symptoms of PCC.

Clinical Area	Symptom	Prevalence Range	Prevalence Studies
<i>Speech-Language Pathology</i>			
Voice	Hoarseness	13.3 - 25.9%	Bek et al., 2021; Peter et al., 2022
	Dysphonia	Up to 33.0%	Wahlgren et al., 2023
Swallowing	Swallowing difficulties	0.6 - 21.0%	Han et al., 2022; Kintrilis et al., 2023; Munblit et al., 2021; Wahlgren et al., 2023
Cognition & Cognitive-Communication	Overall cognitive impairment/brain fog	2.6 - 85.0%	Asadi-Pooya et al., 2022; Caspersen et al., 2022; Castro et al., 2022; Chudzik et al., 2022; Dennis et al., 2022; Fernandez-de-las-Penas et al., 2022a; Fernandez-de-las-Penas et al., 2022b; Fernandez-de-las-Penas et al., 2022c; Goldhaber et al., 2022; Ho et al., 2023; Holdsworth et al., 2022; Jain et al., 2023; Moy et al., 2022; Perez-Gonzalez et al., 2022; Peter et al., 2022; Sivan et al., 2022; Staudt et al., 2022; Zuschlag et al., 2022
	Memory problems	3.3 - 73.5%	Agergaard et al., 2022; Akova & Gedikli, 2022; Anaya et al., 2021; Bek et al., 2021; Bernas et al., 2022; Caspersen et al., 2022; Castro et al., 2022; da Costa e Silva et al., 2023; Desgranges et al., 2022; Fernandez-de-las-Penas et al., 2022a; Fernandez-de-las-Penas et al., 2022b; Fernandez-de-las-Penas et al., 2022c; Grisanti et al., 2022; Han et al., 2022; Ho et al., 2023; Holdsworth et al., 2022; Imoto et al., 2022; Jacobs et al., 2023; Jain et al., 2023; Kaplan et al., 2022; Kintrilis et al., 2023; Lapa et al., 2023; Mirfazeli et al., 2022; Munblit et al., 2021; Nehme et al., 2022a; Oliveira et al., 2023; Soh & Cho 2022; Tawfik et al., 2021; Wahlgren et al., 2023
	Attention/concentration difficulties	Up to 38.0%	Agergaard et al., 2022; Akova & Gedikli, 2022; Anaya et al., 2021; Becker et al., 2021; Bek et al., 2021; Bernas et al., 2022; Dryden et al., 2022; Faghy et al., 2022; Fernandez-de-las-Penas et al., 2022a; Fernandez-de-las-Penas et al., 2022b; Fernandez-de-las-Penas et al., 2022c; Forster et al., 2022; Gorelik et al., 2023; Han et al., 2022; Ho et al., 2023; Holdsworth et al., 2022; Imoto et al., 2022; Kaplan et al., 2022; Kintrilis et al., 2023; Lapa et al., 2023; Mirfazeli et al., 2022; Munblit et al., 2021; Nehme et al., 2022a;

Clinical Area	Symptom	Prevalence Range	Prevalence Studies
			Oliveira et al., 2023; Seeble et al., 2022; Wahlgren et al., 2023
	Mental fatigue/ exhaustion	6.9 - 65.0%	Nehme et al., 2022a; Wahlgren et al., 2023
	Word-finding challenges	32.3 - 48.0%	Seeble et al., 2022; Wahlgren et al., 2023
	Expressive language difficulties	Up to 38.0%	Castro et al., 2022; Shanbehzadeh et al., 2023; Wahlgren et al., 2023
	Receptive language difficulties	16.0 - 27.0%	Jacobs et al., 2023; Shanbehzadeh et al., 2023; Wahlgren et al., 2023
<i>Audiology</i>			
Central & Peripheral Hearing	Hearing loss	7.5 - 19.6%	Bek et al., 2021; Mirfazeli et al., 2022
Tinnitus	Tinnitus	7.5 - 30.6%	Anaya et al., 2021; Degen et al., 2022b; Mirfazeli et al., 2022
Balance & Vestibular Function	Vertigo	0.6 - 16.7%	Bernas et al., 2022; Degen et al., 2022b; Forster et al., 2022; Gorelik et al., 2023; Mirfazeli et al., 2022; Nehme et al., 2022a; Perna et al., 2022; Seeble et al., 2022; Staudt et al., 2022; Tawfik et al., 2021; Zuschlag et al., 2022
	Dizziness	0.1 - 44.4%	Agergaard et al., 2022; Anaya et al., 2021; Bek et al., 2021; Caspersen et al., 2022; Degen et al., 2022b; Desgranges et al., 2022; Dryden et al., 2022; Han et al., 2022; Ho et al., 2023; Holdsworth et al., 2022; Imoto et al., 2022; Mirfazeli et al., 2022; Moy et al., 2022; Munblit et al., 2021; Nehme et al., 2022a; Peter et al., 2022; Shivani et al., 2022; Soh & Cho 2022; Taufik et al., 2021; Wahlgren et al., 2023

Appendix G

Distribution of Evidence for S-LP and Audiology Areas of Practice

Table 5

Distribution of symptom assessment/impact studies for S-LP and audiology areas of practice.

Clinical Area	Number of Articles	Symptom Assessment/Impact Studies
<i>Speech-Language Pathology</i>		
Voice	4	An et al., 2022; Bouldin et al., 2023; Jeleniewska et al., 2022; Krasnodębska et al., 2022
Swallowing	2	Bouldin et al., 2023; Shah et al., 2022
Cognition & Cognitive-Communication	26	Abelmagid et al., 2022; Albu et al., 2021; Ariza et al., 2022; Ariza et al., 2023; Azcune et al., 2022; Birberg Thornberg et al., 2022; Braga et al., 2022; Cummings et al., 2022a; Cummings et al., 2022b; Cummings et al., 2022c; Cummings et al., 2022d; Cummings et al., 2022e; Delgado-Alonso et al., 2022a; Delgado-Alonso et al., 2022b; Dressing et al., 2022; Garcia-Molina et al., 2022; Garcia-Sanchez et al., 2022; Guo et al., 2022; Holdsworth et al., 2022; Llana et al., 2022; Loft et al., 2022; Matias-Guiu et al., 2023; Norrefalk et al., 2021; Schaap et al., 2022; Schlid et al., 2023; Whiteside et al., 2022
Fluency	1	Furlanis et al., 2023
<i>Audiology</i>		
Central & Peripheral Hearing	5	Alexander et al., 2022; Andreeva et al., 2023; Degen et al., 2022a; Ludwig et al., 2022; Thrane et al., 2022
Tinnitus	3	Degen et al., 2022b; Ludwig et al., 2022; Thrane et al., 2022
Balance & Vestibular Function	5	Andreeva et al., 2023; Degen et al., 2022b; Grach et al., 2022; Ludwig et al., 2022; Zaubitzer et al., 2023

Appendix H

Quality of Life and Functional Impacts

Table 6

Prevalence ranges of quality of life and functional impacts of PCC.

	Impact	Prevalence Range	Prevalence Studies
Psychological/ Mental Health	Anxiety	0.6 - 90.0%	Agergaard et al., 2022; Akova & Gedikli, 2022; Becker et al., 2021; Bek et al., 2021; Bernas et al., 2022; Caspersen et al., 2022; Castro et al., 2022; Fernandez-de-las-Penas et al., 2022b; Han et al., 2022; Ho et al., 2023; Holdsworth et al., 2022; Mirfazeli et al., 2022; Moy et al., 2022; Munblit et al., 2021; Peter et al., 2022; Sivan et al., 2022; Soh & Cho 2022; Wahlgren et al., 2023; Zuschlag et al., 2022
	Depression	0.6 - 40.0%	Agergaard et al., 2022; Akova & Gedikli, 2022; Anaya et al., 2021; Becker et al., 2021; Bernas et al., 2022; Caspersen et al., 2022; Fernandez-de-las-Penas et al., 2022b; Forster et al., 2022; Han et al., 2022; Ho et al., 2023; Holdsworth et al., 2022; Kintrilis et al., 2023; Lapa et al., 2023; Mirfazeli et al., 2022; Moy et al., 2022; Munblit et al., 2021; Peter et al., 2022; Wahlgren et al., 2023; Zuschlag et al., 2022
	Post-traumatic stress disorder	1.2 - 13.0%	Becker et al., 2021; Holdsworth et al., 2022; Zuschlag et al., 2022
Psychosocial/ Quality of Life	Poor health-related quality of life	20.4 - 57.0%	Agergaard et al., 2022; Akova & Gedikli, 2022; Becker et al., 2021; Dennis et al., 2022; Soh & Cho 2022
Activities of Daily Living (e.g., school, work, etc.)	Difficulty completing usual activities (e.g., work, study, housework, leisure activities, etc.)	13.6 - 93.0%	Dryden et al., 2022; Faghy et al., 2022; Goldhaber et al., 2022; Moy et al., 2022; Nehme et al., 2022a; Nehme et al., 2022b; Shanbehzadeh et al., 2023; Wahlgren et al., 2023
	Problems with self-care	4.6 - 24.0 %	Dryden et al., 2022; Faghy et al., 2022