

Oral Lesions Associated with Long COVID: A Scoping Review



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Abstract

Objective: This scoping review aimed to address the question: "What are the scientific evidences regarding the diagnosis, management, and prognosis of oral lesions in patients with Long COVID?" **Materials and Methods:** This investigation followed the PRISMA Extension for Scoping Reviews (PRISMA-ScR) guidelines as proposed in the Joanna Briggs Institute (JBI) Manual. The research protocol was registered on the Open Science Framework (OSF) to facilitate open collaboration in scientific research. **Results:** The review highlighted a variety of oral lesions in Long COVID patients, including ulcers, leukoplakia, and fungal infections. Patients with Long COVID experience a diverse range of symptoms persisting weeks or months after the initial SARS-CoV-2 infection, such as fatigue, shortness of breath, chest pain, and neurocognitive dysfunctions. Oral symptoms include ulcers, throat inflammation, fungal infections, dry mouth, and loss of taste. **Conclusions:** These findings underscore the importance of an integrated approach in diagnosing and treating oral manifestations in Long COVID patients, contributing to the development of more effective clinical practices and guiding future research in this emerging field..

Keywords: Evidence-based health; Oral manifestations; Post-Covid Syndrome; Covid 19; Symptoms; Dentistry

Abbreviations: JBI: Joanna Briggs Institute; OSF: Open Science Framework; PHEIC: Public Health Emergency of International Concern; WHO: World Health Organization; LILACS: Latin American and Caribbean Health Sciences Literature; MeSH: Medical Subject Headings; ARB: Angiotensin Receptor Blockers; ACE: Angiotensin-Converting Enzyme

Introduction

The Covid-19 pandemic posed a significant challenge to public health worldwide. On May 5, 2023, during an Emergency Committee meeting in Geneva, Switzerland, the World Health Organization (WHO) declared the end of the Public Health Emergency of International Concern (PHEIC) related to Covid-19. The Committee highlighted that the decline in hospitalizations and intensive care unit admissions related to the disease, as well as the population's immunization through vaccines, marked the end of the pandemic status [1]. With the emergence of the novel coronavirus SARS-CoV-2, there was a substantial increase in primary and secondary publications due to researchers' efforts to address the lack of information about the new disease affecting the world. Although the scientific community has been successful in controlling the spread of this pathogen, there are still patients experiencing its sequelae [2]. Cases of Covid-19 with more prolonged symptoms have been increasingly reported in the literature [3,4]. Long Covid Syndrome, also known as Post-Covid Syndrome, is a

set of symptoms that persist for more than three months after SARS-CoV-2 infection, even in patients who had mild or asymptomatic cases.

There is still no clear and consensual definition for the syndrome, but recent studies suggest it can affect up to 50% of patients infected with the virus [5]. Various studies have reported the presence of oral lesions in Covid-19 patients, including ulcerations, oropharyngeal inflammations, retromandibular edemas, fungal infections, xerostomia, anosmia, and ageusia [6,7]. Although these manifestations have been described in the literature, there is a lack of clinical guidelines addressing the specific oral conditions of patients with Long Covid, including appropriate treatment information, the healthcare professionals involved, and situations, if applicable, that require referral to specialists [8]. There are also studies in the literature describing multisystemic symptoms in Long Covid, involving various organ systems such as

cardiovascular, respiratory, and digestive (including the mouth) [9,10]. Thus, secondary studies like scoping reviews can track articles with various methodological designs that have described oral lesions associated with Long Covid. Additionally, scoping reviews are essential for identifying gaps in the existing literature and understanding research trends in a specific field of knowledge [11]. Therefore, the objective was to survey the main oral lesions in patients affected by Long Covid based on scientific publications and identify the main clinical approaches and gaps observed in published studies on oral manifestations in Long Covid patients.

Material & Methods

This work was registered on the Open Science Framework (OSF) and used the PCC strategy, Population, Concept, and Context, to construct the research question. In this case, P = Patients with Long Covid; C = Oral lesions; C = Diagnosis, management, and prognosis. Based on these definitions, the guiding question was established: “What are the scientific evidence regarding the diagnosis, management, and prognosis of oral lesions in patients with Long Covid?” A survey of works published between 2020

and 2023 was conducted in the following databases: MEDLINE/ Pubmed, Web of Science, Embase, Scopus, Latin American and Caribbean Health Sciences Literature (LILACS), Cochrane Library, Epistemonikos, and Litcovid. The search equation was constructed with keywords and DEC’s (Health Sciences Descriptors) and MeSH (Medical Subject Headings) descriptors adapted for each database, using Boolean operators AND and OR (Table 1) Inclusion and Exclusion Criteria Primary and secondary studies without date restrictions were included to cover a broader range of studies on the main topic. Narrative or integrative reviews, letters to the editor, and articles in press were excluded. The reference list was managed using the Rayyan software. After eliminating duplicates, a preliminary selection was made by reading titles and abstracts. Both in the first and second phases, discrepancies in eligibility criteria were resolved among the reviewers during both processes. To improve the methodological rigor of the research, data extraction was performed by two blinded and independent reviewers, using the blinding option of the Rayyan tool [12]. The findings were presented according to the ‘Preferred Reporting Items for Systematic Reviews and Meta-Analyses: extension for scoping reviews’ checklist.

Table 1: Search Strategy.

Database	Search Strategy	Results Jan 29th 2024
Medline / PubMed	(«post acute covid 19 syndrome»[MeSH Terms] OR «post acute covid 19 syndrome»[All Fields] OR «Post-Acute COVID-19 Syndromes»[All Fields] OR «long haul covid»[All Fields] OR «long haul covid»[All Fields] OR «long haul covid 19»[All Fields] OR «long haul covid 19»[All Fields] OR «post acute sequelae of covid 19»[All Fields] OR «post acute sequelae of covid 19»[All Fields] OR «post acute sequelae of sars cov 2 infection»[All Fields] OR «post acute sequelae of sars cov 2 infection»[All Fields] OR «COVID-19 Post-Acute Sequelae»[All Fields] OR «post covid conditions»[All Fields] OR «post covid conditions»[All Fields] OR «Post-COVID Condition»[All Fields] OR «Long COVID»[All Fields] OR «pasc post acute sequelae of covid 19»[All Fields] OR «pasc post acute sequelae of covid 19»[All Fields] OR «post acute covid 19 syndrome»[All Fields]) AND («Oral Manifestations»[MeSH Terms] OR «Oral Manifestations»[All Fields] OR «Oral Manifestation»[All Fields] OR «oral lesions»[All Fields] OR ((«Disease»[MeSH Terms] OR «Disease»[Title/Abstract] OR «diseases»[Title/Abstract] OR «disorders»[All Fields] OR «disorder»[All Fields] OR «Wounds and Injuries»[MeSH Terms] OR «injury»[All Fields] OR «injurie»[All Fields] OR «injuried»[All Fields] OR «injuries»[All Fields] OR «injurys»[All Fields] OR «injured»[All Fields] OR «wounds»[All Fields] OR «wound»[All Fields] OR «lesion»[All Fields] OR «lesions»[All Fields] OR «lesional»[All Fields] OR «Trauma»[All Fields] OR «Traumas»[All Fields] OR «Pathology»[All Fields] OR «Pathologies»[All Fields]) AND («oral»[All Fields] OR «Mouth»[All Fields] OR «buccal»[All Fields] OR «Mouth»[MeSH Terms] OR «dental»[All Fields] OR «Tooth»[MeSH Terms] OR «Tooth»[All Fields] OR «Teeth»[All Fields])) OR «Mouth Diseases»[MeSH Terms] OR «Mouth Diseases»[All Fields] OR «Mouth Disease»[All Fields] OR «oral diseases»[All Fields] OR «oral disease»[All Fields] OR «pathology, oral»[MeSH Terms] OR «Oral Pathology»[All Fields] OR «Oral and Maxillofacial Pathology»[All Fields] OR «Maxillofacial Pathology»[All Fields] OR «Oral Health»[MeSH Terms] OR «Oral Health»[All Fields] OR «Dentistry»[MeSH Terms] OR «Dentistry»[All Fields] OR «dental»[All Fields] OR «dentally»[All Fields] OR «dentals»[All Fields] OR «Mouth»[MeSH Terms] OR «Mouth»[Title/Abstract] OR «Oral Cavity»[All Fields] OR «Cavitas Oris»[All Fields] OR «Vestibule of the Mouth»[All Fields] OR «Oral Cavity Proper»[All Fields] OR «Cavitas oris propria»[All Fields])	240

Embase	(‘long COVID’/exp OR ‘post acute covid 19 syndrome’ OR ‘post acute covid 19 syndrome’ OR ‘post-acute covid-19 syndromes’ OR ‘long haul covid’ OR ‘long haul covid’ OR ‘long haul covid 19’ OR ‘long haul covid 19’ OR ‘post acute sequelae of covid 19’ OR ‘post acute sequelae of covid 19’ OR ‘post acute sequelae of sars cov 2 infection’ OR ‘post acute sequelae of sars cov 2 infection’ OR ‘covid-19 post-acute sequelae’ OR ‘post covid conditions’ OR ‘post covid conditions’ OR ‘post-covid condition’ OR ‘long covid’ OR ‘pasc post acute sequelae of covid 19’ OR ‘pasc post acute sequelae of covid 19’ OR ‘post acute covid 19 syndrome’ OR ‘long-haul covid’ OR ‘long haul covid-19s’) AND (‘mouth disease’/exp OR ‘oral manifestations’ OR ‘oral manifestation’ OR ‘oral lesions’ OR ‘oral lesions’ OR ‘diseases’/exp OR ‘disease’:ti,ab,kw OR ‘diseases’:ti,ab,kw OR ‘disorders’ OR ‘disorder’ OR ‘wound’/exp OR ‘injury’/exp OR ‘injury’ OR ‘injurie’ OR ‘injured’ OR ‘injuries’ OR ‘injurys’ OR ‘injured’ OR ‘wounds’ OR ‘wound’ OR ‘lesion’ OR ‘lesions’ OR ‘lesional’ OR ‘trauma’ OR ‘traumas’ OR ‘pathology’ OR ‘pathologies’) AND (‘oral’ OR ‘mouth’ OR ‘buccal’ OR ‘mouth’/exp OR ‘dental’ OR ‘tooth’/exp OR ‘tooth’ OR ‘teeth’)) OR ‘mouth disease’/exp OR ‘mouth diseases’ OR ‘mouth disease’ OR ‘oral diseases’ OR ‘oral disease’ OR ‘oral pathology’ OR ‘maxillofacial pathology’ OR ‘oral health’ OR ‘dentistry’/exp OR ‘dentistry’ OR ‘dental’ OR ‘dentally’ OR ‘dentals’ OR ‘mouth’/exp OR ‘mouth’:ti,ab,kw OR ‘oral cavity’ OR ‘cavitas oris’ OR ‘vestibule of the mouth’ OR ‘oral cavity proper’ OR ‘cavitas oris propria’)	603
Scopus	TITLE-ABS-KEY(«post acute covid 19 syndrome» OR «post acute covid 19 syndrome» OR «Post-Acute COVID-19 Syndromes» OR «long haul covid» OR «long haul covid» OR «long haul covid 19» OR «long haul covid 19» OR «post acute sequelae of covid 19» OR «post acute sequelae of covid 19» OR «post acute sequelae of sars cov 2 infection» OR «post acute sequelae of sars cov 2 infection» OR «COVID-19 Post-Acute Sequelae» OR «post covid conditions» OR «post covid conditions» OR «Post-COVID Condition» OR «Long COVID» OR «pasc post acute sequelae of covid 19» OR «pasc post acute sequelae of covid 19» OR «post acute covid 19 syndrome») AND TITLE-ABS-KEY(«Oral Manifestations» OR «Oral Manifestation» OR «oral lesions» OR «oral lesions» OR «Disease OR diseases OR disorders OR disorder OR injury OR injurie OR injured OR injuries OR injurys OR injured OR wounds OR wound OR lesion OR lesions OR lesional OR Trauma OR Traumas OR Pathology OR Pathologies) AND (oral OR Mouth OR buccal OR dental OR Tooth OR Teeth)) OR «Mouth Diseases» OR «Mouth Disease» OR «oral diseases» OR «oral disease» OR «Oral Pathology» OR «Oral and Maxillofacial Pathology» OR «Maxillofacial Pathology» OR «Oral Health» OR Dentistry OR dental OR dentally OR dentals OR Mouth OR «Oral Cavity» OR «Cavitas Oris» OR «Vestibule of the Mouth» OR «Oral Cavity Proper» OR «Cavitas oris propria»)	163
Web of Science	TS=(«post acute covid 19 syndrome» OR «post acute covid 19 syndrome» OR «Post-Acute COVID-19 Syndromes» OR «long haul covid» OR «long haul covid» OR «long haul covid 19» OR «long haul covid 19» OR «post acute sequelae of covid 19» OR «post acute sequelae of covid 19» OR «post acute sequelae of sars cov 2 infection» OR «post acute sequelae of sars cov 2 infection» OR «COVID-19 Post-Acute Sequelae» OR «post covid conditions» OR «post covid conditions» OR «Post-COVID Condition» OR «Long COVID» OR «pasc post acute sequelae of covid 19» OR «pasc post acute sequelae of covid 19» OR «post acute covid 19 syndrome») AND TS=(«Oral Manifestations» OR «Oral Manifestation» OR «oral lesions» OR «oral lesions» OR «Disease OR diseases OR disorders OR disorder OR injury OR injurie OR injured OR injuries OR injurys OR injured OR wounds OR wound OR lesion OR lesions OR lesional OR Trauma OR Traumas OR Pathology OR Pathologies) AND (oral OR Mouth OR buccal OR dental OR Tooth OR Teeth)) OR «Mouth Diseases» OR «Mouth Disease» OR «oral diseases» OR «oral disease» OR «Oral Pathology» OR «Oral and Maxillofacial Pathology» OR «Maxillofacial Pathology» OR «Oral Health» OR Dentistry OR dental OR dentally OR dentals OR Mouth OR «Oral Cavity» OR «Cavitas Oris» OR «Vestibule of the Mouth» OR «Oral Cavity Proper» OR «Cavitas oris propria»)	69
Cochrane Library	(«post acute covid 19 syndrome» OR «post acute covid 19 syndrome» OR «Post-Acute COVID-19 Syndromes» OR «long haul covid» OR «long haul covid» OR «long haul covid 19» OR «long haul covid 19» OR «post acute sequelae of covid 19» OR «post acute sequelae of covid 19» OR «post acute sequelae of sars cov 2 infection» OR «post acute sequelae of sars cov 2 infection» OR «COVID-19 Post-Acute Sequelae» OR «post covid conditions» OR «post covid conditions» OR «Post-COVID Condition» OR «Long COVID» OR «pasc post acute sequelae of covid 19» OR «pasc post acute sequelae of covid 19» OR «post acute covid 19 syndrome»):ti,ab,kw AND («Oral Manifestations» OR «Oral Manifestation» OR «oral lesions» OR «oral lesions» OR «Disease OR diseases OR disorders OR disorder OR injury OR injurie OR injured OR injuries OR injurys OR injured OR wounds OR wound OR lesion OR lesions OR lesional OR Trauma OR Traumas OR Pathology OR Pathologies) AND (oral OR Mouth OR buccal OR dental OR Tooth OR Teeth)) OR «Mouth Diseases» OR «Mouth Disease» OR «oral diseases» OR «oral disease» OR «Oral Pathology» OR «Oral and Maxillofacial Pathology» OR «Maxillofacial Pathology» OR «Oral Health» OR Dentistry OR dental OR dentally OR dentals OR Mouth OR «Oral Cavity» OR «Cavitas Oris» OR «Vestibule of the Mouth» OR «Oral Cavity Proper» OR «Cavitas oris propria»):ti,ab,kw	25

LILACS	(«post acute covid 19 syndrome» OR «post acute covid 19 syndrome» OR «Post-Acute COVID-19 Syndromes» OR «long haul covid» OR «long haul covid» OR «long haul covid 19» OR «long haul covid 19» OR «post acute sequelae of covid 19» OR «post acute sequelae of covid 19» OR «post acute sequelae of sars cov 2 infection» OR «post acute sequelae of sars cov 2 infection» OR «COVID-19 Post-Acute Sequelae» OR «post covid conditions» OR «post covid conditions» OR «Post-COVID Condition» OR «Long COVID» OR «pasc post acute sequelae of covid 19» OR «pasc post acute sequelae of covid 19» OR «post acute covid 19 syndrome» OR «Síndrome Pós-COVID-19 Aguda» OR «Afeções Pós-COVID» OR «COVID Longa» OR «COVID de Longo Curso» OR «Sequela Pós-Infecção por SARS-CoV-2 Aguda» OR «Síndrome Post Agudo de COVID-19» OR «COVID Largo» OR «COVID-19 de Largo Plazo» OR «Condiciones Post-COVID» OR «Covid de Largo Plazo» OR «Secuela Post Aguda de la Infección por SARS-CoV-2» OR «Síndrome Posagudo de COVID-19» OR «síndrome de COVID-19 postagudo» OR «COVID persistente» OR «COVID prolongado» OR «COVID-19 persistente» OR «secuelas postagudas de la infección por el SARS-CoV-2» OR «trastornos post-COVID») AND («Oral Manifestations» OR «Oral Manifestation» OR «oral lesions» OR «(disease OR diseases OR disorders OR disorder OR injury OR injurie OR injured OR injuries OR injurys OR injured OR wounds OR wound OR lesion OR lesions OR lesional OR trauma OR traumas OR pathology OR pathologies) AND (oral OR mouth OR buccal OR dental OR tooth OR teeth)» OR «Mouth Diseases» OR «Mouth Disease» OR «oral diseases» OR «oral disease» OR «Oral Pathology» OR «Oral and Maxillofacial Pathology» OR «Maxillofacial Pathology» OR «Oral Health» OR dentistry OR dental OR dentally OR dentals OR mouth OR «Oral Cavity» OR «Cavitas Oris» OR «Vestibule of the Mouth» OR «Oral Cavity Proper» OR «Cavitas oris propria» OR tooth OR teeth OR «Manifestações Bucais» OR «Manifestações Estomatológicas» OR «Manifestações Oraís» OR «Manifestaciones Bucales» OR «manifestaciones orales» OR «lesões orais» OR «lesões bucais» OR «ferimentos orais» OR «lesiones orales» OR «lesiones bucales» OR «(boca OR «Cavidade Bucal» OR «Cavidade Oral» OR «Cavidad Bucal» OR «Cavidad Oral») AND (lesão OR lesões OR ferimento OR ferimentos OR lesión OR lesiones)» OR «Doenças da Boca» OR «Doenças Bucais» OR «Enfermedades de la Boca» OR «Enfermedades Bucales» OR «enfermedades de la boca» OR «Patologia Bucal» OR «Saúde Bucal» OR «Salud Bucal» OR odontologia OR dentística OR boca OR «Cavidade Bucal» OR «Cavidade Oral» OR «Cavidad Bucal» OR «Cavidad Oral»)	162
ProQuest Dissertations & Theses Global (PQDT Global)	noft(«post acute covid 19 syndrome» OR «post acute covid 19 syndrome» OR «Post-Acute COVID-19 Syndromes» OR «long haul covid» OR «long haul covid» OR «long haul covid 19» OR «long haul covid 19» OR «post acute sequelae of covid 19» OR «post acute sequelae of covid 19» OR «post acute sequelae of sars cov 2 infection» OR «post acute sequelae of sars cov 2 infection» OR «COVID-19 Post-Acute Sequelae» OR «post covid conditions» OR «post covid conditions» OR «Post-COVID Condition» OR «Long COVID» OR «pasc post acute sequelae of covid 19» OR «pasc post acute sequelae of covid 19» OR «post acute covid 19 syndrome») AND noft(«Oral Manifestations» OR «Oral Manifestation» OR «oral lesions» OR «(Disease OR diseases OR disorders OR disorder OR injury OR injurie OR injured OR injuries OR injurys OR injured OR wounds OR wound OR lesion OR lesions OR lesional OR Trauma OR Traumas OR Pathology OR Pathologies) AND (oral OR Mouth OR buccal OR dental OR Tooth OR Teeth)» OR «Mouth Diseases» OR «Mouth Disease» OR «oral diseases» OR «oral disease» OR «Oral Pathology» OR «Oral and Maxillofacial Pathology» OR «Maxillofacial Pathology» OR «Oral Health» OR Dentistry OR dental OR dentally OR dentals OR Mouth OR «Oral Cavity» OR «Cavitas Oris» OR «Vestibule of the Mouth» OR «Oral Cavity Proper» OR «Cavitas oris propria» OR Tooth OR Teeth)	3
Epistemonikos	(«post acute covid 19 syndrome» OR «post acute covid 19 syndrome» OR «Post-Acute COVID-19 Syndromes» OR «long haul covid» OR «long haul covid» OR «long haul covid 19» OR «long haul covid 19» OR «post acute sequelae of covid 19» OR «post acute sequelae of covid 19» OR «post acute sequelae of sars cov 2 infection» OR «post acute sequelae of sars cov 2 infection» OR «COVID-19 Post-Acute Sequelae» OR «post covid conditions» OR «post covid conditions» OR «Post-COVID Condition» OR «Long COVID» OR «pasc post acute sequelae of covid 19» OR «pasc post acute sequelae of covid 19» OR «post acute covid 19 syndrome») AND («Oral Manifestations» OR «Oral Manifestation» OR «oral lesions» OR «(Disease OR diseases OR disorders OR disorder OR injury OR injurie OR injured OR injuries OR injurys OR injured OR wounds OR wound OR lesion OR lesions OR lesional OR Trauma OR Traumas OR Pathology OR Pathologies) AND (oral OR Mouth OR buccal OR dental OR Tooth OR Teeth)» OR «Mouth Diseases» OR «Mouth Disease» OR «oral diseases» OR «oral disease» OR «Oral Pathology» OR «Oral and Maxillofacial Pathology» OR «Maxillofacial Pathology» OR «Oral Health» OR Dentistry OR dental OR dentally OR dentals OR Mouth OR «Oral Cavity» OR «Cavitas Oris» OR «Vestibule of the Mouth» OR «Oral Cavity Proper» OR «Cavitas oris propria»)	52

LitCovid	(«post acute covid 19 syndrome» OR «post acute covid 19 syndrome» OR «Post-Acute COVID-19 Syndromes» OR «long haul covid» OR «long haul covid» OR «long haul covid 19» OR «long haul covid 19» OR «post acute sequelae of covid 19» OR «post acute sequelae of covid 19» OR «post acute sequelae of sars cov 2 infection» OR «post acute sequelae of sars cov 2 infection» OR «COVID-19 Post-Acute Sequelae» OR «post covid conditions» OR «post covid conditions» OR «Post-COVID Condition» OR «Long COVID» OR «pasc post acute sequelae of covid 19» OR «pasc post acute sequelae of covid 19» OR «post acute covid 19 syndrome») AND («Oral Manifestations» OR «Oral Manifestation» OR «oral lesions» OR ((Disease OR diseases OR disorders OR disorder OR injury OR injurie OR injured OR injuries OR injurys OR injured OR wounds OR wound OR lesion OR lesions OR lesional OR Trauma OR Traumas OR Pathology OR Pathologies) AND (oral OR Mouth OR buccal OR dental OR Tooth OR Teeth)) OR «Mouth Diseases» OR «Mouth Disease» OR «oral diseases» OR «oral disease» OR «Oral Pathology» OR «Oral and Maxillofacial Pathology» OR «Maxillofacial Pathology» OR «Oral Health» OR Dentistry OR dental OR dentally OR dentals OR Mouth OR «Oral Cavity» OR «Cavitas Oris» OR «Vestibule of the Mouth» OR «Oral Cavity Proper» OR «Cavitas oris propria»)	66
Google Scholar	(«Post-Acute COVID-19 Syndrome» OR «long covid» OR «Post-COVID» OR «COVID Longa» OR «COVID persistente» OR «COVID prolongado» OR «COVID-19 persistente» OR «trastornos post-COVID») AND («Oral Manifestations» OR «Oral Manifestation» OR «oral lesions» OR «Oral Health» OR «Manifestações Bucais» OR «Manifestações Oraís» OR «Manifestaciones Bucales» OR «manifestaciones orales» OR «Saúde Bucal» OR «Salud Bucal»)	40

Search strategies were performed for each database by using specific words combinations and truncations with the support of a librarian.

Results

A total of 1,398 records were obtained, and 623 duplicate studies were then removed. One article was included after a manual search, resulting in 776 articles to be evaluated. Most of the excluded articles dealt with the global understanding of long COVID, such as cognitive dysfunctions, "brain fog," olfactory dysfunction, and facial paralysis. Additionally, these studies also addressed the impacts on quality of life and the difficulties patients face in seeking adequate care within their countries' healthcare systems, often due to the lack of physicians capable of recognizing and understanding this new condition. After this screening, 56 articles remained for full-text evaluation. The second phase began with a complete reading of the selected articles. In this stage, nine publications consisting of narrative reviews or letters to the editor, which did not meet the established inclusion criteria, were excluded. Additionally, 37 other articles were excluded for not aligning with the research objectives. Among these, two articles addressed long COVID in a population of dental professionals, while the remaining 35 dealt with other long COVID-related manifestations such as dysgeusia, xerostomia, osteonecrosis, and periodontal disease.

Although these studies were not included in the review, they will be considered for later discussion. At the end of this stage, nine articles remained, which will be the subject of this review. The process is summarized in the Prisma Flowchart (Figure 1). This study, composed of nine publications, investigated a total of approximately 1,051 patients addressed in the studies, with the exception of an exploratory study that did not report the number of patients involved. The findings described in the methodological design and results of the included studies are detailed in Table 2 & 3. Regarding the publication year, it was observed that the publications span from 2020 to 2024, highlighting the emerging nature of this topic. As for the study locations, there was a wide heterogeneity, including countries such as Brazil, India, Italy, Egypt, Romania, the United Kingdom, Mexico, and Poland. In terms of study design,

Case Reports, Observational Studies, Cross-Sectional Studies, and an Exploratory Review were found, which also signals that this is a recent topic still lacking systematic reviews. The analysis of data on the management and prognosis of the lesions revealed a variety of therapeutic approaches and clinical outcomes. Guidance on oral hygiene and the prescription of prophylactic medications were common, including chlorhexidine mouthwash and medications to prevent superimposed infections, such as Nystatin. Some patients received specific treatments, such as laser therapy and the use of saliva-stimulating medications.

In some cases, the oral lesions disappeared spontaneously after a few weeks, while others required specialized treatment due to the persistence or severity of the manifestations. Both Cross-Sectional Studies by Patel et al. [8] and Radhakrishnan et al. [13] were conducted in the form of online questionnaires and did not report on the management and prognosis of the patients' lesions. Additionally, Popa's et al. [14] Observational Study was limited to analyzing the occurrence and impact of the lesions and also did not report these data. Some studies, such as Patel et al. [8] and Radhakrishnan et al. [13], included patients at different stages, both in the acute and prolonged phases of COVID-19, in their sample. However, they did not provide a clear differentiation in their percentage data regarding the types of lesions per patient concerning which corresponded to long COVID. Moreover, a lack of standardization was observed in the classification or diagnosis of the lesions, which were often generically described as ulcers, plaques, or fungal lesions without specifying the precise diagnosis (e.g., herpes, erythema multiforme, etc.). These limitations hindered the approach and comparison concerning the number of lesions per patient. Therefore, to express in quantitative data the type of oral lesion reported in the patients from the nine studies included in this review, the number of times the lesions were cited was counted. Nonspecific ulcers were the most common, representing 40% of the citations, followed by leukoplakia, fungal lesions (13.3%), among others (Graph 1). These findings suggest a variety of oral manifestations associated with long COVID.

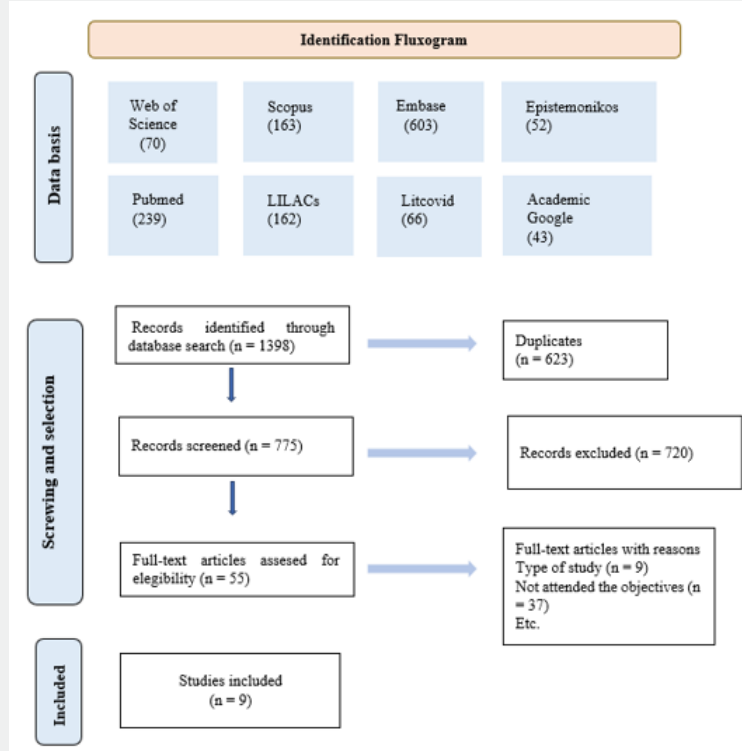


Figure 1: PRISMA-Scr Fluxogram, adapted from PRISMA (2020).

Table 2: Description of included studies.

Author/Year	Country	Study Design	No. of Patients	Sex	Age	Objective
Eita [39]	Egypt	Case Report	1	1F	31	Contribute to current literature by presenting a case of post-acute COVID-19 syndrome
Limongelli [40]	Italy	Observational Study	6	2F 4M	9 to 65	Clarify such post-COVID-19 lesions
Sood [17]	India	Exploratory Review	Not Applicable (NA)	NA	NA	The article explores the pathogenic mechanism behind the development of oral lichen planus as a post-COVID-19 condition due to its target receptor, T cell responses, cytokine profile, mucosal immune barriers, and nutritional deficiency.
Popa [14]	Romania	Observational Study	80	87%F 13%M	≈ 47	Identify post-COVID-19 syndromes among healthcare professionals infected with SARS-CoV-2 and its influence on work capacity.
Patel [8]	UK	Cross-Sectional Study	≈33	89,4% F	35 a 49	Investigate the prevalence of long COVID oral manifestations and the views, experiences, and practices of healthcare professionals for managing these conditions.
Rafałowicz [15]	Poland	Case Report	≈ 865*	≈419F ≈436M	≈ 70	Present selected cases of the most common long COVID symptoms in the oral cavity.
Radhakrishna [13]	India	Cross-Sectional Study	63	36F	≈ 43,96 to 16,78.	Estimate the prevalence of oral health problems and associated factors among individuals diagnosed with COVID-19.

Medeiros [16]	Brazil	Case Report	1	F	78	Report the presentation of oral lesions found in a post-COVID-19 patient.
Villanueva-Sánchez, 2023	Mexico	Case Report	2	2M	67 e 47	The main objective of this report is to present cases of patients who developed oral lesions after SARS-CoV-2 infection and emphasize the importance of a thorough evaluation of the soft and adjacent tissues of the oral cavity.

According to the article, among 1,256 patients, oral symptoms appeared in 68% of them.

Table 3: Description of Oral Lesion Characteristics, Treatment, and Prognosis.

Author/Year	Lesion Characteristics	Diagnosis	Management and Prognosis
Eita [39]	Non-scrapable white plaque on the dorsum of the tongue with prominent papillae.	Not specified, but suspected fungal lesion.	Guidance on oral hygiene, prescription of prophylactic medications to prevent superimposed infections (chlorhexidine mouthwash 0.12% and nystatin oral drops 100,000 IU/ml 2 to 3 times a day). After one month of treatment (4 weeks from viral clearance), the tongue's characteristics were restored to normal.
Limongelli [40]	Lip ulcers in 4 cases and oral mucosa in the remaining 2, synchronously lip and oral mucosa in only 1, always associated with irregular margins, pain, hemorrhagic and necrotic areas, and often deeply involving the subepithelial tissue with increased consistency.	Ulcers	All patients underwent biopsy under local anesthesia preceded by chlorhexidine 2% mouthwash for at least 1 minute. No information on treatment or follow-up.
Sood [17]	Reticular, papular, plaque, atrophic, erosive, and bullous lesions	Lichen planus	A four-pronged strategy to handle cases: Tracking and recording new cases as part of longitudinal observational studies in multiple countries; telephone follow-up of pre-existing cases and encouragement for self-examination and daily recording; frequent follow-up of COVID-19 cases with comorbidities; providing mental health support to individuals working in high-stress environments or with a history of psychological disorders.
Popa [14]	Ulcerations and mucosal lesions	Nonspecific ulcers	Not reported
Patel [8]	Most participants presented taste and/or smell alterations (58%), dry mouth (48.1%), and mouth sores (45.7%)	Canker sores or ulcers in 35.6%; white/red plaques or patches in 18.3%; deep grooves on the tongue surface in 17.3%	Not reported
Rafałowicz [15]	Patient 1: Unilateral aphthous-like lesions with inflamed border on the left side of the hard palate; Patient 2: hemorrhagic changes in the palate, extensive sores, spontaneous bleeding, and cheilitis; Patient 3: intensely red-purple mucosa and smooth tongue surface; angioma-like lesion on the right side of the palate; Patient 4: extensive vascular-like changes on the hard palate with spontaneous bleeding without pain; Patient 5: fungal infection on tongue, extensive palate lesions, spontaneous bleeding, and cheilitis.	Nonspecific ulcers, Unspecified fungal lesions	Patient 1: Semiconductor laser therapy with bio-stimulation function five treatments and recommended the use of chlorhexidine mouthwash three times a day for 14 days. After periodic observation, local lesions healed. Patient 2: Referred to Periodontology. Patient 3: Use of saliva-stimulating tablets and chlorhexidine mouthwash three times a day for 14 days. After 2 weeks, the intensity of the oral mucosa discoloration decreased. Patient 4: Change spontaneously decreased after 3 months, but no additional improvement was observed in the following 2 months, was referred for specialized treatment. Prognosis for dental treatment is good, and the change decreased. Patient 5: Referred to Periodontology and Oral Diseases. Local changes disappeared after 60 days. Patient 6: For 10 days, antifungal antibiotic Nystatin along with vitamin A + E + F ointment on the lips. Referred for specialized treatment.

Radhakrishna [13]	Fungal infection, difficulty opening mouth, ulcers, halitosis, abnormal features, white spots, eruptions, and burning sensation in the mouth	Not specified	Not reported
Medeiros [16]	Erosive lesions with circumscribed halos of different sizes along the entire dorsum, bilateral margins of the tongue, and labial mucosa. Herpes simplex or candidiasis, or benign migratory glossitis after COVID-19 have been suggested.	Not confirmed	Topical vitamin E 40 mg, oral nystatin suspension 100,000 IU, and artificial saliva spray were prescribed. Complete repair was observed after 14 days.
Villanueva-Sánchez, 2023	Patient 1: Erosive lesions on both dorsal surfaces of the tongue with 1-month evolution; Patient 2: Multiple vesiculobullous lesions distributed on the lower and upper labial mucosa, the anterior third of the tongue, and buccal mucosa with intense painful symptoms	Patient 1: Nonspecific ulcers; Patient 2: Pemphigus vulgaris	Patient 1: Therapy composed of enhanced oral hygiene, use of antifungal solutions, super oxidant solution mouthwashes, and B complex. Patient 2: Treatment protocol initiated with topical mometasone 0.1% and miconazole gel 2g, with adequate lesion regression observed after 20 days.

Although opportunistic lesions such as herpes simplex and candidiasis were identified in some studies [8,15,13], it is important to note that due to the study designs, patients were not assessed in person. As a result, diagnostic specificity was compromised, and the lesions were described generically without precise distinction between different conditions. For example, in Medeiros et al. [16] study, although a possible secondary infection was suggested, the diagnosis was not clinically confirmed. Among the selected articles, the observational study conducted by the “Stomatologia Rafałowicz” clinic, published by Rafałowicz et al. [15], stands out, with a significant incidence of oral symptoms in patients diagnosed with COVID-19. Of the 1,256 patients studied, 68% had oral cavity symptoms, indicating the presence of post-acute oral sequelae of COVID-19. These symptoms included discoloration, ulceration, and hemorrhagic changes in the oral mucosa (32%), tongue mycosis (29.69%), unilateral aphthous-like lesions on the hard palate (25.79%), and atrophic cheilitis. The authors of the study also observed that approximately 36% of patients chose not to follow the proposed treatment, opting only for oral hygiene recommendations and regular check-ups, and it was noted that most pathological changes spontaneously disappeared in this group after 3 weeks. Regarding the location of the lesions, it was possible to ascertain that oral lesions associated with long COVID have a pattern similar to the acute form. The most frequently cited locations were the buccal mucosa, lips, and tongue. Three studies did not identify the location of the lesions [13,8,17].

Discussion

A significant portion of individuals who survived COVID-19 are at risk of developing long-term nonspecific sequelae, a condition known as Long COVID [18]. Long COVID symptoms vary widely, including fatigue, shortness of breath, chest pain, joint pain, brain fog, and other neurological and psychological manifestations. Identifying factors associated with Long COVID is an emerging public health priority due to its lasting and debilitating

potential [19]. Moreover, many older adults receive angiotensin receptor blockers (ARBs) and angiotensin-converting enzyme (ACE) inhibitors to manage chronic illnesses. However, these medications upregulate ACE2 receptors-the same receptors used by SARS-CoV-2 to enter host cells. Consequently, patients on these medications face an elevated risk of SARS-CoV-2 infection. Additionally, older patients who survived COVID-19 may experience organ damage, including acute respiratory distress syndrome, acute kidney injury, and cardiac issues [20]. The relationship between Long COVID and the emergence of persistent oral lesions is under investigation. Studies have shown that pathological changes in the oral cavity can persist long after acute infection. According to Melo Neto et al. [21], these changes can appear between 10 to 42 days after the onset of systemic COVID-19 symptoms and persist for 2 to 6 months, manifesting as ulcers, plaques, fungal lesions, and other mucosal changes.

Data from this study indicate a predominance of cases in men in some samples, while others show a predominance in women, suggesting that Long COVID may affect sexes differently. A study by Davis et al. [22] revealed a 4:1 disease burden for women in 56 countries, indicating that although men more frequently test positive and suffer more severe illness, females are more likely to develop post-acute syndrome. Regarding age, Long COVID affects a wide range, from young adults to the elderly, but most studies focus on middle-aged and older adults, with an average age of around 47 years. Approximately 30% of reported patients are over 70, suggesting that the elderly may be at higher risk of developing Long COVID. Nalbandian et al. [23] identified older age, higher BMI, and five or more acute COVID-19 symptoms as risk factors for developing persistent symptoms. A retrospective cohort study of 2,433 patients followed for a year indicated that advanced age, female sex, and severe COVID-19 predispose individuals to long-term sequelae [24]. Recent evidence by Banks et al. [25] shows SARS-CoV-2 infection can lead to oral manifestations like xerostomia, dysgeusia, periodontal disease, mucositis, and opportunistic

infections, aligning with past findings of viruses like HIV, CMV, and herpesvirus persisting in the oral cavity [26-29].

Amorim dos Santos et al. [30] noted that stress, inflammation, and corticosteroid use could trigger HHV reactivation, explaining herpes simplex in some patients. Brandini et al. [31] suggested treatments for viral infections like COVID-19 might cause adverse reactions leading to oral lesions such as candidiasis and gingivitis. Zubchenko et al. [32] observed Long COVID triggering herpes reactivation, reinforcing the link between SARS-CoV-2 and oral lesions. Huang et al. [33] found the virus detectable in saliva for over 2 months in some symptomatic individuals and up to 3.5 weeks in asymptomatic cases. Therapeutic strategies for Long COVID oral lesions lack standardization. However, treatments for acute COVID-19 oral manifestations may guide these cases, including 2% chlorhexidine for lacerations, hyaluronic acid, and tranexamic acid for bleeding control, and miconazole for diagnosed candidiasis [34,35]. Many COVID-19 treatments, such as analgesics, antivirals, antibiotics, and immunomodulators, also treat oral conditions but may have long-term adverse effects impacting dental management of Long COVID lesions [36,37].

This study's findings align with literature citing these lesions as frequently associated with COVID-19 and similarly with Long COVID, highlighting the importance of tracking and documenting these occurrences in primary studies to support consistent epidemiological research. As Binmadi et al. [38] discussed, it's crucial to clarify which oral manifestations persist in Long COVID to establish it as a clinical diagnosis after excluding other common causes, allowing for effective management of these conditions and early identification of patients needing specific interventions. This scoping review mapped the landscape of Long COVID-associated oral lesions, highlighting lesion types and patient characteristics. However, limitations include not searching thesis and dissertation databases and not assessing methodological quality or bias risk of included studies, which may affect data reliability. Nonetheless, the study's strength lies in mapping oral lesion occurrences in Long COVID patients and identifying knowledge gaps, particularly in management and prognosis. This contributes to understanding associated symptoms and benefits health services by identifying these conditions that compromise quality of life [39,40].

Conclusion

In summary, this scoping review provides a comprehensive overview of the current evidence on oral manifestations in Long Covid patients. The findings underscore the importance of continued research and the development of clinical guidelines to address this emerging aspect of post-acute sequelae of Covid-19. By advancing our understanding of these oral manifestations and their management, we can improve the care and outcomes for Long Covid patients, ultimately contributing to the broader efforts to address the ongoing challenges posed by the Covid-19 pandemic.

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