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Definition and measurement of post-COVID-19 conditions in real-world practice: a global systematic literature review

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ABSTRACT

BACKGROUND

Post-COVID-19 conditions (PCC) is an umbrella term that encompasses a range of signs, symptoms and conditions present weeks after the acute phase of a SARS-CoV-2 infection. This systematic literature review summarises the heterogeneous methodology used to measure PCC across real-world studies and highlights trends by region, age group, PCC follow-up period and data source.

Methods Medline, EMBASE and the Cochrane Library were searched and supplemented with conference and grey literature searches. Eligible studies included individuals with (1) PCC or (2) a positive SARS-CoV-2 test or COVID-19 diagnosis who were followed over time. Included studies were published in English between 1 January 2020 and 14 November 2022.

Findings Of 291 publications included, 175 (60%) followed individuals with confirmed COVID-19 over time for PCC and 116 (40%) used a prespecified PCC definition. There was substantial heterogeneity in study design, geography, age group, PCC conditions/symptoms assessed and their classification and duration of follow-up. Among studies using a prespecified PCC definition, author-defined criteria (51%) were more common than criteria recommended by major public health organisations (19%). Measurement periods for PCC outcomes from date of acute COVID-19 test were primarily 3 to <6 months (39.2%), followed by 6 to <12 months (27.5%) and <3 months (22.9%). When classified by organ/system, constitutional-related PCC were the most frequently assessed in adult (86%) and paediatric (87%) populations. Within constitutional symptoms, fatigue was most frequently assessed in adult (91.6%) and paediatric (95.0%) populations, followed by fever/chills (37.9% and 55%, respectively).

Conclusions PCC definitions are heterogenous across real-world studies, which limits reliable comparisons between studies. However, some similarities were observed in terms of the most frequently measured PCC-associated symptoms/conditions, which may aid clinical management of patients with PCC.

PROSPERO REGISTRATION NUMBER

CRD42022376111.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This review provides a succinct summary of the methodological characteristics of studies on post COVID-condition (PCC).
⇒ PCC outcomes were extracted verbatim and summarized individually and then grouped according to organ and system class to facilitate analysis.
⇒ Studies including participants with a specific comorbidity or focusing on a specific residual outcome of PCC were excluded, which might introduce selection bias or under-estimate the extent to which certain PCC-associated symptoms/conditions are measured in those subpopulations.
⇒ Heterogeneity of study design posed difficulties in the comparison of the results from the included studies
⇒ New or persisting symptoms/signs/conditions following a SARS-CoV-2 infection, now widely referred to as 'post COVID-conditions (PCC)' in scientific literature, have posed a significant burden to societies and healthcare systems.
⇒ Due to the complex and evolving nature of PCC, clinical and real-world studies vary in how PCC is defined and investigated. This has resulted in a broad range of PCC-associated symptoms and conditions, making it difficult to compare findings across studies.
⇒ Rather than using definitions published by major public health organizations such as the WHO or CDC, most publications derived their own definition or referenced definitions used by other published studies.
⇒ This study identified substantial heterogeneity with respect to how PCC were defined and measured, including study design, geography, length of follow-up, data sources, and the PCC symptoms/conditions assessed. Even so, constitutional symptoms/conditions were the most frequently assessed PCC-associated symptoms/conditions in both adult and pediatric populations, followed by neurologic and respiratory symptoms

STRENGTH AND LIMITATIONS OF THIS STUDY

⇒ Until there is a standardized definition for PCC, it will remain difficult to measure changes in the burden of PCC over time and differences across populations. Additional studies are needed to facilitate translation of real-world evidence into the clinical management of patients with PCC.

INTRODUCTION

Some patients with COVID-19 exhibit mild or no symptoms and fully recover within the acute infection phase (ie, initial 28 days).[1 2] However, other patients have persistent symptoms or develop new sequelae after the acute phase of an infection with SARS-CoV-2. Post-COVID-19 conditions (PCC) is an umbrella term used by the US Centers for Disease Control and Prevention (CDC) that encompasses a range of signs, symptoms and conditions that are present for at least 4weeks after infection. PCC can include conditions that first appear during the acute infection phase and persist beyond the expected recovery period and those that first appear after the acute phase, some of which may relapse and remit while others worsen or improve over time. Other public health organisations (eg, WHO, National Institute for Health and Care Excellence (NICE)) in the UK have adopted slightly different terms and definitions.[3 4] For example, the CDC definition considers signs, symptoms and conditions present at 4 or more weeks after infection, whereas WHO uses a cut-point of 3 or more months post-COVID-19 onset.[4 5] Moreover, NICE defines post-COVID-19 syndrome as new or persistent symptoms that continue >12 weeks after diagnosis.[6] Another commonly used term is postacute sequelae of SARS-CoV-2 (PASC), which is separately defined by the CDC, as the direct and indirect effects of SARS-CoV-2.[7] The varying definitions used makes it challenging to measure the overall burden and to compare findings across different regions and populations.[8 9]

PCC presents a significant burden to global public health.[10 11] At least 65 million individuals globally are estimated to have long COVID and the true number is likely much higher due to under-reported cases.[12] The prevalence is estimated at 10%–30% of non-hospitalised cases and 50%–80% of hospitalised cases.[10 13] However, estimates vary depending on study design (ie, study population, PCC definition, data source, follow-up duration, time period and predominant variant). For example, PCC prevalence is estimated to be higher for certain patients such as older adults, unvaccinated individuals and those who were hospitalised (higher still in those who required critical care or mechanical ventilation) during the acute phase.[10 11] Furthermore, recent findings from the UK Office for National Statistics show that PCC-associated symptoms have adversely affected the day-to-day activities of 1.5 million people in the UK (77% of those with self-reported PCC).[14]

While there have been several literature reviews assessing the mechanism, prevalence and risk factors of PCC, to the best of our knowledge, no studies have systematically reviewed the definitions of PCC in real-world practice.[12 15 16] Given that it is widely acknowledged that the new or persisting signs, symptoms and conditions comprising PCC and the time intervals over which PCC are assessed vary across public health agencies and researchers, it is crucial to systematically summarise how PCC is defined and measured in real-world studies.

The purpose of this systematic literature review (SLR) was to (1) summarise the approaches used to define and collect data on PCC in real-world studies, (2) identify PCC-associated symptoms and conditions assessed in real-world studies and (3) qualitatively summarise similarities and differences across regions, age groups, data collection approaches and follow-up periods.

METHODS

This review was conducted according to the updated 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and the review protocol is registered in the international registry of systematic reviews (PROSPERO registration number: CRD42022376111).[17]

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Search strategy

Searches were carried out in Medline and EMBASE (via the OVID platform) and the Cochrane Library, using the search strategies presented in online supplemental tables 1–3. Each search strategy was designed to capture publications from 1 January 2020 to 14 November 2022 (date range was identified to capture the emergence of potential PCC outcomes) reporting on real-world studies exploring PCC in adult and/or paediatric populations. This SLR included studies using any of the following terminology, to ensure all relevant data were captured: PCC, long COVID, chronic COVID, PASC or long-hauler COVID-related outcomes. Clinical trials were excluded from this review.

To capture a comprehensive evidence base, conference proceedings including abstracts and posters from European Society of Clinical Microbiology and Infectious Diseases, American Thoracic Society International Conference, Conference on Retroviruses and Opportunistic Infections and American Academy of Pediatrics published between 2020 and 2022 were included in the search. Grey literature reports, including epidemiology data and real-world studies published by WHO, European Centre for Disease Prevention and Control and the US CDC were also reviewed for eligibility.

Study selection and data extraction

Abstracts of retrieved citations were screened according to the study PICO criteria (online supplemental table 4). Studies including adult and/or paediatric patients with self-reported or clinically diagnosed PCC or those with a confirmed SARS-CoV-2 infection or COVID-19 diagnosis that were followed over time for the development of PCC were included in this review. Studies restricted to patient populations defined by comorbid conditions were excluded, due to potentially limited generalisability. Screening was conducted by two independent reviewers, with a third reviewer resolving any discrepancies in decisions. For abstracts that met the inclusion criteria, full-text publications were reviewed for eligibility and progressed to data extraction. Where full texts were unavailable, abstracts were extracted. Extraction was conducted by a single reviewer and each data point verified by a second reviewer.

For each eligible study, information was extracted on study sample, PCC definition (ie, author-defined, CDC, NICE, WHO), specific PCC assessed and measures used, data collection approach (ie, patient-reported, clinical diagnosis, laboratory measurements), length of follow-up. A risk-of-bias assessment was performed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklists.[18]

Due to substantial heterogeneity in terminology used to assess symptoms/conditions, both via clinical diagnoses and patient-reported methods, outcomes in this SLR were extracted verbatim before grouping by organ and system class to facilitate analyses. Existing approaches in the literature and medical specialists were consulted.[19–22] Individual symptoms and conditions were grouped by domains, as described in online supplemental table 5.

RESULTS

Summary of included studies

A total of 2033 articles were identified via electronic database searches, and a further 33 articles were sourced using supplementary search methods. Following deduplication and abstract screening against the PICOS criteria, 452 full-text articles (including those sourced through supplementary methods) were assessed for inclusion in the review. A total of 291 articles were deemed eligible for inclusion and were extracted. The majority of included studies were journal articles (n=262), followed by conference abstracts (n=28). Studies were most frequently excluded for not meeting the eligibility criteria set for PCC (n=73), followed by population (n=24; primarily studies focusing on populations defined by their comorbid conditions). The screening and inclusion process is summarised in the PRISMA flow diagram (figure 1).

Summary of study characteristics

A tabular summary of included study characteristics is presented in online supplemental table 6. Across included studies (n=291), the median sample size was 323 (IQR 134, 1106). Most studies included adults (76%; n=222), while 8% (n=23) included only children, and 14% (n=40) included both adults and

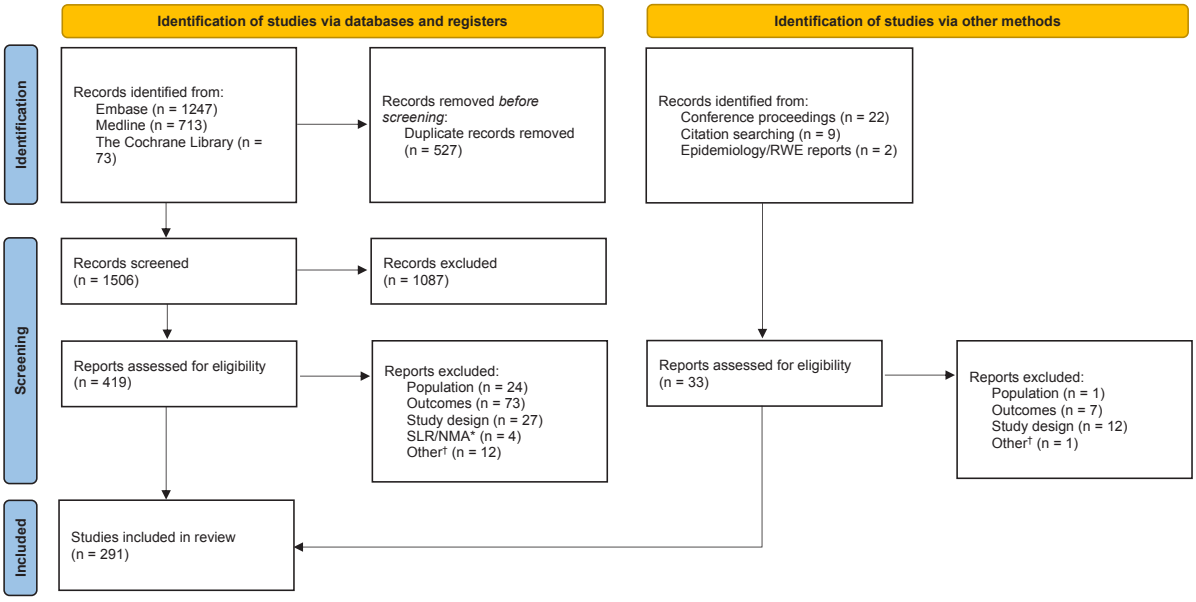

Figure 1 PRISMA flow chart of publications included in the SLR. *SLR/NMA were excluded but bibliographies were reviewed to ensure all relevant publications were included. †Duplicate and non-English publications were excluded as 'other'. NMA, network meta-analysis; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; RWE, real-world evidence; SLR, systematic literature review.

Table 1 Distribution of prespecified PCC definition sources used in included studies by age group, n=291 studies

Definition source	Total (n=291) N (%)	Paediatric (n=23) N (%)	Adult (n=221) N (%)	Mixed (n=41) N (%)	Not reported (n=6) N (%)
Author definition	150 (51.5)	10 (43.5)	119 (53.1)	18 (43.9)	3 (50.0)
Based on another referenced study	37 (12.6)	4 (17.4)	24 (10.7)	9 (22.5)	0 (0)
CDC	7 (2.4)	0 (0)	6 (2.7)	1 (2.5)	0 (0)
ICD-10 U09.9*	5 (1.7)	1 (4.3)	3 (1.3)	2 (4.9)	0 (0)
ICD-10 codes†	1 (0.3)	1 (4.3)	0 (0)	0 (0)	0 (0)
National guidelines‡	1 (0.7)	0 (0)	1 (0.4)	0 (0.0)	0 (0)
NICE	18 (6.2)	4 (17.4)	14 (6.3)	0 (0)	0 (0)
Not prespecified by author§	53 (18.1)	0 (0)	38 (17.2)	8 (17.5)	3 (50.0)
WHO	22 (7.5)	3 (13.0)	16 (7.1)	3 (7.5)	0 (0)

*Includes studies explicitly reporting ICD-10 U09.9 diagnoses, and a mixed adult and paediatric study that used a Danish equivalent of ICD-10 U09.9 diagnostic code (DB948A implemented 1 April 2020 by the Danish Board of Health.[64]
†A literature review[65] which analysed ICD-10 codes by clustering 121 syndromic, and systemic symptoms and conditions, and medication uses (therapeutic classes) reported for postacute sequelae of COVID-19, to predict clinically relevant symptoms.[65]
‡Adult study used definition from National Comprehensive Guidelines for Management of Post-COVID Sequelae for India.[66]
§Refers to included studies that prospectively followed patients with confirmed acute SARS-CoV-2 to investigate and characterise persistent symptoms.
CDC, Centers for Disease Control and Prevention; ICD-10-CM, International Classification of Diseases, Tenth Revision, Clinical Modification; NA, not applicable; NICE, National Institute for Health and Care Excellence.;

children. Of note, age was not reported in 2% (n=6) of studies.

Most studies were conducted in the USA (25%, n=73), followed by the UK (8%, n=24).

Summary of PCC definitions in real-world practice

A summary of the distribution of pre-specified PCC definition sources used in included studies by age group is presented in table 1. The majority of studies used author-created definitions (52%, n=150), followed by definitions that had been used in prior studies (13%, n=37) (table 1). There was no clear trend across countries as to which definition researchers used. For example, the NICE definition was used in 18 (6.2%) studies across 12 countries, of which only 1 was conducted in the UK.[23] In addition, the CDC definition was used by 7 (2%) studies, of which 6 were conducted in the USA and 1 in Saudi Arabia, while the WHO definition was used by 22 (7.5%) studies, conducted in 15 different countries. Of note, all 53 studies without a prespecified PCC definition prospectively followed patients with a confirmed SARS-CoV-2 infection over time to investigate and characterise persistent symptoms.

The SLR captured evidence from all six WHO regions. The global distribution of PCC definitions used is presented in online supplemental table 7.

Comparison of study designs

The majority of studies included participants with a recent documented COVID-19 diagnosis that were followed-up for a specified period of time (n=175). The remaining 116 studies included participants with PCC.

Retrospective cohort studies (n=102) were the most commonly used study design, followed by prospective cohort (n=91), cross-sectional (n=77) and case-control (n=11). Of the prospective cohort studies, 48 (64%) followed participants after a positive COVID-19 diagnosis. See online supplemental figure 1 for a breakdown of included studies by study design. Overall, 44% (n=128) of studies were conducted in a single-centre setting and 47% (n=137) were conducted in a multicentre setting. The remaining 9% (n=26) of studies were community (n=2), online (n=2), remote (n=2) or studies that did not report the setting (n=20).

With respect to data collection methods/sources, 229 studies assessed PCC using patient/self-reported questionnaires or surveys, 61 analysed data from administrative claims and/or electronic health record (EHR) databases, and 20 used a combination of patient-reported PCC with at least one other measurement type (eg, ICD-10 codes, laboratory results).

Length of follow-up varied across included studies, both by measure (eg, mean, median, range) and duration. We grouped follow-up periods used in included studies as <3, 3 to <6, 6–12 and >12 months post-SARS-CoV-2 infection or COVID-19 diagnosis (see table 2). The most common follow-up period was ≥3 months to <6 months (n=97).

Summary of PCC assessed

Across studies, PCC outcomes were assessed as symptoms/conditions (93%), health state and quality of life (QoL) measures (43%), clinical and laboratory assessments (15%), healthcare resource utilisation (8%) and new or worsened comorbidities (18%). Of symptoms/conditions

Table 2 Distribution of measurement periods for PCC outcomes relative to most recent SARS-CoV-2 test results or diagnosis, n=291

Follow-up range	Number of studies (%)*
<3 months	66 (22.9)
3 months to <6 months	114 (39.2)
6 months to <12 months	80 (27.5)
≥12 months	38 (13.1)
Overlapping range†: <3 months to 6 months	2 (0.9)
Overlapping range†: <3 months to ≥12 months	1 (0.5)
Not reported	26 (8.9)

*Studies reporting multiple follow-up points have been included in each respective category therefore, total number of studies is ≥100%.
†Studies capturing data at a single timepoint over a range of time.
.PCC, post-COVID-19 condition.

reported across all studies, 74% (4842/6578) were self-reported (ie, no clinical diagnosis; includes reported via parent proxy).

Symptoms/Conditions by symptom/condition domains

Symptoms/Conditions were measured in 271 of 291 (93%) included studies. Due to the heterogeneity in terminology used, individual symptoms/conditions were categorised based on organ system to facilitate analysis. The number of studies measuring each symptom/condition (ie, the frequency), stratified by adult versus paediatric population, data source, study design and follow-up duration across studies is presented in figure 2.

As depicted in figure 2A, constitutional symptoms/conditions were most frequently assessed in both adult and paediatric populations (86% and 87%, respectively). Neurological and respiratory symptoms were the next most frequently assessed conditions (84% and 82% among adults, respectively; 83% for each among children). When stratified by data source (figure 2B), studies using databases (n=61; eg, EHR, medical/insurance databases), questionnaires (n=229) and studies conducting laboratory-based testing or clinical assessment (n=20) most frequently assessed constitutional PCC (82.0%, 84.7% and 90.0%, respectively). Laboratory results were more likely to be used to measure symptom severity and PCC in the genitourinary symptom/condition domain (figure 2B). In all symptom/condition domains bar symptom severity, there was a lower proportion of database studies than questionnaire-based studies (figure 2B).

Constitutional PCC were most commonly measured in retrospective cohort (79%), cross-sectional (90%) and ambidirectional cohort (100%, n=10) studies. Neurological PCC were most frequently assessed in case-control studies (91%; n=11), followed by prospective cohort studies (87%) (figure 2C). Of the five study designs, ambidirectional cohort studies were more likely than other study designs to measure musculoskeletal, cardiovascular, genitourinary, immune, gastrointestinal and dermatological symptom/condition domains (figure 2C).

The symptom/condition domains measured did not differ substantially by follow-up duration (figure 2D).

Frequency of symptom/condition domains

The three most frequently assessed symptom/condition domains by age group are reported in figure 3. A summary of the distribution of number of symptoms/

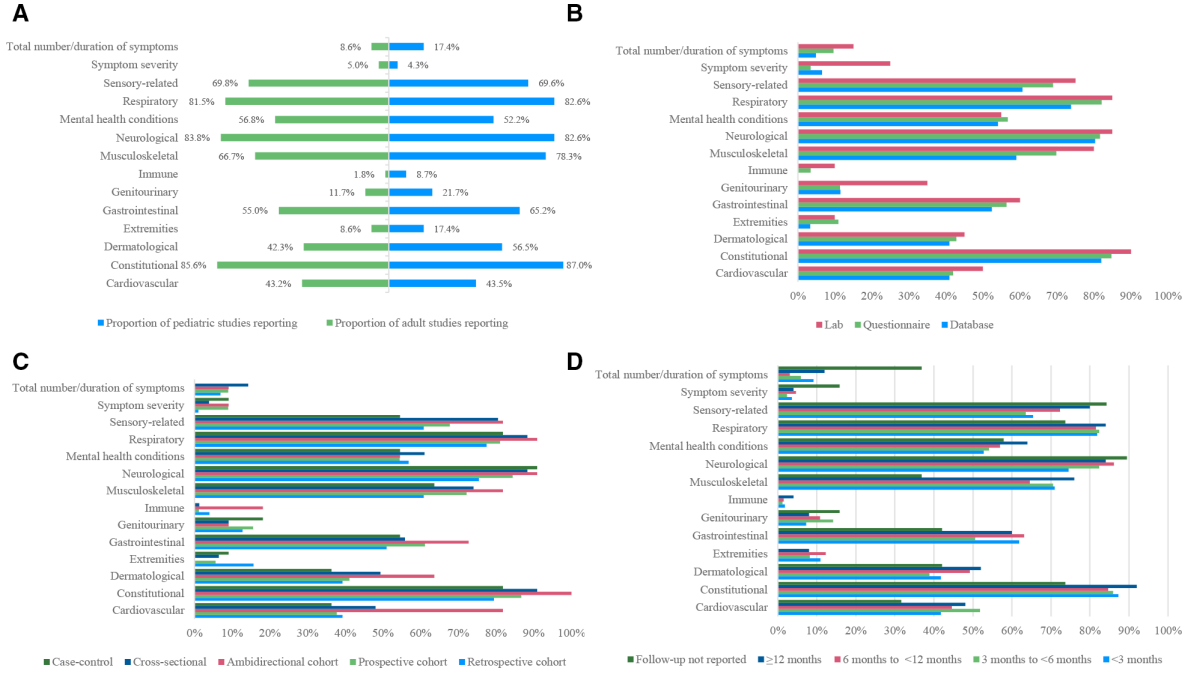

Figure 2 Distribution of the most frequently assessed symptom/condition domains stratified by (A) age group, (B) data source, (C) study design and (D) follow-up length.

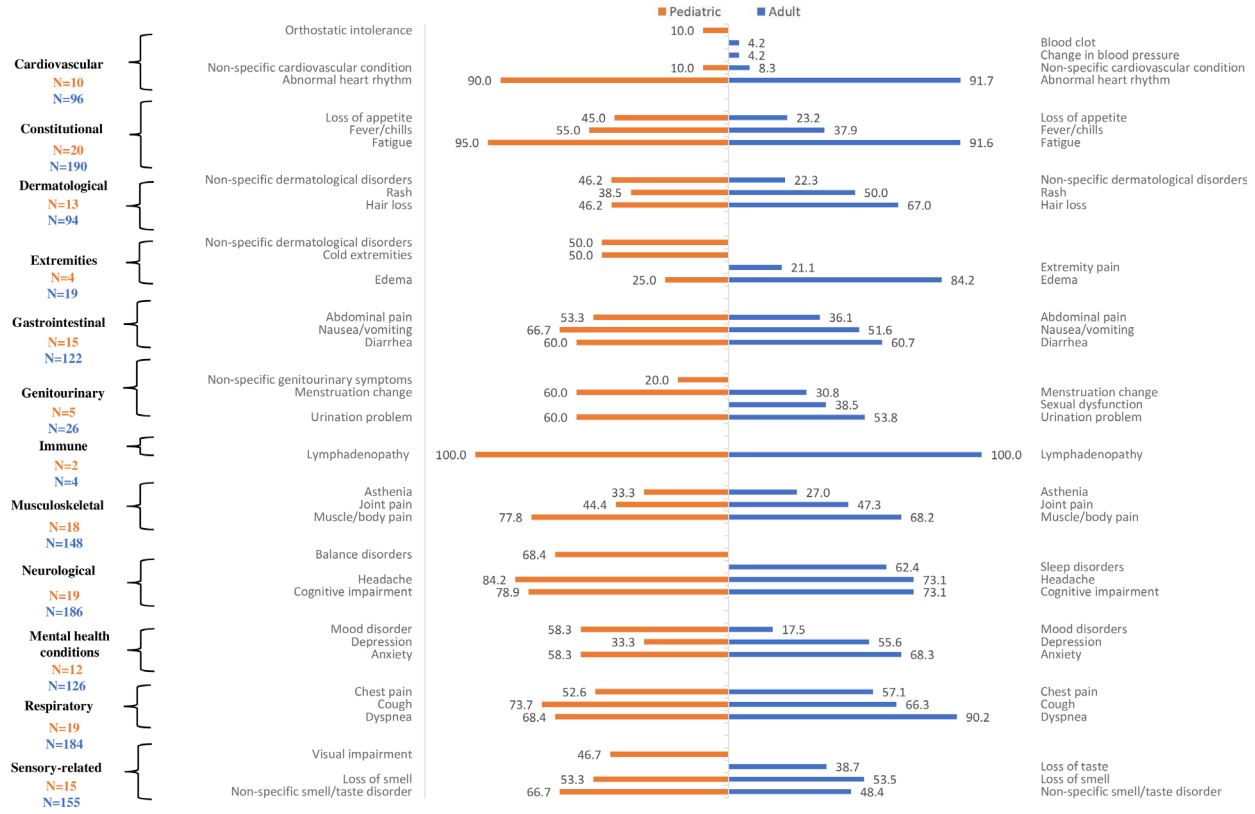

Figure 3 Distribution of the most frequently assessed symptoms/conditions by symptom/condition domain in adult and pediatric population.

conditions assessed in each PCC domain is presented in online supplemental table 8.

Similarities across symptom/condition domains were observed however, some individual symptoms/conditions were unique to adult or paediatric populations, making it difficult to compare the grouped domains directly.

Abnormal heart rhythm (eg, included palpitations, dysrhythmia, arrhythmia, tachycardia and bradycardia) was the most frequently assessed symptom/condition in adults (91.7%, 88/96), and 90% (9/10) of paediatric studies. Fatigue was the most frequently assessed constitutional PCC among adult (91.6% (174/190)) and paediatric populations (95.0% (19/20)).

Age-related differences were observed. For example, change in blood pressure, sexual dysfunction, extremity pain, oedema and sleep disorders were more frequently assessed in adults. Conversely, in paediatric populations, a notable difference was the proportion of studies assessing mood and balance disorders (58.3% vs 17.5%; 68.4% vs 0%, respectively).

Other PCC outcomes

Health state measures and quality of life

Health state and QoL outcomes were assessed in 124 studies. The most frequently assessed health state measure was general QoL (n=50), which was primarily measured using the EQ-5D (n=20), followed by limitations in daily activities (n=30) (online supplemental figure 2).

Clinical and laboratory assessment

Clinical and laboratory testing was conducted in 45 studies. These assessments were used to identify biomarkers or diagnostic criteria for PCC and were reported by 40 studies. The laboratory measures most frequently used to assess PCC were inflammatory markers (37.8%), followed by lymphocyte testing (15.6%) (online supplemental figure 3).

Healthcare resource use

Twenty-two studies assessed PCC-associated healthcare resource use (HCRU) outcomes, broadly categorised as hospitalisation, intensive care unit admission, pharmaceutical treatment and outpatient clinical visit or rehabilitation (online supplemental table 9). HCRU outcomes were more likely to be assessed in outpatient clinical visits/rehab (86/150 studies overall; 70/97 studies among adults; 13/14 studies among paediatrics).

New or worsened comorbidities

A range of new or worsening comorbidities were assessed in 52 of the included studies, and were measured as distinct outcomes from PCC-associated symptoms/conditions. These outcomes refer to reported disease manifestations either during the acute COVID-19 illness or post-COVID-19—as opposed to diagnosed symptoms/conditions. Due to uncertainty in reporting, these conditions have been grouped separately and were excluded from analysis of PCC-associated symptoms/conditions as

they are not necessarily COVID-19-related. Diabetes and cardiac events/disease (including heart failure and myocarditis) (n=16) were the most commonly assessed new or worsening comorbidities, followed by stroke (n=12).

Summary of validated methods for PCC outcome assessment

Several studies reported use of validated measures for PCC outcomes, with terminology varying between COVID-19/long COVID/post-COVID. These studies refer to measures/tools designed, tested and validated specifically for assessment of PCC outcomes. The key characteristics of these validated methods and measures are presented in the online supplemental table 10.

Quality appraisal of included studies

A risk-of-bias assessment was performed using the JBI Critical Appraisal Checklist (online supplemental table 11–14).[18] Studies were assessed using a series of study design-specific questions, and the meeting of each criteria rated as 'yes', 'no', 'unclear' or 'not applicable'. A qualitative conclusion of low, high or unclear risk of bias was assigned to each study.

An assessment of high risk of bias or unclear in cohort studies was assigned for 25 studies, primarily due to limited description of study sample characteristics, confounding factors and study follow-up presented within conference abstracts (n=10). However, within published full texts, a high risk of bias was also assigned for differences between comparative study samples, lack of control group and selective inclusion of most severe acute cases (eg, study sample only comprising hospitalised patients with PCC). Similarly, among cross-sectional studies, limited description of study sample characteristics, unclear inclusion criteria and follow-up led to assessment of high risk of bias or unclear (n=12). One case-control study was deemed 'unclear', as it was a journal letter and did not provide comprehensive study details.

DISCUSSION

This SLR sought to summarise how PCC are defined and measured in real-world evidence studies. Of the 291 studies included, substantial heterogeneities across study design, geography, age group, data sources, PCC-associated conditions/symptoms assessed and duration of follow-up were identified. The adoption of PCC definitions that matched guidance from NICE, WHO and the CDC was low, with variations of author-generated definitions being most common in the literature. This is consistent with the findings published in a recent review study on PCC definitions, which found that 66.8% of 193 studies reviewed used their own definitions for PCC, while 33.2% studies did not define PCC.[24] The use of multiple and varied definitions further impaired our qualitative synthesis of PCC definitions across studies. A standardised universally accepted definition and nomenclature is the first step to appropriately diagnose and manage a disease, to measure the disease burden and changes in the burden over time and across different populations. WHO and other related organisations might consider an integrative classification and unified terms or PCC measurement tools to homogenise the literature. However, irrespective of age group, data collection method and study design, the most frequently assessed PCC-associated symptoms/conditions were constitutional, and included fatigue, fever/chills and loss of appetite, which may shed light on targeted intervention strategies for patients with PCC.

The time reference points for measuring PCC or follow-up periods are also critical to establish in order to define PCC.[25] Across studies, PCC were measured over different follow-up periods (sometimes across multiple time periods and other times only at one time point). Furthermore, the way studies described the follow-up period differed. For example, 140 studies reported the mean, median or range of follow-up time, 104 reported time intervals (eg, <3 months to ≥12 months), and the remaining 47 studies did not specify a follow-up duration. Furthermore, some studies assessed PCC at consistent time intervals while others collected data at any time-point within a range (eg, one completed questionnaire >6 months postacute COVID-19 infection). Prior reviews suggested that studies assessing PCC over shorter periods (eg, 1 month after an infection) may not capture the full range of PCC-associated symptoms/conditions.[16 26] Davis *et al*[12] noted that the onset and time course of symptoms differ across patients and by type of symptom. For instance, neurological symptoms often have a delayed onset, and some worsen over time and will likely persist longer, whereas respiratory and gastrointestinal symptoms are more likely to resolve within weeks.[27–29] Other symptoms like body and joint pain, and swelling of the legs and feet, are more commonly seen at 1 year.[30] An analysis of ICD-10 codes with potential links to long COVID was conducted by Mizrahi *et al*, to compare symptoms and diagnoses recorded in an early post-COVID-19 period (30–180 days postinfection) versus a later period (180–360 days postinfection).[31] HRs for a variety of symptoms and diagnoses differed across the two follow-up periods, for example, dyspnoea and weakness remained high throughout 1 year while palpitations and chest pain and cough returned to baseline within 8 and 4 months of a COVID-19 diagnosis, respectively.[31] Thus, a sufficient follow-up length defining people 'at risk for long COVID' is extremely important to minimise misclassification or misdiagnosis of PCC.[32]

We observed substantial heterogeneity in the frequency in which different PCC-associated symptom/condition domains were assessed, which was consistent with previous studies.[12 16 33 34] However, constitutional-related PCC were the most frequently assessed in both adults and children (n=190, n=20). Prior PCC studies presenting the prevalence of persistent symptoms following SARS-CoV-2 infection reported that constitutional symptoms are very common, which supported the high frequency of measurements. For example, the prevalence of fatigue was estimated to be 35%–45% at 4 weeks, 30%–77% at 8 weeks and 16%–55% at 12 weeks after infection and 21%

more likely ≥6 months after infection.[34–41] Neurological-related PCC were the next most frequently assessed PCC (measured in 83% of studies among both children and adults). This finding likely reflects ongoing concerns regarding the impact of PCC-associated neurological symptoms/conditions in adults and children.[42–44] Brain fog, loss of smell and taste (anosmia and ageusia) and headache are among the most prevalent neurological symptoms.[45–47] According to two single-centre cohort studies conducted in the USA and France, respectively, 60% of hospitalised cases reported persistent neurocognitive symptoms at 6 months and 33% had a dysexecutive syndrome including inattention, disorientation or poorly organised movements in response to command at hospital discharge.[48 49] Additionally, findings from the RECOVER cohort study highlighted that brain fog, dizziness and abnormal movements were among the most common PCC symptoms reported at 6 months postinfection, with frequencies of 64%, 62% and 15%, respectively.[50] The underlying mechanism of long-term neurological manifestations is unknown, and could involve viral neuroinvasion, persistent viral shedding and serotonin reduction.[51 52] Future studies are needed to better understand the long-term impact on neurocognitive impairment and QoL in adults, as well as neurodevelopment in children.[42 53]

Moreover, PCC-associated respiratory symptoms/conditions including cough and dyspnoea were also frequently measured, in alignment with previous assessments in the literature.[26 54] According to an SLR and MA conducted up to 15 March 2021, that included 29 peer-reviewed publications and 4 preprints, dyspnoea were among the most prevalent post-COVID-19 symptoms in both hospitalised and non-hospitalised COVID-19 cases.[55] An earlier SLR and MA conducted in 2020 also noted that 26% of the individuals experienced dyspnoea.[56] Notably, a recent retrospective study conducted in Saudi Arabia has shown a high reported frequency of residual cough within 12 months in children post-COVID-19 infection, as a cough was reported in 69.8% of patients.[54] Moreover, a longitudinal study conducted in Spain explored the recovery curve of dyspnoea in previously hospitalised COVID-19 cases aged around 60 years and found that patients with dyspnoea tend to slowly recover during the 3 years post-SARS-CoV-2 infection, which might also explain why those symptoms were likely well captured regardless of the study design and follow-up length.[57]

Well-designed studies, including sufficient longitudinal follow-up and a well-matched control group (eg, the same amount of time in the study following an initial infection), are also needed to correctly identify PCC.[58] In the present study, only 8% of the studies were longitudinal and only 4% included a control group.

This SLR also identified substantial heterogeneity in terminology used to measure symptoms/conditions, both via clinical diagnoses and patient-reported methods. A lack of standardised symptom/condition nomenclature and recording methods has been similarly reported in landscaping and systematic literature reviews investigating persistent symptoms associated with PCC.[59–61] These studies identified loss of granularity due to grouping of similar symptoms under umbrella terms, poor EHR characterisation and general ambiguity in measurement of acute SARS-CoV-2 infections.[59–61] A chart review of the ICD U09.9 code across three US healthcare databases found that the definition varied by provider and that bias was introduced by inclusion of long COVID clinic attendance data.[32 62] Furthermore, among patients with the U09.9 code (n=300), only 40% and 65% met the WHO and CDC definitions of PCC, respectively.[32 62]

There are distinct limitations associated with self-reported and database methods of collection. Less severe PCC-associated symptoms may not be accurately captured by diagnostic codes, due to bias towards more severe diagnoses that require medical attention or where patients feel a medical intervention will resolve the complaint. Furthermore, there may be inconsistencies across doctors regarding which conditions are discussed and documented as relevant to PCC, highlighting the lack of certainty surrounding the definition of PCC. Conversely, patients may be more likely to report minor symptoms using a self-completed survey such as headache or cough. A study exploring self-reported long COVID prevalence raised uncertainty regarding their prevalence estimates, due to higher frequency of self-reported outcomes versus clinical diagnosis reported in other disease areas.[63]

Another key consideration for clinician diagnosed/EHR database PCC is that some symptoms/conditions are reported as incident outcomes (ie, not present prior to or during the acute phase of infection), while others distinguish between chronic, acute and persistent symptoms.[31] Thus, comparisons of findings between different studies on this topic should be approached with caution. Our study assessed the frequency that different PCC-associated symptoms/conditions (and PCC-related symptoms/conditions, when grouped by organ system) were measured. However, further research that quantifies the prevalence of specific PCC symptoms/conditions as well as common phenotypes are needed to guide clinicians on the diagnosis, treatment and management of PCC. Also, additional studies are needed to identify appropriate physical, mental and biological tests to diagnose PCC symptoms/conditions, aiding clinical decision-making.

Due to heterogeneity in terminology used for to assess symptoms/conditions, both via clinical diagnosis and patient-reported methods, outcomes in this SLR were extracted verbatim before consolidation to allow for interpretation and presentation in tables and figures. For example, shortness of breath, breathlessness and dyspnoea were consolidated and analysed as one symptom. This consolidation approach to group by symptom/condition domain, although informed by existing approaches in the literature and included consultation with medical specialists, may have limited the reproducibility of our findings. Furthermore, as detailed in PICOS table, the exclusion of studies that focused on a specific PCC-associated symptom

or condition may have led to the exclusion of studies with relevant data. If a specific PCC-associated symptom/condition or patients with a specific underlying condition is of interest, future studies restricted to those conditions might be needed.

The format of questionnaires used in included studies that investigated patient-reported outcomes may also have impacted participant response. For example, open-ended questions or availability of free-text entries may have fewer responses than closed-ended questions. Even for close-ended questions, different questionnaires may have different wording and therefore may result in different recall periods, limiting the comparability across studies. In addition, individual clinical relevance or symptom intensity could not be accessed or differentiated across different terminologies used.

Moreover, heterogeneity by study sample, follow-up duration, method of data collection and whether outcomes were patient-reported or based on diagnostic/claims codes limited our ability to summarise differences and similarities across studies. Lastly, given the rapidly emerging literature on PCC, a timely updated review is needed in near future to better understand the evolving dynamics in PCC-related fields.

CONCLUSION

Overall, a considerable global body of evidence was identified and summarised in this SLR for adult and paediatric populations which demonstrates the wealth of evidence being generated in real-world settings for PCC. The SLR found high heterogeneity in PCC definition, study design, follow-up period, PCC symptom/condition domains assessed and data sources. It has been acknowledged that COVID-19 has a very broad clinical spectrum and thus it can have long-term impacts on various organ systems. Ongoing real-world studies assessing PCC (across multiple organs/systems) are critical as there is lack of certainty in the medical and scientific community regarding a standardised PCC definition that is appropriate in both the clinical and research settings. Care must be taken to balance the sensitivity and specificity of a diagnosis before a standard definition of PCC can be applied.

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Definition and measurement of Post COVID conditions in real-world practice: A global systematic literature review – Supplementary Materials

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Table 1. Ovid search strategy for EMBASE

#		Query	Results from 14 Nov 2022
1	*Long COVID terms*	*exp long COVID/*	*2480*
2		*((long or post or persist* or sequela* or complication) adj5 (COVID* coronavirus* or SARS*)).mp.*	*3174*
3		*(longCOVID or long COVID or long-COVID or long haul COVID or long-haul COVID or post-acute COVID syndrome or persistent COVID-19 or post-acute COVID19 syndrome or long hauler COVID or post-acute sequelae of SARS-COV-2 infection or chronic COVID syndrome or post COVID-19 syndrome or post COVID-19 condition or post-acute sequelae of COVID).mp.*	*3748*
4		*(longcovid* or long covid* or longcoronavirus* or longcorona* virus* or long coronavirus* or long corona* virus* or longCov or long Cov or longsars* or long sars* or "long severe acute respiratory syndrome*" or long cov* or long cov*).ti,ab,kw,kf.*	*2446*
5		*or/1-4*	*6549*
6	*Filters to remove study types which are not of interest*	*Clinical Trial/ or Randomized Controlled Trial/ or controlled clinical trial/ or multicenter study/ or Phase 3 clinical trial/ or Phase 4 clinical trial/ or exp RANDOMIZATION/ or Single Blind Procedure/ or Double Blind Procedure/ or Crossover Procedure/ or PLACEBO/ or randomi?ed controlled trial$.tw. or rct.tw. or (random$ adj2 allocat$).tw. or single blind$.tw. or double blind$.tw. or ((treble or triple) adj blind$).tw. or placebo$.tw. or Prospective Study/*	*2773940*
7		*exp Meta Analysis/ or ((meta adj analy$) or metaanalys$).tw. or ((mega adj analy$) or megaanalys$).tw. or (systematic adj (review$1 or overview$1)).tw.*	*525947*
8		*(exp Animal/ or nonhuman/) not exp human/*	*6921483*
9		*exp letter/ or exp preliminary communication/ or exp note/ or exp editorial/ or exp editor/ or exp editorial policies/ or exp newspaper/*	*2949179*
10		*5 not (6 or 7 or 8 or 9)*	*4638*
11	*Study types to include*	*Clinical study/ or Case control study/ or Family study/ or Longitudinal study/ or Retrospective study/ or Prospective study/*	*2541128*
12		*11 not (6 or 7)*	*1593927*
13		*Cohort analysis/ or (Cohort adj (study or studies)).tw. or (Case control adj (study or studies)).tw. or (follow up adj (study or studies)).tw. or (observational adj (study or studies)).tw. or (epidemiologic$ adj (study or studies)).tw. or (cross sectional adj (study or studies)).tw.*	*1779823*
14		*patient-reported outcome/*	*44591*
15		*"Patient reported outcomes".tw.*	*32432*
16		*or/12-15*	*2996513*
17	*Total: disease terms and observational terms*	*5 and 16*	*1760*
18	***Total: disease terms and observational terms (with filters applied)***	***17 not (6 or 7 or 8 or 9)***	***1211***

Table 2. Ovid search strategy for Medline

#	Description	Query	Results from 14 Nov 2022
1	Long COVID terms	((long or post or persist* or sequela* or complication) adj5 (COVID* coronavirus* or SARS*)).mp.	2611
2		(longCOVID or long COVID or long-COVID or long haul COVID or long-haul COVID or post-acute COVID syndrome or persistent COVID-19 or post-acute COVID19 syndrome or long hauler COVID or post-acute sequelae of SARS-COV-2 infection or chronic COVID syndrome or post COVID-19 syndrome or post COVID-19 condition or post-acute sequelae of COVID).mp.	2507
3		(longcovid* or long covid* or longcoronavirus* or longcorona* virus* or long coronavirus* or long corona* virus* or longCov or long Cov or longsars* or long sars* or "long severe acute respiratory syndrome*" or long cov* or long cov*).ti,ab,kw,kf.	2090
4		or/1-3	4833
5	Filters to remove study types which are not of interest	Clinical Trial/ or Randomized Controlled Trial/ or controlled clinical trial/ or multicenter study/ or Phase 3 clinical trial/ or Phase 4 clinical trial/ or exp RANDOMIZATION/ or Single Blind Procedure/ or Double Blind Procedure/ or Crossover Procedure/ or PLACEBO/ or randomi?ed controlled trial$.tw. or rct.tw. or (random$ adj2 allocat$).tw. or single blind$.tw. or double blind$.tw. or ((treble or triple) adj blind$).tw. or placebo$.tw. or Prospective Study/	1909034
6		exp Meta Analysis/ or ((meta adj analy$) or metaanalys$).tw. or ((mega adj analy$) or megaanalys$).tw. or (systematic adj (review$1 or overview$1)).tw.	403964
7		(exp Animal/ or nonhuman/) not exp human/	5058068
8		exp letter/ or exp preliminary communication/ or exp note/ or exp editorial/ or exp editor/ or exp editorial policies/ or exp newspaper/	1825510
9		4 not (5 or 6 or 7 or 8)	3967
10	Study types to include	Clinical study/ or Case control study/ or Family study/ or Longitudinal study/ or Retrospective study/ or Prospective study/	2072565
11		10 not (5 or 6)	1310217
12		Cohort analysis/ or (Cohort adj (study or studies)).tw. or (Case control adj (study or studies)).tw. or (follow up adj (study or studies)).tw. or (observational adj (study or studies)).tw. or (epidemiologic$ adj (study or studies)).tw. or (cross sectional adj (study or studies)).tw.	1095584
13		patient-reported outcome/	12383
14		"Patient reported outcomes".tw.	18049
15		or/11-14	2174500
16	Total: disease terms and observational terms	4 and 15	867
17	**Total: disease terms and observational terms (with filters applied)**	**16 not (5 or 6 or 7 or 8)**	**689**

Table 3. Search strategy for The Cochrane Library

#		Query	Results from 14 Nov 2022
1	*Long COVID terms*	*((long or post or persist* or sequela* or complication) adj5 (COVID* coronavirus* or SARS*))*	*34*
2		*(longCOVID or long COVID or long-COVID or long haul COVID or long-haul COVID or post-acute COVID syndrome or persistent COVID-19 or post-acute COVID19 syndrome or long hauler COVID or post-acute sequelae of SARS-COV-2 infection or chronic COVID syndrome or post COVID-19 syndrome or post COVID-19 condition or post-acute sequelae of COVID)*	*4248*
3		*long covid*	*1114*
4		*#1 or #2 or #3*	*4255*
5	*Study types to include*	*Clinical study or Case control study or Family study or Longitudinal study or Retrospective study or Prospective study*	*1090788*
6		*Cohort analysis or Cohort stud* or Case control stud* or follow up stud* or observational stud* or epidemiologic* stud* or cross sectional stud**	*358672*
7		*patient-reported outcome or PRO*	*33853*
8		*#5 or #6 or #7*	*1160929*
9	*Long COVID and study types to include*	*#4 and #5*	*3513*
10	*Filters to remove study types which are not of interest*	*Clinical Trial or Randomized Controlled Trial or controlled clinical trial or multicenter study or Phase 3 clinical trial or Phase 4 clinical trial or RANDOMIZATION or Single Blind Procedure or Double Blind Procedure or Crossover Procedure or PLACEBO or randomi?ed controlled trial$.tw. or rct.tw. or (random$ adj2 allocat$).tw. or single blind$.tw. or double blind$.tw. or ((treble or triple) adj blind$).tw. or placebo$.tw. or Prospective Study*	*1480199*
11		*Meta Analysis or ((meta adj analy$) or metaanalys$).tw. or ((mega adj analy$) or megaanalys$).tw. or (systematic adj (review$1 or overview$1)).tw.*	*31920*
12		*Animal or nonhuman*	*48956*
13		*#10 or #11 or #12*	*1483816*
14	***Total: disease terms and observational terms (with filters applied)***	***#9 not #13***	***70***

Table 4. Study eligibility criteria

Topic	Inclusion Criteria	Exclusion criteria
Population(s)	*People with post-COVID conditions (PCC)* with no limitations on whether patient-reported or clinically diagnosed* *Follow up of patients with a positive SARS-CoV-2 test result or COVID-19 diagnosis to investigate development of PCC*	*NA*
Intervention	*Any/none*	*NA*
Comparison	*All*	*NA*
Outcomes	> *Definition and diagnosis of PCC used by the study* > *Length of follow-up for PCC* > *Symptoms, signs, and conditions measured* > *Other outcomes measured* > *Method used to measure outcome (e.g. survey, questionnaire, database registry)*	*NA*
Time	*Studies published from 1 January 2020 to 14 November 2022*	*NA*
Study design	*Study types to be included are:* > *Case-control studies* > *Prospective cohort studies* > *Retrospective cohort studies* > *Cross sectional studies* > *Database registry reports* > *Systematic literature reviews and meta-analyses (for bibliography checks only)*	*Study types to be excluded are:* > *Editorials* > *Case studies* > *Letters to journals* > *Non-systematic literature reviews* > *Study protocols* > *Conference minutes* > *Randomized Clinical Trials* > *Studies with sample size <50 participants* > *Studies that only include participants with a specific comorbidity* > *Studies that only include a specific residual symptom/ complication of post COVID-19*

NA: not applicable; PCC: post-COVID condition.
**Studies reporting PCC, long COVID, PASC, and long-hauler COVID were included to ensure all relevant data were captured.*

Table 5. PCC symptoms/conditions terms according to symptom/condition domains

Symptom/condition domain	***Symptoms/conditions as reported by studies***
Cardiovascular	***Abnormal heartbeat*** *(Palpitations, Other dysrhythmias, Tachycardia, Arrhythmia, Bradycardia, Palpitations/tachycardia, Palpitations-Tachycardia, Palpitation/tachycardia, Cardiac dysrhythmia, Tachycardia/palpitations, Chest pain/tachycardia, Feeling your heart pound or race, Heart rate dysfunction, Heart rhythm disturbances, Arrythmia or palpitations, Palpitations/dizziness, Tachycardia/palpitations/arrhythmia, Tachycardia / palpitations / Arrythmia, Palpitations and cardiac disorders, Arrythmia, Abnormal heartbeat)* ***Change in blood pressure*** *(high blood pressure, change in blood pressure, hypertension, hypotension, high or low blood pressure),* ***Non-specific cardiovascular condition*** *(circulatory symptoms, circulatory symptoms, CV problems, cardiologic, cardiovascular, cardiopulmonary, cardiorespiratory symptoms, heart complaints, CV, circulatory signs and symptoms, circulatory problems (incl. bulging veins), cardiovascular symptoms), other coagulation disorders, low oxygen level, acute myocardial infarction, cardiac dysrhythmias, cardiovascular disease, heart failure, myocarditis and cardiomyopathy, hypercoagulability DVT PE PAO, visibly inflamed/bulging veins, bleeding, hematomas, hypercoagulability , blood clot, blood clots in vein, new SAH, hematologic sequelae, chest pain or palpitations , low oxygen levels, orthostatic intolerance, hypotension or syncope, C19-YRS item: bruising/bleeding, hypoxemia*
Constitutional	***Change in temperature*** *(chills or sweat, cold, other temperature issues, low temperature, chills/flushing/sweats, hot flushes, heat/cold intolerance), Fatigue (fatigue, exercise capacity, weakness/tiredness, malaise/fatigue, energy levels, decreased stamina, fatigue or lethargy, fatigue related disorders, chronic fatigue, easy fatigability, persistent fatigue, rapid physical exhaustion, constant fatigue, general fatigue, C19-YRS item: fatigue, tired),* ***Fever/****chills (chills, fever, persistent fever, elevated temperature (98.8-100.4F), chills or fever, intermittent fever, low-grade fever, shaking chills, feeling unusually cold, subjective fever, objective fever),* ***Loss of appetite*** *(Poor appetite, Loss of appetite, Loss of appetite/taste/smell, Loss of appetite , Loss of appetite or weight, Decreased appetite, Loss of appetite or anorexia, Appetite loss , Hyporexia/anorexia, Food reduction, Appetite loss, Anorexia/decrease in appetite, Gastrointestinal Loss of appetite , Skipping meals, Lack of appetite, Loss of appetite/weight),* ***General pain*** *(Pain/discomfort, Pain, Neuralgia (nerve pain), Impact of symptoms of daily activities/living: Pain or discomfort, Burning pain, Pain Symptoms , Persistent pain, Unspecified pain, Pain or discomfort, Aches and pains, Non-specific pain, General pain, Pain and discomfort, Localised pain, Widespread pain, Generalized pain, Pain disorder, C19-YRS item: Pain/discomfort, Other pain),* ***Non-specific constitutional symptom*** *(Any symptom, Infection, Flu-like symptoms, Co-occurrence of symptoms, Any, Any general symptoms, Physical symptoms, Bodily reactions, Constitutional symptoms, Systemic, Worsening of previous condition, General, Non-specific, General signs/symptoms, Generalized symptoms, General symptoms, General signs), Weight changes, Malaise, Excess sweating, Weight loss, Weight gain, Post-exertional malaise, Excessive sweating, Clinical presentation of Long COVID by time (variant), Post-exertion malaise, Decreased physical/athletic performance, Post exertional malaise, Appetite change, Mental health, Changes in symptoms following peak activity, Nausea and fatigue, Weight loss , Tired looking at screen, Sweating, Eating changes, Food increase, Sudden weight loss, Sweating, Night sweats, Long COVID symptoms, Sweat, Hyperhidrosis, Malaise , Excessive night sweat , Appetite, Body weight changes, Nocturnal sweating, General malaise, Increased appetite, C19-YRS item: Post-exertional malaise, C19-YRS item: Appetite changes, C19-YRS item: Weight changes, Heartburn, Sweats, Increased or decreased appetite, Malnutrition*
Dermatological	***Non-specific dermatological symptom*** *(Dermatological ailments, Skin irritation/ lesions, Skin problems, Dermatographia, COVID toe, Skin alterations, Skin lesions, Nail changes , New skin findings, Skin signs, Cyanosis, Skin disease, Cutaneous signs, Dermatological sequelae, Cutaneous, Cutaneous lesions, Skin signs/symptoms, Other specified inflammatory condition of skin, Dermatological, Cutaneous disorders, Lumpy lesions: (purple/pink/bluish) on toes/COVID toes, Skin, Discoloration of fingers/toes, Nail discoloration, Toe lesions, Nail changes, Skin disorders, Dermatological disorders, Skin lesion, Blue or purple lips or fingers, Dermatological lesions),* ***Hair loss*** *(hair loss, alopecia),* ***Rash*** *(rash, rash/skin conditions, itching/rash, skin lumps or rashes, lumps or rashes on toes, new spots or rash on skin, rash or paresthesia, exanthema),* ***Dry skin*** *(dry skin, peeling skin, scaly skin),* ***Itching*** *(itchiness, itching skin, itching whole body, pruritus), Skin allergy, Red and cracked lips, Ulcers, Other Skin*

	and Allergy, Petechiae, Red spots on the skin, Ulcer, Dark circles under eyes, Pressure ulcer, Eczema , Acne, Black fungus, Herpes, Raised welts on skin or swelling, Neoplasm related encounters, Spontaneous bruises, Erythema, Dark spots (pigmentation) on lower limbs, Discontinuous flushing, Pressure ulcers, Pressure ulcer of skin
Extremities	***Cold extremities*** *(cold feet, cold hands or feet),* ***Edema*** *(Lower limb edema, Pedal oedema, Swollen hands and feet, Edema, Blue/purple/white or swollen fingers or toes, Lower extremity edema, Swollen ankle, Swelling or oedema in lower limbs, Limb swelling, Discoloration / swelling of hands and feet, Heavy legs / swelling of the legs, Swelling, Peripheral edema, Limb edema),* ***Extremity pain*** *(limb pain, melalgia, articular pain, pain in extremities, pain in hands and feet)*
Gastrointestinal	***Abdominal pain*** *(Abdominal pain, Abdominal pain/digestive symptoms, Abdominal pain , Constipation/abdominal pain, Other abdominal pain, Stomach/abdominal pain, Unusual abdominal pain),* ***Dyspepsia*** *(stomach ache, stomach pain, indigestion, bloating, abdominal discomfort, gas or indigestion),* ***gastritis*** *(esophagus burning/reflux, stomach burn, pyrosis/reflux, gastritis, acidity or gastritis, C19-YRS item: acid reflux, gastroesophageal reflux),* ***Non-specific gastrointestinal symptom*** *(Gastrointestinal ailments, Gastrointestinal, Gastrointestinal and esophageal, Gastrointestinal problems, Any gastrointestinal symptoms, Digestive symptoms (nausea/vomiting/diarrhea), Abdominal pain/nausea/bowel movements, Bowel dysfunction, Gastrointestinal issues, Gastrointestinal (heartburn, diarrhea), Gastrointestinal disorders, Gastrointestinal symptoms, Abdominal symptoms, Gastrointestinal complications, Abdominal signs and symptoms),* ***Diarrhea*** *(diarrhea, loose motion, bowel incontinence, loose stools, gastrointestinal diarrhea),* ***Nausea/vomiting*** *(nausea, vomiting, feeling sick, sickness/vomiting, retching, C19-YRS item: Nausea), Constipation, Nausea or diarrhea, Diarrhea and vomiting,, Nausea or abdominal pain, Diarrhea/vomiting, Constant diarrhea/constipation,, Digestive disorder, Constipation , Digestive disorders, Loose motion, Digestive tract problems*
Genitourinary	***Menstruation changes*** *(Menstrual issues , Changes in menstruation, All menstrual/period issues, Menstruation modification, Menstrual cramps or other problems with your periods, Menstrual cramps, Menstrual disturbances, Dysmenorrhea, Abnormal menstruation, C19-YRS item: Menstrual cycle changes, Vaginal discharge, Menorrhagia),* ***Sexual dysfunction*** *(decreased libido, erectile dysfunction, sexual dysfunction, problems during sexual intercourse, dyspareunia, ejaculation difficulty, reduced libido),* ***Non-specific genitourinary symptom*** *(Genitourinary symptoms, urinary symptoms, gynecological symptoms),* ***Urinary tract infections***, ***Urination problem*** *(incontinence, toilet habits, bladder control issues, urination problem, urinary pain, problems passing urine, bladder dysfunction, continence, urinary retention, polyuria, nocturia),* ***kidney problem***
Lymphatic	***Lymphadenopathy*** *(Lymph node swelling, Tender lymph nodes, Lymphadenopathy)*
Musculoskeletal	***Asthenia*** *(weakness, muscle weakness, asthenia, limb weakness, strength deficit, Weakness in arms or legs/muscle weakness, reduced muscle strength),* ***bone pain*** *(bone ache or burning, bone aches, bony aches),* ***joint pain*** *(joint pain, arthralgia),* ***joint swelling***, ***muscle/body pain*** *(Generalized muscle pain, Myalgia, Muscle pain, Body ache, Low back pain, Muscle or body ache, Muscle ache, Myalgia (excluding chest pain), Body aches or muscle pains , Musculoskeletal pain, Muscle aches, Muscle aches (myalgia), Back pain or backache, Body pain or ache, Back pain, Neck/back muscle ache, Myalgias, Lumbago, Muscle/body ache, Muscular cramps, Persistent muscle pain, Muscular pain, Myalgia , Pain (chest/muscle/joint), Leg pain, Myalgia (muscle pain), Muscular pain/soreness, Unusually strong muscle pains, Muscle/body aches, Body/muscle pain, Neck, back and low back pain, Joint or muscle pain),* ***muscle/joint pain*** *(joint or muscle pain, myalgia/arthralgia, Muscle or joint pain in the upper limbs, Muscle or joint pain in the lower limbs, Musculoskeletal (joint pain, muscle aches),* ***non-specific musculoskeletal symptoms/conditions*** *(muscle disorders, somatic complaints, musculoskeletal disorder, muscular problems, musculoskeletal),* ***paresthesia*** *(tingling, numbness, paresthesia, twitching, pins and needles, tingling/pain in extremities, burning or pins/needles), muscle stiffness, muscle spasms, muscular sequelae, sarcopenia, bone/joint pain*
Neurological	***Balance disorders*** *(dizziness, vertigo, light headedness, coordination problems, balance issues, loss of balance, dizziness after physical effort, dizzy/blackout/fits, dizziness when standing, balance deficit, trouble with balance or feeling unsteady, C19-YRS item: Balance and weakness),* ***Cognitive impairment*** *(Disorientation, Forgetting, Memory loss / trouble concentrating, Ability to talk, Academic impairment, Acute (sudden) confusion/disorientation, Altered mental status/confusion, Amnesia, Amnesia or memory difficulty, Attention, Attention deficit, Attention disorder,*

Attention instability, Attention or concentration disorders, Attention or memory deficit , Attention problems, Attention/concentration difficulties, Bradypsychia, Brain fog, Brain fog / Difficulty concentrating, Brain fog, concentration, forgetfulness, Brain fog/cognitive issues, C19-YRS item: Cognition, Change in ability to think, Change in memory, Cognition, Cognition: concentration, Cognition: short-term memory, Cognitive (poor attention/concentration), Cognitive Blurring-Frain Fog, Cognitive complaints, Cognitive dysfunction, Cognitive function, Cognitive functioning, Cognitive functions and awareness, Cognitive impairment, Cognitive problems, Cognitive problems , Cognitive symptoms, Cognitive symptoms: Attention, Cognitive symptoms: Concentration, Cognitive symptoms: Confusion, Cognitive symptoms: Memory, Communication/motor disorders, Concentration, Concentration difficulties, Concentration difficulty, Concentration disorders, Concentration impairment, Concentration Loss, Concentration problems, Concentration/memory difficulties, Confused/difficulty concentrating, Confusion, Confusion or brain fog , Confusion or disorientation, Confusion or lack of concentration, Confusion, disorientation, or drowsiness, Confusion/ delirium, Decision making, Deficit in work performance, Deterioration of ability to concentrate, Difficulties in making decision/ impulse control, Difficulties Remembering, Difficulty concentrating, Difficulty understanding instruction, Disorientation or confusion, Dysarthria, Either brain fog or poor memory, Executive dysfunction complaints, Find it difficult to make a decision, Find it hard to work out what order to do tasks in, Forget what they are saying, Forgetfulness, Forgetfulness/absent minded, Growling, Hesitating before speaking or moving, Impaired attention, Impaired concentration, Impaired concentration/forgetfulness, Impaired memory, Inability to concentrate, Information processing difficulty, Lack of concentration, Lack of focus, Language difficulties, Language problem, Long-term memory, Loss of concentration, Memory, Memory and concentration impairment, Memory changes, Memory disorder, Memory disturbance, Memory failure, Memory impairment, Memory impairment/ forgetfulness, Memory issues, Memory lapses, Memory loss, Memory loss or confusion, Memory problems, Memory/concentration, Mental confusion, Mental fogging/lack of concentration, Mild cognitive impairment, Neurocognitive, Neurocognitive decline, Neuro-cognitive difficulties, Neurocognitive impairment, Neurological and cognitive impairments, New cognitive function, Oblivion, Often have a vacant look, Poor concentration, Poor memory, Problems speaking, Problems speaking or communicating, Sense of comprehension, Short term memory issues, Short-term memory, Slowed thinking, Slurring words/speech, Speech disturbances, Speech impairment, Speech/language issues, Struggle to choose appropriate clothes, Struggle to find the right words, Stuttering, Subjective cognitive function, Swearing, Thinking, Trouble concentrating, trouble with your thinking, or trouble with your memory, Trouble remembering or concentrating, Use the wrong words for people or objects, Word finding difficulty, Word finding problems, Word repetition, Word-finding difficulty, Worsened memory/concentration), ***Headache*** *(headache, migraine),* ***Movement impairment*** *(Abnormal gait, Changes in ability to move, Gait impairment, Inability to control body movement, Inability to walk, Jerking of limbs, Motor disabilities, Motor disorders, Movement impairments, Problems with gait/ falls, Restricted movement, Slowness of movement, Slowness of movement (bradykinesia), Tics, Walking difficulties, Walking intolerance, Walking; getting around),* ***Non-specific neurological symptom*** *(All sensorimotor symptoms, Neurological, Neurological (concentration, tremors etc.), Neurological ailments, Neurological disorders, Neurological symptoms, Neuropathies, Neuropsychiatric sequelae, Neuropsychotic, Onset of neurological problems, Other nervous system disorders, Vibrating Sensations),* ***Sleep disorders*** *(Insomnia, C19-YRS item: Sleep, C19-YRS item: Sleep apnoea, Difficulty sleeping, Disturbed sleep, Drowsiness, Excessive sleep, Hypersomnia, Insomnia severity, Insomnia Severity Index, Irregular sleeping, Nightmare, Other sleeping symptoms, Poor sleep quality, Problem sleeping, Sleep, Sleep aids, Sleep apnea, Sleep complaints, Sleep difficulty, Sleep disorder, Sleep disturbances, Sleep less, Sleep more, Sleep problems, Sleep quality, Sleep wake disorders, Sleeping difficulties, Sleep-wake cycle alterations, Somnipathy, Unable to sleep lying down, Unrefreshing sleep, Worsened sleep quality), Any central nervous system symptoms, Autonomic dysfunction, Can't move and/or feel one side of body or face, Can't feel one side of the body or face, Cognitive assessment, Cognitive testing, Cranial nerve abnormalities, Disturbance of leg sensitivity, Dysautonomy, Dysesthesia, Dysthesia, Epileptic attacks, Extreme paleness, Fainting, Fainting/blackout, Fainting/blackouts, Hand tremors, Hyperactivity, Hypoesthesia, Loss of sensation, one side of body, Loss of sensation, one side of the body, Nervous signs and symptoms, Nervous system symptoms, Neuropathic, Neuropathic pain, Neuropathy, Orthostasis, Peripheral neuropathy, Pre-Syncope, Reflex deficit, Seizure, Sensitive disorders, Sensitivity deficit, Tremor, Trigeminal function*

Other	*Other symptoms*
Mental health conditions	***Affective disorders*** *(adjustment disorder, affective disorders, externalizing, emotionally reactive, dissociation index, overt dissociation, covert dissociation, affective symptoms),* ***Anxiety*** *(anxiety, stress, worry/anxiety, nervousness, separation anxiety, generalized anxiety, social anxiety, performance anxiety, panic, tension-restlessness, avoidance of danger, feeling having COVID again, situative anxiety, PTSD, fear and anxiety, emotional stress, fear or panic attack, psychological distress, mood/anxiety disorders, Anguish/nervousness/agitation, sensation of danger/fear),* ***anxiety/depression****,* ***behaviour changes*** *(behaviour changes, use of technological tools, use of mobile phone/computer),* ***Depression*** *(depression, decreased mood, apathy/feeling sad, low mood, sadness, internalization, upsetting thoughts/memories, C19-YRS item: Thoughts of self-harm, feeling of emptiness, feelings of inferiority),* ***hallucinations*** *(hallucinations, auditory, visual),* ***mood disorders*** *(Altered mood, Anger, Angry/irritable/easily frustrated about unimportant matters, Anhedonia, C19-YRS item: Anxiety/ mood/ post-traumatic stress, Change in mood, Changing mood / impact on morale, Desire to cry, Dysphoria, Feeling jumpy, Frustration, Irritability, Less motivation, Loss of interest, Loss of interest or pleasure, Mood, Mood changes, Mood disorder, Mood swing or disorders, Mood swings, Mood, good, Mood, moderate, Motivation loss, Personality change, Unexplained irritability),* ***Non-specific psychiatric symptoms*** *(Mental complaints, Mental illness, Neuro-psychiatric, Neuropsychiatric symptoms, Other mental conditions, Psychiatric, Psychiatric disorders, Psychiatric illness, Psychological, Psychological & social, Psychological (anxiety, depression etc.) Psychological symptoms, Psychosocial symptoms, Pure physiosomatic),* ***substance use disorders*** *(alcohol, drug), obsessions-compulsions disorder, anhedonia, anorexia, suicidal, delirium, COVID-19 related distress*
Respiratory	***Abnormal breathing*** *(abnormal breathing, tachypnea, pain on breathing, rattling of breath, polypnoea),* ***Chest*** *pain (chest pain, chest tightness, non-specific chest pain, pain/burning in chest, thoracic pain, chest discomfort, chest heaviness, recurring chest pain),* ***Cough*** *(dry cough, productive cough, cough, hiccough, wheezing/coughing, cough with blood, cough with mucus production, cough with phlegm, fatty cough, persistent cough, new onset cough, cough with expectoration, C-19 YRS item: cough/voice),* ***Dyspnea*** *(dyspnea, shortness of breath, breathlessness, dyspnea at rest, exertional dyspnea, breathing difficulty),* ***non-specific respiratory symptom*** *(respiratory complaint, respiratory symptom, respiratory tract symptom, other),* ***non-specific URTI symptom*** *(sore throat, runny nose, congestion, laryngeal/airway complications, rhinorrhea, mucus in throat or nose, throat pain, sinus pain, rhinitis, upper respiratory symptom, ear, nose, and throat symptom, sinusitis), Bloody sputum, Excess sputum, Expectoration, Hemoptysis, Increased sputum production, Pleurisy or pleural effusion, Productive sputum, Respiratory failure, Sputum, Sputum production, Wheezing*
Sensory-related	***Conjunctivitis*** *(red eyes, itchy eyes, pink eye, conjunctivitis, conjunctival inflammation, ocular hyperemia),* ***dry eyes/mouth*** *(xerostomia, dry mouth, feeling of dryness in mouth, dry eyes),* ***dysphagia*** *(swallowing difficulties, dysphagia, problems swallowing or chewing, C19-YRS item: swallow),* ***dysphonia*** *(dysphonia, voice problems, hoarseness, voice change),* ***ear pain****,* ***eye pain*** *(eye pain, irritation, otalgia),* ***gum disorders*** *(disorders of teeth/gingiva, gum or teeth pain, bleeding gum),* ***hearing impairment*** *(hearing disturbances, hearing problems, hearing loss, hypoacusis, sensitivity to sound, tinnitus, deafness, clogged ears),* ***loss of smell*** *(loss of smell, smell impairment, anosmia, decreased sense of smell, olfactory dysfunction, hyposmia),* ***loss of taste*** *(loss of taste, altered taste, ageusia, taste impairment, change/loss of taste),* ***non-specific smell/taste disorder*** *(decreased smell/taste sensation, dysgeusia, anosmia, chemosensory deficit, altered taste/smell, smell, taste, change in smell, change in taste, hyperosmia, cacosmia, parosmia, C19-YRS item: smell/taste)* ***non-specific ENT*** *(eye, ENT ailments, sensory alterations, C19-YRS item: eye changes),* ***visual impairment*** *(sight disturbances, vision issues, changes in vision, eye sight, photophobia, sensitivity to light, diplopia, double vision, vision impairment, visual distortion, ocular symptoms, asthenopia, C19-YRS item: visual changes, blurred vision, unusual eye soreness), Dysphonia, Allergy, C19-YRS item: Allergies, C19-YRS item: Dry mouth/ulcers, C19-YRS item: Tinnitus, Chapped lips, Coryza, Dysphonia/aphonia, Epistaxis, Itching in the ear, Itching in the eyes, Mouth sores, Mouth ulcer, Mucosal dryness, New allergies, Newly appeared allergy, Oral ulcers, Otitis, Otitis externa, Periorbital pigmentation, Phantosmia, Recurrent feeling of thirst, Vomiting Ageusia*
Symptom severity	*Symptom severity*

Total number/duration of symptoms	*Duration of symptoms, Total number of symptoms*

CV: cardiovascular; C19-YRS: COVID-19 Yorkshire Rehabilitation Scale; DVT-PE-PAO; deep vein thrombosis, pulmonary embolism, partial pressure of oxygen; ENT: ear, nose, and throat; PTSD: post-traumatic stress disorder; SAH: systemic arterial hypertension; URTI: upper respiratory tract infection.

*Terms in **bold** indicate groupings of similar symptoms that were used for analysis.*

Table 6. Summary of included study characteristics (N=291)

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Abdelrahman(67)	2021	Cross-sectional	Egypt	Outpatient	Single center	May 2020–March 2021	Author definition	172	Adult
Abdelwahab(68)	2022	Retrospective cohort study	US	Clinical/hospital	Multicenter	March 2020–January 2021	Author definition	17808	Adult
Abramoff(69)	2022	Prospective cohort study	US	Outpatient	Single center	June 2020–April 2021	Previous study	324	Adult
Adler(70)	2022	Retrospective cohort study	Israel	Community	Multicenter	September 2021	NA	819	Adult
Al-Aly(71)	2021	Retrospective cohort study	US	Outpatient	Multicenter	March–November 2020	Author definition	73435	Adult
Al-Aly(72)	2022	Prospective cohort study	US	Outpatient	Multicenter	January 2021–December 2021	Previous study	33940	Adult
Alkwai(73)	2022	Cross-sectional	Saudi Arabia	Community	Multicenter	November 2020–December 2021	Author definition	213	Adult
Areekal(74)	2021	Cross-sectional	India	Outpatient	Single center	December 2020 - February 2021	NICE/NHS England	335	Adult
Arjun(75)	2022	Retrospective cohort study	India	Outpatient	Single center	January 2022–February 2022	Author definition	524	Adult

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Arnold(76)	2020	Prospective cohort study	UK	Outpatient	Single center	March-June 2020	NA	110	Adult
Asadi-Pooya(77)	2021	Retrospective cohort study	Iran	Inpatient	Multicenter	February - November 2020	Author definition	4681	Adult
Asadi-Pooya(78)	2022	Retrospective cohort study	Iran	Clinical/hospital	Multicenter	February 2020– November 2020	Author definition	51	Pediatric
Augustin(79)	2021	Prospective cohort study	Germany	Outpatient	Single center	January– October 2021	Author definition	958	Adult
Ayoubkhani(80)	2021	Prospective cohort study	UK	Community	Multicenter	February 2021– September 2021	Patient perception/self-diagnosis	28,356	Adult
Ayoubkhani(81)	2022	Prospective cohort study	UK	Community	Multicenter	April 2020– November 2021	Author definition	3,090	Adult
Ayoubkhani(82)	2022	Prospective cohort study	UK	Community	Multicenter	February– September 2021	Author definition	28,356	Adult
Ayuso(83)	2022	Cross-sectional	Spain	Inpatient and outpatient	Single center	November 2020– February 2021	NA	433	Adult
Bahat(84)	2022	Retrospective cohort study	Turkey	Clinical/hospital, outpatient	Single center	May 2020– June 2020	Author definition	665	Adult

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Bahmer(85)	2022	Prospective cohort study	Germany	Community	Multicenter	November 2020–September 2021	Previous study	1442	Adult
Ballering(86)	2021	Retrospective cohort study	Netherlands	Community	Multicenter	March 2020–August 2020	Author definition	1,106	NR
Ballouz(87)	2022	Ambidirectional cohort study	Switzerland	Community	Multicenter	February–August 2020, August 2020–January 2021	Previous study	1543	Adult
Baptiste da Silva(88)	2021	Retrospective cohort study	Brazil	Outpatient	Single center	March - December 2020	Author definition	90 (2-month follow-up); 67 (6-month follow-up)	Adult
Baris(89)	2022	Ambidirectional cohort study	Turkey	Clinical/hospital	Multicenter	March 2020–July 2020	NICE	504	Adult
Barreto(90)	2022	Cross-sectional	Brazil	Outpatient	Multicenter	August 2020–September 2021	Author definition	1164	Adult
Becker(91)	2021	Prospective cohort study	Switzerland	Inpatient	Multicenter	March–June 2020	Previous study	90	Adult
Bell(92)	2021	Prospective cohort study	US	Community	NA	May 2020–February 2021	Author definition	303	Adult
Bergia(93)	2022	Retrospective cohort study	Spain	Outpatient	Multicenter	March 2020–December 2020	NICE	451	Pediatric

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Bhargava(94)	2021	Retrospective cohort study	US	Outpatient	NR	March 2020–June 2020	Author definition	57	Both
Biharie(95)	2022	Retrospective cohort study	Netherlands	Inpatient and outpatients	Single center	March 2020–April 2021	NICE	83	Pediatric
Bonilla(96)	2022	Retrospective cohort study	US	Outpatient	Single center	May 2021–February 2022	Author definition	134	Adult
Boparai(97)	2022	Retrospective cohort study	US	Outpatient	Single center	January 2020–August 2020	Author definition	79	Both
Borch(98)	2022	Prospective cohort study	Denmark	Community	Multicenter	March–May 2021	WHO	30121	Pediatric
Bozkanat(99)	2022	Retrospective cohort study	US	Outpatient	Multicenter	March 2021–February 2022	Author definition	312	Pediatric
Brackel(100)	2021	Cross-sectional	Netherlands	Inpatient	Multicenter	December 2020–February 2021	Author definition	89	Pediatric
Brinkley(101)	2021	Prospective cohort study	UK, US	Community	Multicenter	US: April 2020–NR, UK: August 2020–NR	Author definition	25000	NR
Budhiraja(102)	2022	Prospective cohort study	India	Outpatient	Multicenter	April 2020–August 2020	Author definition	990	Both
Budhiraja(103)	2022	Retrospective cohort study	India	Clinical/hospital	Multicenter	March 2020–February 2022	Author definition	5529	Both

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Bull-Otterson(15)	2022	Retrospective cohort study	US	Inpatient, emergency department, outpatient	Multicenter	March 2020–November 2021	CDC	353164	Adult
Buonsenso(104)	2022	Retrospective cohort study	Italy	Outpatient and community	Multicenter	April 2020–June 2021	Author definition	See subgroups	Both
Buonsenso(105)	2022	Retrospective cohort study	Multinational	Community	Multicenter	February–March 2021	Author definition	510	Pediatric
Buonsenso(106)	2022	Retrospective cohort study	Italy	Outpatient	Single center	April 2020–April 2021	NA	155	Adult
Burton(107)	2022	Cross-sectional	UK	Community	Multicenter	July 2021–October 2021	Author definition	74	Adult
Caspersen(108)	2022	Cross-sectional	Norway	Community	Multicenter	March 2020–March 2021	Author definition	73727	Adult
Catalán(109)	2022	Retrospective cohort study	Spain	Outpatient	Single center	March - May 2020	Author definition	76	Adult
Cervia(110)	2022	Prospective cohort study	Switzerland	Inpatient and outpatient	Multicenter	April 2020–August 2021	Previous study	134	Adult
Chand(111)	2022	Retrospective cohort study	US	Outpatient	Single center	March 2020–April 2020	NA	103	Adult
Charfeddine(112)	2021	Cross-sectional	Tunisia	Community	Multicenter	January 2021–May 2021	Previous study	798	Adult

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Chatwani(113)	2021	Retrospective cohort study	US	Database/registry	Multicenter	March 2020– (ongoing at time of abstract publish)	Author definition	NR	Adult
Chaumont(114)	2022	Retrospective cohort study	France	Outpatient	Multicenter	March 2020–April 2020	NA	60	Adult
Chen(115)	2022	Retrospective cohort study	China	Outpatient	Single center	October 2020–December 2020	NA	129	Adult
Chen(116)	2022	Prospective cohort study	US	Inpatient and outpatient	Single center	March 2020–	NA	200	Adult
Chevinsky(117)	2021	Case-control	US	Inpatient/outpatient	Multicenter	March–June 2020	Author definition	74446	Both
Chirouze(118)	2022	Prospective cohort study	France	Inpatient	Single center	February - July 2020	Author definition	737	Adult
Chowdhury(119)	2021	Prospective cohort study	Bangladesh	Clinical/hospital	Multicenter	NR	Author definition	313	Both
Chudzik(120)	2022	Retrospective cohort study	Poland	Clinical/hospital and outpatient	Multicenter	September 2020–September 2021	WHO	2218	Adult
Chun(121)	2021	Prospective cohort study	US	Trial cohort	Single center	NR	Author definition	61	Adult

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Cohen(122)	2022	Retrospective cohort study	US	Database/registry and outpatient	Multicenter	January 2020–December 2020	NA	2895943	Adult
Comelli(123)	2022	Prospective cohort study	Italy	Inpatient	Multicenter	February–May 2020	Author definition	456	Adult
Danesh(124)	2021	Cross-sectional	US	Database	Multicenter	November 2020–February 2021	NA	200	Adult
Darcis(125)	2021	Prospective cohort study	Belgium	Clinical/hospital	Single center	March-October 2020	NA	199	Adult
D'Avila(126)	2022	Prospective cohort study	Brazil	Clinical/hospital	Single center	January–June 2021	Author definition	289	Adult
Davis(34)	2021	Retrospective cohort study	Multinational	Database/registry	Multicenter	September 2020–November 2020	Previous study	3762	Adult
de Arriba Fernandez(127)	2022	Retrospective cohort study	Spain	Community	Multicenter	June 2021–February 2022	Previous study	110,726	Both
De Miranda(128)	2022	Prospective cohort study	Brazil	Community, hospital, and outpatient	Single center	March 2020–November 2021	Author definition	646	Adult
de Oliveira(129)	2022	Cross-sectional	Brazil	Clinical/hospital	Single center	July 2020–March 2021	Author definition	439	Adult

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Degen(130)	2022	Prospective cohort study	Germany	Outpatient	Multicenter	September 2021–January 2022	Author definition	1082	Adult
Desgranges(131)	2022	Retrospective cohort study	Switzerland	Outpatient	Multicenter	February–April 2021	Author definition	418	Adult
Deuel(132)	2022	Prospective cohort study	Switzerland	Community	Single center	May 2021–November 2021	NA	493	Adult
Diem(133)	2022	Cross-sectional	Switzerland	Online	NA	October 15, 2021–December 12 2021	WHO	309	Adult
Donnachie(134)	2022	Retrospective cohort study	Germany	Outpatient	Multicenter	Until 31 March 2022	ICD-10 diagnosis code	391990	Adult
Dryden(135)	2022	Prospective cohort study	South Africa	Inpatient and outpatient	Multicenter	December 2020–July 2021	NA	1873	Adult
Duan(136)	2022	Retrospective cohort study	US	Outpatient	Multicenter	Post-April 2020	NA	134	Adult
Duerlund(26)	2022	Retrospective cohort study	Denmark	Outpatient	Single center	February 2020–August 2021	Referral requirements for North Denmark long COVID outpatient clinic	266	Both

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Dumont(137)	2022	Prospective cohort study	Switzerland	Community	Multicenter	December 2021–February 2022	Previous study	1034	Pediatric
Eitner(138)	2022	Case-control	Germany	Community	Multicenter	NR	Author definition	81	Pediatric
Elkan(139)	2021	Cross-sectional	Israel	Outpatient	Single center	March - July 2020	Author definition	66	Adult
Estrada-Codecido(140)	2022	Retrospective cohort study	Canada	Outpatient	Single center	March 2020–October 2020	NA	206	NR
Fernández-de-las-Peñas(141)	2022	Cross-sectional	Spain	Outpatient	Multicenter	March 2020–May 2020	NA	1969	Adult
Fernandez-de-las-Penas(142)	2022	Retrospective cohort study	Spain	Clinical/hospital inpatient	Single center	July 2021–August 2021	NA	201	Adult
Ferreira(143)	2022	Prospective cohort study	Brazil	Inpatient	Single center	March 2020–August 2020	NICE	749	Adult
Fischer(144)	2022	Prospective cohort study	Luxembourg	Community	Multicenter	May 2020–November 2020	WHO	289	Adult
Fjelltveit(145)	2022	Case-control	Norway	Outpatient	Single center	February - April 2020	WHO	233	Both
Fogh(146)	2022	Retrospective cohort study	Denmark	Community	Multicenter	February 2020–March 2021	WHO	341	Adult

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Förster(147)	2022	Retrospective cohort study	Germany	Population based	Multicenter	March 2020–September 2020	NICE, WHO	1459	Adult
Galan(148)	2022	Prospective cohort study	Spain	Community	Single center	March 2020–April 2020	NICE	50	Adult
Gallardo-Cartagena(149)	2022	Prospective cohort study	Peru, US, Republic of South Africa, non-RSA Sub-Saharan Africa	Clinical/hospital	Multicenter	May 2020–March 2021	Author definition	759	Adult
Ganesh(150)	2022	Prospective cohort study	US	Outpatient	Single center	January 2021–April 2021	Author definition	108	Adult
Garcia-Abellan(151)	2022	Prospective cohort study	Spain	Clinical/hospital inpatient	Single center	March 2020–June 2020	NA	72	Adult
Gasnier(152)	2022	Cross-sectional	France	Outpatient	Single center	July 2020–September 2020	Author definition	177	Adult
Gaur(153)	2022	Cross-sectional	India	Outpatient	Single center	November 2020–May 2021	Author definition	97	Adult
Geong Taat(154)	2022	Retrospective cohort study	Malaysia	Outpatient	Single center	January 2020 - July 2021	NA	74	Adult
Gonzalez(155)	2022	Cross-sectional	Spain	Outpatient	Single center	March–August 2021	WHO	181	Adult

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Gonzalez-Aumatell(156)	2022	Prospective cohort study	Spain	Outpatient	Single center	December 2020–May 2021	Author definition	50	Pediatric
Gruber(157)	2022	Retrospective cohort study	Germany	Outpatient	Multicenter	May 2020–May 2021	Author definition	221	Adult
Guido(158)	2022	Cross-sectional	Italy	Outpatient	Single center	February–November 2021	Previous study	322	Pediatric
Gupta(159)	2022	Cross-sectional	India	Inpatient/outpatient	Single center	October - November 2020	Author definition	300	Both
Gutierrez-Martinez(160)	2022	Retrospective cohort study	US	Outpatient	Single center	February 2020–May 2021	Author definition	100	Adult
Guven(161)	2022	Case-control	Turkey	Clinical/hospital	Single center	August–October 2020	NICE	251	Pediatric
Guzel(162)	2022	Cross-sectional	Turkey	Clinical/hospital	Single center	December 2020–May 2021	NICE	123	Adult
Hansen(163)	2021	Cross-sectional	Denmark	Clinical/hospital, community	Single center	NR	Author definition	55	Adult
Harashchenko(164)	2022	Cross-sectional	Ukraine	Outpatient	NR	NR	Author definition	243	Pediatric

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Hassan(165)	2022	Cross-sectional	Iraq	Outpatient	Multicenter	May-September 2021	Author definition	165	Adult
Hastie(21)	2022	Ambidirectional cohort study	Scotland	Electronic health records	Multicenter	April 2020–January 2022	Author definition	96238	Adult
Hayek(166)	2021	Cross-sectional	Lebanon	Outpatient	Single center	February 2020–February 2021	Previous study	52	Adult
Helmsdal(167)	2022	Prospective cohort study	Faroe Islands	Outpatient	Community	November 2021–January 2022	Previous study	170	Both
Hentschel(168)	2022	Case-control	US	Electronic health records	Multicenter	January 2020–December 2020	Author definition	406630	Adult
Hill(169)	2022	Case-control	US	Electronic health records	Multicenter	March 2021–December 2021	ICD-10 diagnosis code	1062661	Adult
Holdsworth(170)	2022	Prospective cohort study	UK	Outpatient and community	Multicenter	August 2020–April 2021	One of the indications for referral to DCRS	205	Both
Horberg(171)	2022	Case-control	US	Electronic health records	Multicenter	January 2021–December 2021	WHO	98411	Adult
Horwitz(172)	2021	Prospective cohort study	US	Inpatient	Single center	April - May 2020	Author definition	126	Adult

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Houben-Wilke(173)	2022	Cross-sectional	Netherlands	Community	Multicenter	June–September 2020	Author definition	239	Adult
Howe(174)	2022	Retrospective cohort study	US	Community	Multicenter	March 2020–May 2020	Author definition	115	Adult
Howe(175)	2022	Prospective cohort study	Australia	Community	Multicenter	October 2021–September 2022	Previous study	NR	Both
Huang(176)	2021	Ambidirectional cohort study	China	Outpatient	Single center	June-September 2020	NA	1733	Adult
Huang(177)	2022	Ambidirectional cohort study	China	Outpatient	Single center	January 2020–May 2020	Author definition	1192	Adult
Ioannou(178)	2022	Retrospective cohort study	US	Inpatient and outpatient	Multicenter	February 2020–April 2021	Author definition	198601	Adult
Jabali(179)	2022	Cross-sectional	Saudi Arabia	Outpatient	Single center	September 2021–December 2021	WHO	327	Adult
Jacobs(180)	2020	Prospective cohort study	US	Clinical/hospital	Single center	March–April 2020	Author definition	183	Adult
Jamil(181)	2022	Prospective cohort study	US, Canada	Outpatient and community	Multicenter	August 2020–September 2021	NA	157	Adult

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Jia(182)	2022	Prospective cohort study	US	Inpatient and outpatient	Single center	March 2020–February 2021	Author definition	617	Adult
Johnsen(183)	2021	Cross-sectional	Denmark	Outpatient	Single center	March 2020–August 2020	NA	57	Adult
Jones(25)	2021	Retrospective cohort study	UK	Database	Multicenter	August 2020–January 2021	NICE	3151	Adult
Jordan(184)	2022	Retrospective cohort study	US	Clinical/hospital inpatient	Single center	NR	Author definition	116	Adult
Juste(185)	2022	Prospective cohort study	UK	Outpatient	Single center	April 2021–January 2022	WHO	68	Pediatric
Kalaivani(186)	2022	Cross-sectional	India	Outpatient	Single center	March 2021–December 2021	NA	206	Both
Kayaaslan(187)	2021	Prospective cohort study	Turkey	Outpatient	Single center	August-October 2020	NICE	1007	Adult
Kenny(188)	2022	Prospective cohort study	Ireland	Outpatient	Multicenter	March 2020–April 2021	Author definition	233	Adult
Kidwai(189)	2022	Cross-sectional	Pakistan	Outpatient	Single center	44440	Previous study	84	Both
Kikkenborg Berg(190)	2022	Cross-sectional	Denmark	Database study	Multicenter	January 2020 - July 2021	WHO	10997	Pediatric

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Kildegaard(191)	2022	Retrospective cohort study	Denmark	Community	Multicenter	February 2020–October 2021	Author definition	74611	Pediatric
Klein(192)	2022	Cross-sectional	US	Clinical/hospital	Multicenter	NR	Author definition	178	Adult
Knight(193)	2022	Cross-sectional	US	Outpatient	Single center	March–August 2020	NICE, CDC, WHO	437	Adult
Koliadenko(194)	2022	Retrospective cohort study	Ukraine	Outpatient	Single center	March 2020–December 2020	Author definition	129	Adult
Kostev(195)	2022	Retrospective cohort study	Germany	Database/registry	Multicenter	October 2020–August 2021	ICD-10 diagnosis code	51,630	Adult
Kostev(196)	2022	Retrospective cohort study	Germany	Clinical/hospital	Multicenter	October 2020–August 2021	ICD-10 diagnosis code	6,568	Pediatric
Kozak(197)	2021	Retrospective cohort study	Canada	Clinical/hospital and outpatient	Single center	January 2020–June 2020	Previous study	223	Adult
Kuodi(198)	2022	Cross-sectional	Israel	Outpatient	Multicenter	March–November 2021	WHO	951	Adult
Kuodi(199)	2022	Cross-sectional	Israel	Outpatient	Multicenter	March 2020–November 2021	NA	3,398	Adult
Landis(200)	2022	Retrospective cohort study	US	Outpatient	Single center	April 2020 - April 2021	NA	128	Adult

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
LaVergne(201)	2022	Retrospective cohort study	US	Clinical/hospital	Multicenter	NR	Previous study	119	Adult
Lee(202)	2022	Retrospective cohort study	South Korea	Claims database	Multicenter	January–September 2020	Author definition	21615	Both
Leeder(203)	2022	Retrospective cohort study	US	Database study	Multicenter	December 2020 - October 2021	Author definition	1500	Adult
Lemhöfer(204)	2021	Cross-sectional	Germany	Community	NA	July 2020	Author definition	365	Adult
Li(205)	2022	Retrospective cohort study	China	Outpatient	Multicenter	January 2020–February 2020	NA	65	Both
Lionte(206)	2022	Retrospective cohort study	Romania	Inpatient	Multicenter	October 2020–December 2021	Previous study	978	Adult
Lloyd-Evans(207)	2022	Cross-sectional	UK	Online	Multicenter	11 March 2021–9 Novemebr 2021	Author definition	110	Adult
Loizeau(208)	2022	Retrospective cohort study	Switzerland	Outpatient	Multicenter	December 2021–February 2022	Previous study	1034	Pediatric
Lombardo(209)	2021	Retrospective cohort study	Italy	Clinical/hospital and outpatient	Single center	February 2020–May 2020	Author definition	303	Adult

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Lozano(210)	2022	Retrospective cohort study	Colombia	Outpatient	Multicenter	March 2021–August 2021	Author definition	181	Adult
Lund(211)	2021	Retrospective cohort study	Denmark	Database/registry	Multicenter	February 2020–May 2020	Author definition	8983 (SARS-COV-2 positive)	Both
Maamar(212)	2022	Cross-sectional	Spain	Community	Single center	April–September 2020	NICE	121	Adult
Maes(213)	2022	Case-control	Iraq	Clinical/hospital	Multicenter	September 2021–December 2021	WHO	125	Adult
Maestre-Muñiz(214)	2021	Cross-sectional	Spain	Outpatient	Single center	March - June 2020	Author definition	766	Adult
Magnusdottir(215)	2022	Retrospective cohort study	Denmark, Estonia, Iceland, Norway, Sweden, UK	Community	Multicenter	March 2020–August 2021	Previous study	9979	Adult
Mahmoud(216)	2021	Cross-sectional	Saudi Arabia	Outpatient	Multicenter	May 2021–June 2021	Author definition	150	Adult
Mahmoud(217)	2022	Retrospective cohort study	US	Outpatient	Single center	September 2020–May 2021	Author definition	100	Adult
Mammi(218)	2022	Retrospective cohort study	Italy	Outpatient	Single center	October 2020–April 2021	Previous study	50	Adult

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Mandal(219)	2021	Cross-sectional	UK	Outpatient	Multicenter	April 2020–June 2020	NA	384	NR
Martinez(220)	2021	Retrospective cohort study	Switzerland	Hospital	Single center	March 2020 – 15 April 2021	Author definition	260	Adult
Martin-Loeches	2022	Retrospective cohort study	Spain	Outpatient	Multicenter	February 2020–January 2021	Author definition	991	Adult
Massey(221)	2022	Retrospective cohort study	US	Community	Multicenter	Spring 2020–Fall 2021	CDC	14574	Adult
Mayor(222)	2022	Retrospective cohort study	UK	Outpatient/community	Multicenter	March 2020–April 2021	Author definition	403151	Adult
McFann(223)	2021	Prospective cohort study	US	Community	Single center	July 2020–March 2021	Previous study	62	Adult
McGrath(224)	2022	Retrospective cohort study	US	Claims database	Single center	October 2021–January 2022	ICD-10 diagnosis code	12622	Both
McNaughton(225)	2022	Retrospective cohort study	Canada	Outpatient	Multicenter	January 2020–March 2021	Author definition	Total: 530,232 Positive PCR test: 265,116 Negative PCR matched cohort: 265,116	Adult
Mendelsohn(226)	2022	Cross-sectional	South Africa	Outpatient	Single center	December 2020 - January 2021	Author definition	174	Adult

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Menezes Jr(227)	2022	Prospective cohort study	Brazil	Inpatient/outpatient	Multicenter	February 2021– March 2022	Previous study	108	Adult
Menges(228)	2021	Prospective cohort study	Switzerland	Outpatient	Multicenter	February–August 2020	NICE	431	Adult
Messin(229)	2021	Retrospective cohort study	France	Inpatient	Single center	March 2020	Author definition	74	Adult
Mirfazeli(230)	2022	Cross-sectional	Iran	Inpatient/outpatient	Single center	March 2019 - April 2020	Author definition	95	Adult
Mohamed-Hussein(231)	2021	Cross-sectional	Egypt	Inpatient/outpatient	Multicenter	July–October 2020	NICE	262	Adult
Monaghan(232)	2022	Cross-sectional	Ireland	Trial cohort	Single center	May 2021–September 2021	Author definition	85	Adult
Montenegro(233)	2022	Cross-sectional	Spain	Community	Multicenter	May - November 2020	WHO	579	Adult
Morioka(234)	2022	Cross-sectional	Japan	Clinical/hospital	Single center	December 2021– February 2022	Author definition	53	Adult
Moy(235)	2022	Cross-sectional	Malaysia	Community	Multicenter	July - September 2021	NICE	732	Adult
Munblit(236)	2021	Retrospective cohort study	Russia	Clinical/hospital	Multicenter	April 2020– July 2020	Author definition	2649	Adult

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Nakano(237)	2022	Retrospective cohort study	Japan	Outpatient	Single center	February 2021–July 2022	Author definition	353	Adult
Nakayama(238)	2022	Retrospective cohort study	Brazil	Outpatient	Single center	March 2020–March 2021	Previous study	565	Adult
Ng(239)	2022	Retrospective cohort study	US	Clinical/hospital and outpatient	Single center	NR	Author definition	117	Adult
Nune(240)	2022	Cross-sectional	UK	Outpatient	Single center	February - July 2020	Author definition	89	Adult
Ocsovzky(241)	2022	Prospective cohort study	Hungary	Outpatient	Single center	March 2021–December 2021	Author definition	166	Adult
Ogungbe(242)	2022	Cross-sectional	US	Database/registry	Single center	November 2021–January 2022	Author definition	442	Adult
O'Kelly(243)	2022	Prospective cohort study	Ireland	Outpatient	Single center	June 2020–November 2020	Author definition	52	Adult
Osikomaiya(244)	2021	Retrospective cohort study	Nigeria	Outpatient	Single center	April 2020–June 2020	NA	274	Both
O'Sullivan(245)	2021	Cross-sectional	UK	Outpatient	Single center	April–November 2020	Author definition	155	Adult

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Pajor(246)	2022	Retrospective cohort study	US	Clinical/hospital	Multicenter	March 2020–February 2022	Author definition	78744	Both
Pant(247)	2021	Cross-sectional	Nepal	Outpatient	Single center	October 2020–March 2021	NA	150	Adult
Patel(248)	2022	Case-control	Canada	0	Single center	NR	NA	92	Adult
Peghin(249)	2021	Ambidirectional cohort study	Italy	Clinical/hospital	Single center	March-November 2020	Author definition	599	Adult
Pelà(250)	2021	Ambidirectional cohort study	Italy	Outpatient	Single center	May 2020–November 2020	NA	160	Adult
Peluso(251)	2021	Prospective cohort study	US	Outpatient	Multicenter	From April 2020	Author definition	121	Adult
Peluso(252)	2021	Prospective cohort study	US	Community	Single center	NR	Author definition	121	Adult
Peluso(253)	2021	Prospective cohort study	US	Community	Single center	NR	Author definition	70	NR
Peluso(254)	2022	Prospective cohort study	US	Outpatient	Single center	April 2020–January 2021	Author definition	280	Adult
Peluso(255)	2021	Prospective cohort study	US	Community	Single center	April 2020–January 2021	Author definition	179	Adult

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Perlis(256)	2022	Cross-sectional	US	Community	Multicenter	February 2021–July 2022	WHO	16,091	Adult
Perna(257)	2022	Cross-sectional	Kingdom of Bahrain	Outpatient	Multicenter	April–June 2020	NA	52	Adult
Peter(258)	2022	Cross-sectional	Germany	Community	Multicenter	October 2020–April 2021	NA	11,710	Adult
Peter(259)	2022	Retrospective cohort study	Germany	Outpatient	Multicenter	October 2020–April 2021	Author definition	11,710	Adult
Petersen(260)	2021	Prospective cohort study	Faroe Islands	Outpatient	Multicenter	April 2020–August 2020	Author definition	180	Both
Petersen(261)	2022	Prospective cohort study	Germany	Community	Single center	March 2020–December 2020	NA	443	Adult
Petersen(262)	2022	Prospective cohort study	Faroe Islands	Community	Multicenter	August–December 2020	WHO	170	Both
Pinto(263)	2022	Ambidirectional cohort study	US	Community	Multicenter	August 2020 - February 2021	Author definition	5136	Adult
Platten(264)	2022	Prospective cohort study	Germany	Community	Single center	April 2020–April 2021	NA	1,040 (completed round 4)	Adult
Pretorius(265)	2022	Retrospective cohort study	South Africa	Clinical, outpatient and community	Multicenter	NR	Author definition	845	Adult

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Raineri(266)	2022	Retrospective cohort study	Switzerland	Community	Multicenter	March–April 2020, November–December 2021	Author definition	Old cohort: 38, new cohort: 561	Pediatric
Ramos-Usuga(267)	2022	Retrospective cohort study	Multinational	Community	Multicenter	March 2021–June 2021	NA	1,001	Adult
Rao(268)	2022	Retrospective cohort study	US	Inpatient and outpatient	Multicenter	March 2020–October 2021	ICD-10 diagnosis code	659,286	Pediatric
Retuerto(269)	2022	Retrospective cohort study	Spain	Inpatient and outpatient	Single center	March 2020–May 2020	Author definition	251	Both
Richard(270)	2021	Retrospective cohort study	US	Database/registry	Multicenter	March 2020–December 2020	Author definition	1,015	Both
Robineau(271)	2022	Cross-sectional	France	Community	Multicenter	May 2020–September 2021	WHO	3,972	Adult
Roge(272)	2021	Ambidirectional cohort study	Latvia	Outpatient	Multicenter	July 2020 - April 2021	NICE	236	Pediatric
Romero-Duarte(273)	2021	Retrospective cohort study	Spain	Outpatient	Multicenter	March 2020–April 2020	NA	797	Both
Ruenjaiman(274)	2022	Retrospective cohort study	Thailand	Clinical/hospital inpatient	Single center	April 2020–June 2020	NA	62	Both

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Ryan(275)	2022	Prospective cohort study	Australia	Outpatient and community	Multicenter	June–November 2020	Author definition	69	Adult
Sakurada(276)	2022	Cross-sectional	Japan	Outpatient	Single center	February 2021–July 2021	Previous study	65	Both
Samannodi(277)	2022	Cross-sectional	Saudi Arabia	Nationwide	Community	July–September 2021	CDC	7,520	Both
Santos(278)	2022	Prospective cohort study	Brazil	Outpatient	Single center	March 2020–July 2021	Author definition	84	Adult
Sarda(28)	2022	Cross-sectional	India	Outpatient	Single center	May 2020–July 2020	National Comprehensive Guidelines for Management of Post Covid Sequelae.	251	Adult
Sathyamurthy(279)	2021	Prospective cohort study	India	Outpatient	Single center	August–November 2020	Author definition	279	Adult
Schiavi(280)	2022	Cross-sectional	Italy	Outpatient	Single center	April 2020–June 2020	NA	56	Adult
Schultheiß(281)	2022	Retrospective cohort study	Germany	Community	Multicenter	April 2020–December 2020 (Plasma sampling)	Previous study	181	Adult

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Schultheiß(282)	2022	Ambidirectional cohort study	Germany	Community	Multicenter	March 2020–October 2021	Previous study	318	Both
Schulz(283)	2022	Case-control	Germany	Outpatient	Multicenter	Q2 2021	WHO	481,989	Both
Seang(284)	2022	Prospective cohort study	France	Outpatient	Single center	May 2020–July 2020 (enrolment)	Author definition	63	Adult
Senjam(285)	2022	Cross-sectional	India	Community	Single center	January 2021–April 2021	Author definition	773	Adult
Shabat(286)	2022	Prospective cohort study	Israel	Inpatient and outpatient	Single center	NR	NA	61	NR
Shinde(287)	2022	Cross-sectional	India	Outpatient	Single center	NR	Author definition	4354	Both
Shivani(288)	2022	Prospective cohort study	Pakistan	Outpatient	Single center	July 2020–December 2021	Author definition	1,498	Adult
Shoucri(289)	2021	Retrospective cohort study	US	Outpatient	Single center	March - April 2020	Author definition	1,190	Adult
Sigfrid(290)	2021	Prospective cohort study	UK	Outpatient	Multicenter	January–October 2020	Author definition	327	Adult
Silverberg(291)	2022	Cross-sectional	US	Community	Multicenter	April 2021–May 2021	NA	372	Adult

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Sivan(292)	2022	Prospective cohort study	UK	Outpatient	Multicenter	NR	Author definition	370	Adult
Sivan(293)	2022	Cross-sectional	England	Outpatient and community	Multicenter	February 2021–May 2021	Author definition	370	Adult
Sneller(294)	2022	Prospective cohort study	US	Outpatient	Single center	June 2020–July 2021	Author definition	189	Adult
Son(295)	2022	Retrospective cohort study	Canada	Clinical/hospital	Multicenter	August 2020–September 2021	Author definition	162	Adult
Søraas(296)	2021	Prospective cohort study	Norway	Community	Multicenter	February-April 2020	NA	853	Adult
Sperling(297)	2022	Retrospective cohort study	Denmark	Outpatient	Multicenter	NR	NA	218	Adult
Spiers(298)	2022	Cross-sectional	France	Outpatient	Multicenter	Euroimmune assay taken between May 2020–November 2020; Internet questionnaire: December 2020–January 2021.	Author definition	26,823	Adult
Stephenson(299)	2022	Retrospective cohort study	England	Outpatient	Multicenter	January - March 2021	Author definition	6,804	Pediatric

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Strasser(300)	2021	Retrospective cohort study	US	Non-hospitalized	Single center	March 2020–June 2021	Author definition	96,025	Adult
Straudi(301)	2022	Prospective cohort study	Italy	Inpatient	Single center	January–April 2021	Author definition	79	Adult
Su(302)	2022	Prospective cohort study	US	INCOV: Clinical/hospital, HAARVI: clinical/hospital and outpatient	Multicenter	NR	CDC	INCOV: 209, HAARVI: 100	Adult
Subramanian(303)	2022	Retrospective cohort study	UK	Outpatient	Multicenter	January 2020–April 2021	WHO	486,149	Adult
Sugiyama(304)	2022	Cross-sectional	Japan	Clinical/hospital	Multicenter	August–March 2021	Previous study	127	Adult
Sun(305)	2022	Retrospective cohort study	China	Clinical/hospital	Single center	February–March 2020	Previous study	534	Both
Sunada(306)	2022	Retrospective cohort study	Japan	Outpatient	Single center	February 2021–December 2021	Author definition	186	Adult
Susanto(307)	2022	Cross-sectional	Indonesia	Online	Multicenter	January 2021	Author definition	385	Adult
Swank(308)	2022	Retrospective cohort study	US	Clinical/hospital	Single center	NR	Author definition	63	Adult

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Tannous(309)	2022	Retrospective cohort study	US	Clinical/hospital	Multicenter	March 2020–February 2022	CDC	53,239	Adult
Taquet(310)	2021	Retrospective cohort study	US	Clinical/hospital	Multicenter	January 2021–August 2021	Author definition	18,958	Both
Taquet(311)	2021	Retrospective cohort study	US	Outpatient	Multicenter	January 2020–December 2020	Author definition	273,618	Adult
Tarazona(312)	2022	Case-control	France	Outpatient	Multicenter	February 2020 - February 2022	NA	96	Adult
Tartof(313)	2022	Retrospective cohort study	US	Outpatient	Multicenter	March 2019–May 2021	NA	127,859	Both
Taskiran-Sag(314)	2022	Cross-sectional	Turkey	Outpatient and community	Single center	NR	Author definition	50	Adult
Tawfik(315)	2021	Retrospective cohort study	Egypt	Clinical/hospital and outpatient	Multicenter	NR	Previous study	120	Adult
Terlizzi(316)	2021	Cross-sectional	US	Outpatient	Multicenter	44197	Author definition	499	Adult
Thawani(317)	2022	Cross-sectional	US	Outpatient	Single center	NR	Author definition	98	Adult
Thyagaraj(318)	2022	Cross-sectional	India	Outpatient	Single center	February–May 2021	Previous study	259	Adult

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Titze-de-Ameida(319)	2022	Prospective cohort study	Brazil	Outpatient	Multicenter	September 2020–December 2020	Previous study	236	Adult
Tleyjeh(320)	2021	Prospective cohort study	Saudi Arabia	Clinical/hospital	Single center	May 2020–July 2020	Author definition	222	Adult
Tleyjeh(321)	2022	Cross-sectional	Saudi Arabia	Community	Multicenter	December 2020–January 2021	Author definition	5,946	Adult
Tleyjeh(322)	2022	Ambidirectional cohort study	Saudi Arabia	Clinical/hospital	Single center	May 2020–July 2020	Author definition	222	Adult
Tosato(323)	2021	Cross-sectional	Italy	Outpatient	Single center	April 2020–December 2020	Author definition/WHO	165	Adult
Townsend(324)	2021	Prospective cohort study	Ireland	Outpatient	Single center	March 2020–May 2020	Author definition	111	Adult
Townsend(325)	2021	Prospective cohort study	Ireland	Clinical/hospital	Single center	May - September 2020	Previous study	150	Adult
Tran(326)	2022	Retrospective cohort study	France	Database/registry	Multicenter	October 2020–November 2020	Author definition	1,022	Adult
Trapani(327)	2022	Retrospective cohort study	Italy	Inpatient/outpatient	Multicenter	October 2020–June 2021	Previous study	629	Pediatric

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Tsuzuki(328)	2022	Cross-sectional	Japan	Outpatient	Single center	February 2020–March 2021	Author definition	457	Adult
Tuzun(329)	2022	Cross-sectional	Turkey	Outpatient	Single center	October 2021	NICE	1,348	Adult
Vayner(330)	2021	Prospective cohort study	US	Inpatient/outpatient	Single center	March - December 2020	Author definition	141	Adult
Vimercati(331)	2021	Retrospective cohort study	Italy	Community	Single center	March–May 2021	Author definition	352	Adult
Wang(332)	2022	Retrospective cohort study	US	Database/registry	Multicenter	March 2020–February 2021	Author definition	26,117	Adult
Wanga(333)	2021	Prospective cohort study	US	Community	Multicenter	April 9–23 2021	CDC	3,135	Adult
Wiech(334)	2022	Prospective cohort study	Poland	Inpatient and outpatient	Single center	June 2020–November, March 2021–April 2021	NA	59	Adult
Williamson(335)	2022	Prospective cohort study	UK	Outpatient	Multicenter	May 2020–October 2021	Author definition	16,910	Both
Williamson(336)	2022	Prospective cohort study	UK	Community	Multicenter	May 2020–October 2021	Author definition	16,910	Adult
Winkelmann(337)	2022	Cross-sectional	Germany	Community	Multicenter	November 2020–June 2021	NA	667	Adult

Primary author	Publication Year	Study Type	Country	Study setting	Single center/multi-center setting	Study period	Source of definition	Overall sample size	Age group
Wong-Chew(338)	2022	Prospective cohort study	Mexico	Outpatient	Single center	September 2020–January 2021	NA	4,670	Adult
Woodward(339)	2022	Cross-sectional	US	Community	Multicenter	February 2021–March 2021	NA	379	Adult
Xie(340)	2021	Retrospective cohort study	US	Clinical/hospital, community	Multicenter	January–December 2019	Author definition	181,384	Adult
Xiong(341)	2021	Prospective cohort study	China	Inpatients	Single center	NR	NA	538	Adult
Yaksi(342)	2021	Retrospective cohort study	Turkey	Inpatient	Single center	April 2021–July 2021	Author definition	133	Adult
Yelin(343)	2022	Cross-sectional	Israel, Switzerland, Spain, and Italy	Outpatient	Multicenter	May 2020–March 2021	Author definition	1,027	Adult
Zang(344)	2022	Retrospective cohort study	US	Outpatient	Multicenter	March 2020–November 2021	NA	57,616	Adult
Zayet(345)	2021	Retrospective cohort study	France	Inpatients/Outpatients	Single center	Q1 2021	NA	354	Adult
Zhang(346)	2022	Retrospective cohort study	US	Database	Multicenter	March 2020–October 2021	Author definition	100,450	Adult

Primary author	*Publication Year*	*Study Type*	*Country*	*Study setting*	*Single center/multi-center setting*	*Study period*	*Source of definition*	*Overall sample size*	*Age group*
Zhang(347)	*2022*	*Retrospective cohort study*	*France, Germany, Italy, Singapore, US*	*Inpatient and outpatient*	*Multicenter*	*January 2020–March 2021*	*Author definition*	*414,602*	*Adult*
Zuschlag(348)	*2022*	*Retrospective cohort study*	*Germany*	*Clinical/hospital inpatient*	*Single center*	*January 2020–December 2020*	*Author definition*	*162*	*Both*

Table 7. Distribution of PCC definition source by WHO region

Source of definition	*Africa (N=4)*	*Americas (N=86)*	*Eastern Mediterranean (N=20)*	*European (N=142)*	*Multi-regional (N=6)*	*South-east Asian (N=15)*	*Western Pacific (N=17)*	*Total (N=291)*
	N(%)	*N(%)*	*N(%)*	*N(%)*	*N(%)*	*N(%)*	*N(%)*	*N(%)*
Author definition	*1 (25)*	*42 (48)*	*8 (40)*	*81 (56)*	*4 (66)*	*4 (27)*	*9 (53)*	***148 (52)***
CDC	-	*1 (1)*	*1 (5)*	*2 (1)*	-	-	*2 (12)*	***6 (2)***
ICD-10 code/ U09.9	-	*1 (1)*	*2 (10)*	*3 (2)*	-	-	-	***6 (2)***
*Not specified by author**	*1 (25)*	*14 (16)*	*6 (30)*	*26 (18)*	-	*4 (27)*	*2 (12)*	***53 (18)***
National guidelines	-	*1 (1)*	*1 (5)*	-	-	-	-	***2 (1)***
NICE	*1 (25)*	*6 (7)*	-	*5 (4)*	*1 (17)*	*1 (7)*	*1 (6)*	***17 (6)***
Based on referenced study	*1 (25)*	*11 (13)*	*1 (5)*	*19 (13)*	-	*3 (20)*	*2 (12)*	***37 (13)***
WHO	-	*10 (11)*	*1 (5)*	*6 (4)*	*1 (17)*	*3 (20)*	*1 (6)*	***22 (8)***

CDC: Centers for Disease Control and Prevention; ICD-10-CM: International Classification of Diseases, Tenth Revision, Clinical Modification; NICE: National Institute for Health and Care Excellence; WHO: World Health Organization.

**Refers to included studies that prospectively followed patients with confirmed acute COVID-19 to investigate and characterize persistent symptoms, therefore did not use definition of post-COVID condition in study design*

Table 8. Distribution of the number of symptoms/conditions assessed in each PCC domain reported in included studies

Symptom domain (Number of studies)	*Average*	*Minimum*	*Maximum*
Pediatric			
Cardiovascular (N=10)	*1.1*	*1*	*2*
Constitutional (N=20)	*3.4*	*1*	*8*
Dermatological (N=13)	*1.9*	*1*	*13*
Extremities (N=4)	*1.0*	*1*	*2*
Gastrointestinal (N=15)	*2.5*	*2*	*5*
Genitourinary tract (N=5)	*2.2*	*1*	*2*
Immune (N=2)	*1.0*	*1*	*1*
Musculoskeletal (N=18)	*2.8*	*1*	*9*
Neurological (N=19)	*4.8*	*1*	*25*
Mental health conditions (N=13)	*3.7*	*1*	*24*
Respiratory (N=19)	*2.5*	*1*	*5*
Sensory-related (N=17)	*3.4*	*1*	*7*
Adult			
Cardiovascular (N=92)	*1.4*	*1*	*5*
Constitutional (N=157)	*2.4*	*1*	*11*
Dermatological (N=92)	*1.7*	*1*	*8*
Extremities (N=21)	*1.3*	*1*	*4*
Gastrointestinal (N=122)	*2.4*	*1*	*8*
Genitourinary tract (N=31)	*2*	*1*	*8*
Immune (N=10)	*1.5*	*1*	*3*
Musculoskeletal (N=125)	*2.0*	*1*	*6*
Neurological (N=182)	*3.8*	*1*	*15*
Mental health conditions (N=141)	*2.4*	*1*	*10*
Respiratory (N=177)	*2.8*	*1*	*9*
Sensory-related (N=180)	*3.6*	*1*	*27*

Symptom domain (Number of studies)	*Average*	*Minimum*	*Maximum*
Mixed population (Adults and Children)			
Cardiovascular (N=17)	*1.2*	*1*	*3*
Constitutional (N=36)	*2.8*	*1*	*6*
Dermatological (N=18)	*1.4*	*1*	*3*
Extremities (N=4)	*1.3*	*1*	*2*
Gastrointestinal (N=26)	*2.0*	*1*	*5*
Genitourinary tract (N=5)	*2.0*	*1*	*4*
Immune (N=1)	*1.0*	*1*	*1*
Musculoskeletal (N=27)	*2.1*	*1*	*5*
Neurological (N=33)	*3.9*	*1*	*17*
Mental health conditions (N=27)	*1.9*	*1*	*4*
Respiratory (N=34)	*2.8*	*1*	*8*
Sensory-related (N=26)	*3.2*	*2*	*4*

Figure 1. Breakdown of included studies by design*

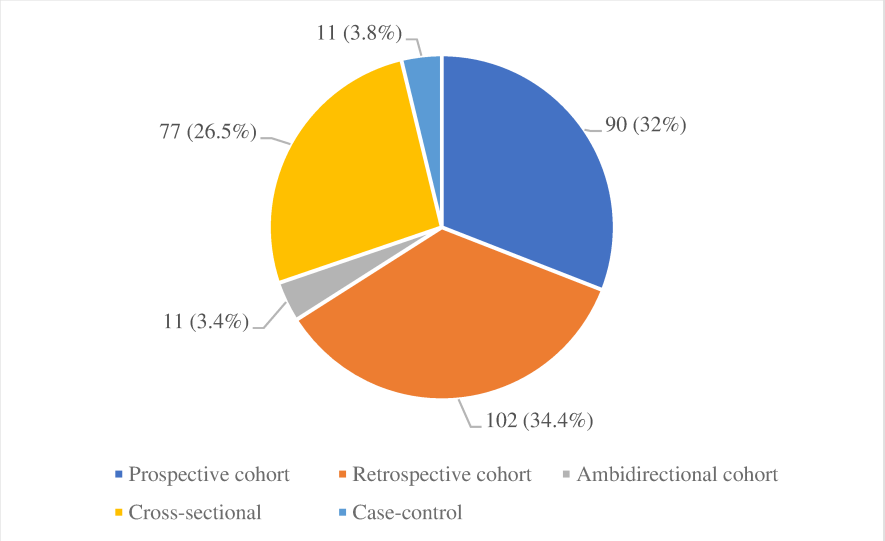
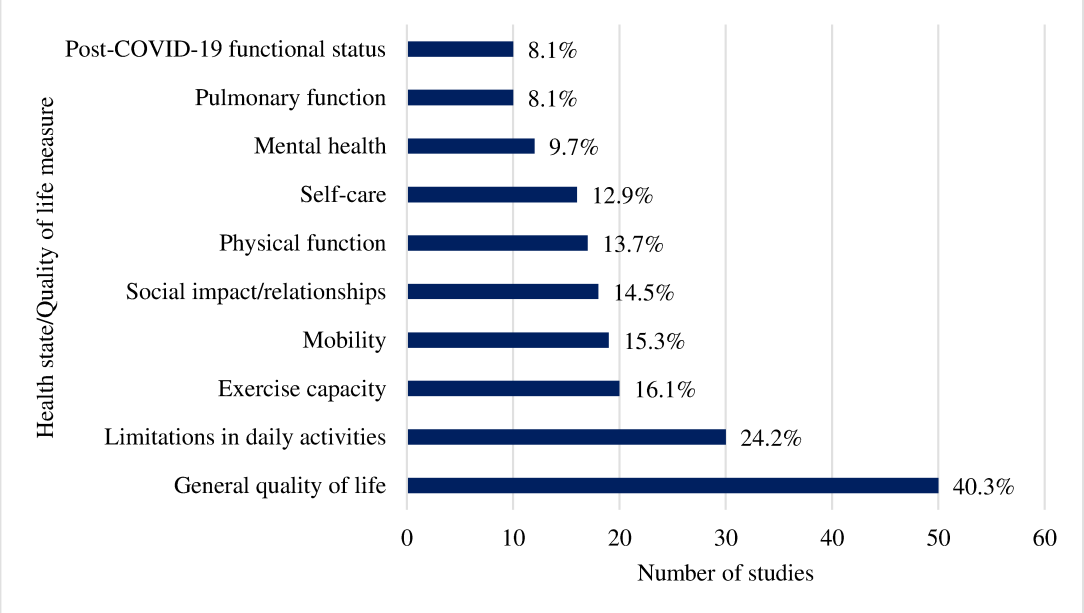


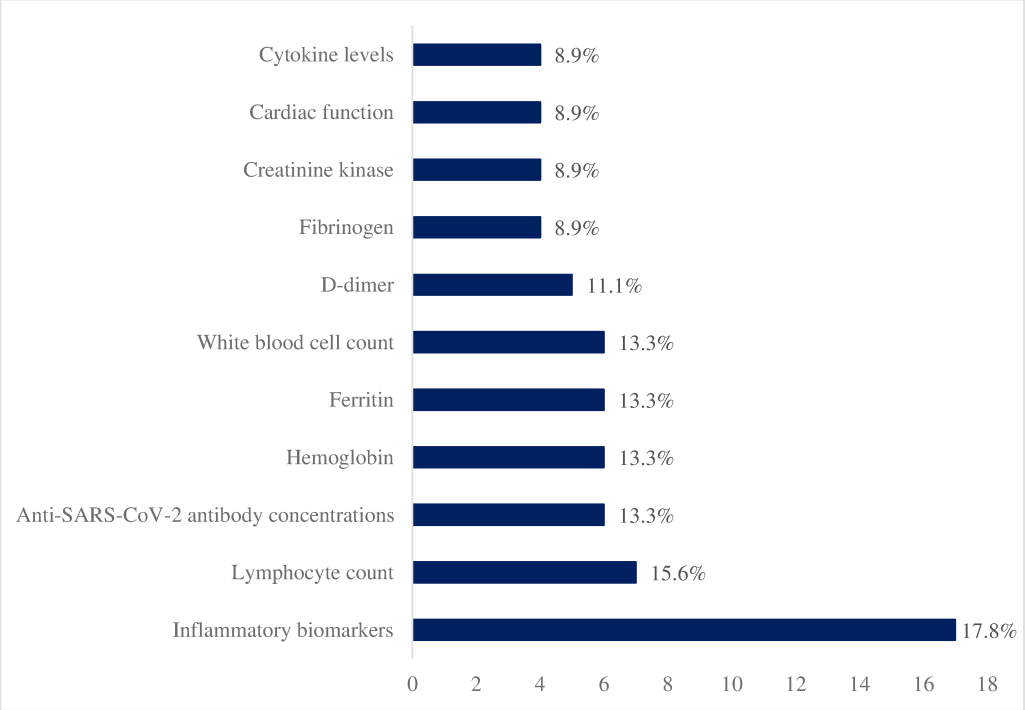
Figure 2. Most frequently* reported health state/quality of life measures† in included studies (N=124)



** Most frequently was defined as the top ten most reported measures. Due to Post-COVID 19 functional status and pulmonary function being reported an equal amount (8.1% of studies) both have been included in this figure for completeness.*

† *Health state/quality of life measured the patients' ability to perform daily activities/study/work/self-care, quality of life measurements using patient-reported outcomes (PROs) such as the EQ5D and WHO-5 wellbeing index and measures of mental and physical function.*

Figure 3. Most frequently* reported laboratory measures in included studies (N=40)



**Most frequently was defined as the top ten most reported measures. Due to outcomes being reported an equal number of times, eleven outcomes have been included for completeness.*

Table 9. Frequency of healthcare resource use outcomes reported by included studies (N=22)*

Outcome type	Adult	Mixed	Pediatric	Total studies by resource use
Hospitalization	*18*	*9*	*1*	*28*
ICU admission	*2*	*12*	*-*	*14*
Pharmaceutical treatment	*7*	*15*	*-*	*22*
Outpatient clinical visit/rehab	*70*	*3*	*13*	*86*
Total studies by age group	***97***	***39***	***14***	***150***

ICU: intensive care unit.
**Sum of outcomes is greater than sum of studies as each reported multiple outcomes.*

Table 10. Methods and measures validated for assessment of PCC applied in included studies

Method/measure	Study	Frequency and timepoint	Data source
COVID-19-Rehabilitation-Needs-Survey (RehabNeS), 5-point scale to rank health problems	*Lemhofer, 2021(183)*	*One completion at ≥3 months post-infection*	*Self/patient-reported*
COVID-19 Yorkshire Rehabilitation Scale (C19-YRS questionnaire) *	*Ayuso, 2022(58)*	*One telephone interview at Mean (SD): 299 days (23) post-diagnosis*	*Clinical evaluation*
	Sivan, 2022(271)	*One assessment at >12 weeks of persistent symptoms*	*Self/patient-reported*
	Straudi, 2022(279)	*At 12 and 26 weeks of persistent symptoms*	*Clinical evaluation*
Diagnostic ICD-10-CM code U09.9 (unspecified Post COVID-19 condition)	*Schulz, 2022(261)*	*NA*	*Diagnostic code*
ISARIC Global COVID-19 questionnaire†	*Buonsenso, 2022(82)*	*One completion of questionnaire ≤1 year post-infection*	*Self/patient-reported*
	Hastie, 2022(143)	*Symptoms in last week at 6-, 12-, and 18-months post-COVID-19 infection*	*Clinical evaluation*
Long COVID Symptoms and Impact Tool	*Tran, 2022(327)*	*Multiple survey completions at ≥3 weeks post infection*	*Self/patient-reported*

Method/measure	*Study*	*Frequency and timepoint*	*Data source*
Post COVID-19 Functional Status Scale ‡	*Chand,2022 (87)*	*One telephone survey at median of 216.5 days post-hospital discharge*	*Self/patient-reported*
	Bonilla, 2022(71)	*Before and during clinic visit, timepoint not specified*	*Self/patient-reported*
	Johnsen, 2021(161)	*3 months post-infection (3 visits over 4 weeks)*	*Self/patient-reported*

‡Recommended by NICE and NHS to assess post-acute COVID-19 syndrome and adopted by the WHO for their self-management guide.

†Measures ability to perform daily tasks (move, personal care, daily activities).

**Post-COVID Functional Status Scale. Classifies patients as either asymptomatic (level 1), symptomatic without limitations (level 2), symptomatic with reduced daily activity (level 3), symptomatic with a struggle to perform daily activities (level 4), or incapacitated and bedridden (level 5).*

ICD-10-CM: International Classification of Diseases, Tenth Revision, Clinical Modification; NA: not applicable; NICE: National Institute for Health and Care Excellence; NHS: National Health Service; SD: standard deviation, WHO: World Health Organization.

Table 11. JBI critical appraisal of included case-control studies

	Eimer et al. 2022	Fjellvveit et al. 2022	Guven et al. 2022	Hentschel et al. 2022	Hill et al. 2022	Horberg et al. 2022
Were the groups comparable other than the presence of disease in cases or the absence of disease in controls?	*Yes*	*No*	*Yes*	*No*	*Yes*	*Yes*
Were cases and controls matched appropriately?	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Were the same criteria used for identification of cases and controls?	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Was exposure measured in a standard, valid and reliable way?	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Was exposure measured in the same way for cases and controls?	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Were confounding factors identified?	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*
Were strategies to deal with confounding factors stated?	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*
Were outcomes assessed in a standard, valid and reliable way for cases and controls?	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Was the exposure period of interest long enough to be meaningful?	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Unclear*
Was appropriate statistical analysis used?	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Overall appraisal	*Low risk of bias*	*Low risk of bias*	*Low risk of bias*	*Low risk of bias*	*Low risk of bias*	*Low risk of bias*

Maes et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Patel et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Schulz et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Unclear*	*Unclear*	*Unclear*
Tarazona et al. 2022	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*	*Yes*	*Low risk of bias*

Table 12. JBI critical appraisal of included cohort studies

	Were the two groups similar and recruited from the same population?	***Were the exposures measured similarly to assign people to both exposed and unexposed groups?***	***Was the exposure measured in a valid and reliable way?***	***Were confounding factors identified?***	***Were strategies to deal with confounding factors stated?***	***Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?***	***Were the outcomes measured in a valid and reliable way?***	***Was the follow up time reported and sufficient to be long enough for outcomes to occur?***	***Was follow up complete, and if not, were the reasons to loss to follow up described and explored?***	***Were strategies to address incomplete follow up utilized?***	***Was appropriate statistical analysis used?***	***Overall appraisal***
Abdelwahab et al. 2022	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*NA*	*NA*	*NA*	*Yes*	*Low risk of bias*
Abramoff et al. 2022	*NA*	*Yes*	*Yes*	*No*	*Unclear*	*No*	*Yes*	*No*	*No*	*NA*	*Yes*	*Low risk of bias*
Adler et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*NR*	*NR*	*Yes*	*Low risk of bias*
Al-Aly et al. 2021	*Unclear*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Unclear*	*Unclear*	*Yes*	*Unclear*
Al-Aly et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Arjun et al. 2022	*NA*	*NA*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*	*NR*	*NA*	*Yes*	*Low risk of bias*
Arnold et al. 2020	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Arriba Fernandez et al. 2022	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*NA*	*NA*	*NA*	*Yes*	*Low risk of bias*
Asadi-Pooya et al. 2021	*Unclear*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*High risk of bias*

Asadi-Pooya et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Asadi-Pooya et al. 2022	*Yes*	*NA*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Low risk of bias*
Augustin et al. 2021	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Ayoubkhani et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Ayoubkhani et al. 2022	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Ayoubkhani et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Bahat et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Bahmer et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*NR*	*NA*	*Yes*	*Low risk of bias*
Ballering et al. 2021	*Yes*	*Yes*	*Yes*	*No*	*NA*	*NA*	*Yes*	*Yes*	*NR*	*NA*	*Yes*	*Low risk of bias*
Ballouz et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Baptista da Silva et al. 2021	*NA*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Yes*	*Unclear*	*Unclear*	*Unclear*	*High risk of bias*
Baris et al. 2022	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Becker et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Bell et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Low risk of bias*
Bergia et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Low risk of bias*
Bhargava et al. 2021	*Yes*	*Yes*	*Yes*	*No*	*NA*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Biharie et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Unclear*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Bonilla et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*No*	*Unclear*	*Unclear*	*Yes*	*Low risk of bias*

Boparai et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*NA*	*NA*	*Yes*	*Yes*	*NR*	*NA*	*Yes*	*Low risk of bias*
Borch et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Bozkanat et al. 2022	*NA*	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*	*No*	*Unclear*	*No*	*Yes*	*Unclear*
Brinkley et al. 2021	*Yes*	*Yes*	*Yes*	*Unclear*	*Unclear*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Unclear*	*Low risk of bias*
Budhiraja et al. 2022	*Yes*	*YEs*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Bull-Otterson et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Buonsenso et al. 2022	*NA*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Buonsenso et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Buonsenso et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Caspersen et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Catalán et al. 2022	*No*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*High risk of bias*
Cervia et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Cervia et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Chand et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Chand et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Low risk of bias*
Chatwani et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*NA*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Chaumont et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Chen et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Chen et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*NR*	*NA*	*Yes*	*Low risk of bias*

Chevinsky et al. 2021	*Yes*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Chirouze et al. 2022	*Unclear*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Yes*	*Unclear*	*Unclear*	*Unclear*	*High risk of bias*
Chowdhury et al. 2021	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Chun et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Cohen et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Comelli et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Darcis et al. 2021	*Yes*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
D'Avila et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*No*	*NA*	*Unclear*	*Yes*	*Unclear*	*Unclear*	*Yes*	*Low risk of bias*
Davis et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Unclear*	*NA*	*Yes*	*Low risk of bias*
De Miranda et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Desgranges et al. 2022	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*High risk of bias*
Deuel et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*NA*	*NA*	*Yes*	*Low risk of bias*
Donnachie et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Unclear*	*Unclear*	*Yes*	*Low risk of bias*
Dryden et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Duan et al. 2022	*NA*	*NA*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*	*NR*	*NA*	*Yes*	*Low risk of bias*
Duerlund et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Dumont et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Estrada-Codecido et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Low risk of bias*

Fernandez-de-las-Penas et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Ferreira et al. 2022	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Unclear*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Fischer et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Fogh et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Forster et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*No*	*NA*	*Unclear*	*Yes*	*Unclear*	*No*	*Yes*	*Low risk of bias*
Galan et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Gallardo-Cartagena et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Ganesh et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Garcia-Abellan et al. 2022	*Yes*	*NA*	*No*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*NA*	*Yes*	*Low risk of bias*
Garcia-Abellan et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*NA*	*NA*	*Yes*	*Low risk of bias*
Gonzalez-Aumatell et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*High risk of bias*
Gruber et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Unclear*
Gutierrez-Martinez et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Hastie et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Low risk of bias*
Helmsdal et al. 2022	*Unclear*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Unclear*	*Yes*	*Yes*	*No*	*Yes*	*Low risk of bias*
Helmsdal et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*No*	*NA*	*Unclear*	*Yes*	*Unclear*	*Unclear*	*Yes*	*Low risk of bias*

Holdsworth et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Horwitz et al. 2021	*Yes*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Howe et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*NA*	*NA*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Low risk of bias*
Huang et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Huang et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Ioannou et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Jacobs et al. 2020	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Jamil et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Yes*	*NR*	*NR*	*Yes*	*High risk of bias*
Jia et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Jones et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Low risk of bias*
Jordan et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Juste et al. 2022	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*No*	*No*	*Unclear*	*Yes*	*Low risk of bias*
Kayaaslan et al. 2021	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Kenny et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Unclear*	*Unclear*	*Yes*	*Low risk of bias*
Kildegaard et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Kostev et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Kostev et al. 2022	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Kozak et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Landis et al. 2022	*NA*	*NA*	*Yes*	*No*	*No*	*NA*	*Yes*	*Unclear*	*Unclear*	*No*	*Unclear*	*High risk of bias*

LaVergne et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Lee et al. 2022	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Unclear*	*Unclear*	*Yes*	*Low risk of bias*
Leeder et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Yes*	*No*	*No*	*Unclear*	*High risk of bias*
Leiser et al. 2022	*Yes*	*NA*	*Yes*	*No*	*NA*	*NA*	*Yes*	*Yes*	*No*	*No*	*Yes*	*High risk of bias*
Li et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*NA*	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Li et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*NA*	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Lionte et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Lionte et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Loizeau et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*NA*	*NA*	*NA*	*Yes*	*Low risk of bias*
Lombardo et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Lozano et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Yes*	*Unclear*	*Unclear*	*Unclear*	*High risk of bias*
Lund et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Magnusdottir et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Low risk of bias*
Magnusdottir et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Low risk of bias*
Mahmoud et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Mammi et al. 2022	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Martinez et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Low risk of bias*

Martin-Loeches et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Low risk of bias*
Mayor et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
McFann et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
McGrath et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
McNaughton et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Unclear*
Menezes Jr et al. 2022	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Unclear*	*Unclear*	*Yes*	*Low risk of bias*
Menges et al. 2021	*Unclear*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Messin et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Low risk of bias*
Munblit et al. 2021	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Nakano et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Unclear*	*Unclear*	*NA*	*Yes*	*Low risk of bias*
Nakayama et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Ocsovzky et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
O'Kelly et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Osikomaiya et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*NR*	*NA*	*Yes*	*Low risk of bias*
Pajor et al. 2022	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Peghin et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Pelà et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Low risk of bias*
Peluso et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*

Peluso et al. 2021	*Yes*	*yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Peluso et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Low risk of bias*
Peluso et al. 2022	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Peter et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Unclear*
Petersen et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Petersen et al. 2022	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Petersen et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Pinto et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Unclear*	*Unclear*	*Unclear*	*Yes*	*Unclear*
Platten et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Powell et al. 2022	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Pretorius et al. 2022	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*NA*	*NA*	*NA*	*Yes*	*Low risk of bias*
Raineri et al. 2022	*Yes*	*Yes*	*Yes*	*Unclear*	*Unclear*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Ramos-Usuga et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*NR*	*NA*	*Yes*	*Low risk of bias*
Rao et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Retuerto et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*YEs*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Richard et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*NA*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Roge et al. 2021	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Unclear*
Romero-Duarte et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Low risk of bias*

Ruenjaiman et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*	*NR*	*NA*	*Yes*	*Low risk of bias*
Ryan et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Santos et al. 2021	*Yes*	*Yes*	*Unclear*	*No*	*No*	*NA*	*Unclear*	*Yes*	*Unclear*	*Unclear*	*Yes*	*Unclear*
Sathyamurthy et al. 2021	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Schultheiß et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Yes*	*Unclear*	*Unclear*	*Yes*	*Unclear*
Schultheiß et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Unclear*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Seang et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*YEs*	*YEs*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Shabat et al. 2022	*NR*	*NR*	*NR*	*No*	*No*	*NA*	*Yes*	*Yes*	*NA*	*NA*	*Yes*	*High risk of bias*
Shivani et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Shoucri et al. 2021	*NA*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Yes*	*Unclear*	*Unclear*	*Unclear*	*High risk of bias*
Sigfrid et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Sivan et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*	*Yes*	*Unclear*	*NA*	*Yes*	*Low risk of bias*
Sivan et al. 2022	*Yes*	*yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Sivan et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*No*	*Unclear*	*Unclear*	*Yes*	*Low risk of bias*
Sneller et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*yes*	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Son et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Søraas et al. 2021	*Yes*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Sperling et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*NA*	*NA*	*Yes*	*Low risk of bias*

Stephenson et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Strasser et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*NA*	*NA*	*NA*	*Yes*	*Low risk of bias*
Straudi et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Low risk of bias*
Su et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Subramanian et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*YEs*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Sunada et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Unclear*	*Yes*	*NA*	*Yes*	*Unclear*
Swank et al. 2022	*NA*	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Taat et al. 2022	*Unclear*	*Unclear*	*Unclear*	*No*	*No*	*NA*	*Unclear*	*Unclear*	*Unclear*	*Unclear*	*Unclear*	*High risk of bias*
Tannous et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Taquet et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Unclear*	*Unclear*	*NA*	*Yes*	*Low risk of bias*
Taquet et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Unclear*	*Unclear*	*Yes*	*Low risk of bias*
Tartof et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Tawfik et al. 2021	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Unclear*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Titze-de-Ameida et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Low risk of bias*
Tleyjeh et al. 2021	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Townsend et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Low risk of bias*
Townsend et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Trapani et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Unclear*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*

Vayner et al. 2021	*Unclear*	*Yes*	*Unclear*	*No*	*No*	*NA*	*Yes*	*Yes*	*Unclear*	*Unclear*	*Unclear*	*High risk of bias*
Wang et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Low risk of bias*
Wanga et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*NA*	*NA*	*Yes*	*Low risk of bias*
Wiech et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Williamson et al. 2022	*NA*	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Williamson et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Wong-Chew et al. 2022	*Yes*	*NA*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Low risk of bias*
Xie et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Xiong et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Yaksi et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Unclear*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Yelin et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Zang et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Zayet et al. 2021	*Yes*	*Yes*	*Yes*	*No*	*No*	*NA*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*
Zhang et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Zhang et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*NA*	*NA*	*Yes*	*Low risk of bias*
Zuschlag et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Low risk of bias*

Table 13. JBI critical appraisal of included cross-sectional studies

	Were the criteria for inclusion in the sample clearly defined?	***Were the study subjects and the setting described in detail?***	***Was the exposure measured in a valid and reliable way?***	***Were objective, standard criteria used for measurement of the condition?***	***Were confounding factors identified?***	***Were strategies to deal with confounding factors stated?***	***Were the outcomes measured in a valid and reliable way?***	***Was appropriate statistical analysis used?***	***Overall appraisal***
Abdelrahman et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*	*Low risk of bias*
Alkwai et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Low risk of bias*
Areekal et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Unclear*	*Yes*	*Low risk of bias*
Ayuso et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Barreto et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Brackel et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*	*Low risk of bias*
Budhiraja et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Burton et al. 2022	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Charfeddine et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Low risk of bias*
Danesh et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Low risk of bias*
Degen et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Diem et al. 2022	*Yes*	*Yes*	*Unclear*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Unclear*

Elkan et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*	*Low risk of bias*
Fernández-de-las-Peñas et al. 2022	*Yes*	*Yes*	*yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Low risk of bias*
Ferreira de Oliveira et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Gasniet et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Gaur et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Gonzalez et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*No*	*Unclear*	*Yes*	*Low risk of bias*
Guido et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*No*	*Unclear*	*Yes*	*Low risk of bias*
Gupta et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*	*Low risk of bias*
Guzel et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Hansen et al. 2021	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Unclear*	*Low risk of bias*
Harashchenko et al. 2022	*No*	*No*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Unclear*	*High risk of bias*
Hassan et al. 2022	*No*	*No*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Unclear*	*High risk of bias*
Hayek et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Low risk of bias*
Houben-Wilke et al. 2022	*Yes*	*Yes*	*Unclear*	*Unclear*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Howe et al. 2022	*Yes*	*No*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*	*Low risk of bias*
Jabali et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Low risk of bias*
Johnsen et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Low risk of bias*
Kalaivani et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Low risk of bias*
Kidwai et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Unclear*	*Yes*	*Low risk of bias*

Kikkenborg Berg et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Klein et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Knight et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Kuodi et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Kuodi et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Lemhöfer et al. 2021	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*High risk of bias*
Lloyd-Evans et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*	*Low risk of bias*
Maamar et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Maestre-Muñiz et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Low risk of bias*
Mahmoud et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Low risk of bias*
Mandal et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Low risk of bias*
Mendelsohn et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Mirfazeli et al. 2022	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Mohamed-Hussein et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Monaghan et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Montenegro et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Morioka et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Moy et al. 2022	*No*	*No*	*Unclear*	*Unclear*	*Yes*	*Yes*	*Yes*	*Yes*	*High risk of bias*
Nune et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*

Ogungbe et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Low risk of bias*
O'Sullivan et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Pant et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*Low risk of bias*
Perlis et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Perna et al. 2022	*No*	*No*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Unclear*	*High risk of bias*
Peter et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Low risk of bias*
Robineau et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Sakurada et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Samannodi et al. 2022	*Yes*	*No*	*No*	*Yes*	*No*	*No*	*Unclear*	*Yes*	*High risk of bias*
Sarda et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Unclear*	*Yes*	*Low risk of bias*
Schiavi et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Senjam et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Shinde et al. 2022	*Yes*	*No*	*Yes*	*Yes*	*No*	*NA*	*Yes*	*Yes*	*High risk of bias*
Silverberg et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Spiers et al. 2022	*Yes*	*No*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*	*Unclear*
Sugiyama et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Susanto et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Unclear*	*Yes*	*Low risk of bias*
Taskiran-Sag et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Low risk of bias*
Terlizzi et al. 2021	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Unclear*	*Unclear*

Thawani et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*	*Low risk of bias*
Thyagaraj et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Tosato et al. 2021	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*High risk of bias*
Tsuzuki et al. 2022	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*
Tüzün et al. 2022	*No*	*No*	*Unclear*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Unclear*
Winkelmann et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*NA*	*Yes*	*Yes*	*Low risk of bias*
Woodward et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Low risk of bias*

Table 14. JBI critical appraisal of the included epidemiological study*

	Was the sample frame appropriate to address the target population?	***Were study participants sampled in an appropriate way?***	***Was the sample size adequate?***	***Were the study subjects and the setting described in detail?***	***Was the data analysis conducted with sufficient coverage of the identified sample?***	***Were valid methods used for the identification of the condition?***	***Was the condition measured in a standard, reliable way for all participants?***	***Was there appropriate statistical analysis?***	***Was the response rate adequate, and if not, was the low response rate managed appropriately?***	***Overall appraisal***
Tran et al. 2022	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Low risk of bias*

**study is epidemiological model using inputs from existing epidemiology literature.*