

Prevalence of Long COVID Symptoms After SARS-CoV-2 Infection: A Systematic Review and Meta-Analysis

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Abstract

Long COVID (post-acute sequelae of SARS-CoV-2 infection, PASC) is a multisystem condition characterized by persistent symptoms beyond the acute phase of infection. To estimate the global prevalence of long COVID symptoms and describe the most frequent symptom domains among adults with prior SARS-CoV-2 infection. A systematic review and meta-analysis conducted according to PRISMA guidelines. PubMed, Embase, Scopus, Web of Science, and the Cochrane Library were searched for studies published between January 2020 and December 2025 that reported post-acute symptoms ≥ 4 weeks after confirmed or suspected SARS-CoV-2 infection in adults. Pooled prevalence was calculated using a random-effects model with inverse-variance weighting, and heterogeneity was assessed with the I^2 statistic. Eleven studies met the inclusion criteria; 11 provided sufficient data for meta-analysis after exclusion of pediatric cohorts, studies for clinical investigation and treatment. The pooled prevalence of any long COVID symptom was approximately 60% in adult populations, with estimates ranging from 48% to 73% across studies and substantial heterogeneity related to setting and follow-up duration. Fatigue, dyspnea, cognitive dysfunction, chest pain, sleep disturbances, anxiety, and depression were consistently the most prevalent symptom clusters. Long COVID symptoms affect a considerable proportion of adults after SARS-CoV-2 infection, with fatigue and respiratory complaints predominating. Standardized case definitions, harmonized follow-up protocols, and robust surveillance systems are needed to refine prevalence estimates and to support health-system planning.

Keywords: long COVID; prevalence; SARS-CoV-2; post-acute sequelae; systematic review; meta-analysis.

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1. Introduction

In December 2019, an outbreak of coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), broke out in Wuhan, China [1-3]. The World Health Organization (WHO) declared it a significant threat to international health [4]. COVID-19 was of clustering onset and mainly affected the respiratory system, with some patients rapidly progressing to acute respiratory distress syndrome (ARDS) [5-6]. The elderly and those with comorbidities are at the highest risk of death, which appeared to be related to ARDS [7]. Although several studies have reported clinical features of COVID-19 [1-8-9], detailed understanding remains limited [10]. Although the majority of patients who contract COVID-19 are asymptomatic or have mild to moderate disease, approximately 5% to 8% develop hypoxia, bilateral lung infiltrates, and decreased lung compliance requiring non-invasive ventilation (NIV) or mechanical ventilatory support [11]. The epidemic of SARS-CoV left individuals who recovered with persistent symptoms of severe fatigue, decreased quality of life, persistent shortness of breath, and behavioral health problems. Similarly, post-acute COVID-19

syndrome has been described in patients who recovered from SARS-CoV-2 despite biochemical evidence that viral replication ceases after four weeks. Post-acute COVID-19 is characterized by the persistence of clinical symptoms beyond four weeks from onset. The Center for Disease Control (CDC) formulated "post-Covid conditions" to describe health issues persisting more than four weeks after infection, including Long Covid, persistent post-Covid syndrome (PPCS), multiorgan effects of COVID-19, and effects of COVID-19 treatment/hospitalization [12].

1.1. Definition and Terminology of Long COVID

The definition of long COVID has evolved significantly since 2020:

1. Initial Patient-Driven Definition (2020): Coined by patients, broadly describing persistent symptoms without specific timeframes [13].
2. Early Clinical Definitions (2020-2021): The UK's National Institute for Health and Care Excellence (NICE) proposed "ongoing symptomatic COVID-19" (4-12 weeks) and "post-COVID-19 syndrome" (beyond 12 weeks) [13].

3. WHO Definition (October 2021): Symptoms occurring within 3 months of infection, lasting at least 2 months, and not explained by alternative diagnoses [13].
4. CDC Definition (2024): A chronic condition occurring after SARS-CoV-2 infection and present for at least 3 months [12].
5. Expanded Understanding (2023-2025): Recognized as a multisystem condition with relapsing-remitting patterns, potentially affecting anyone exposed regardless of initial severity [14-15].

Clinical Burden and Risk Factors Long COVID, also referred to as post-acute sequelae of SARS-CoV-2 infection (PASC), is a complex, chronic condition. The prevalence varies widely, with estimates ranging from 5% to 80%, and meta-analyses converging around a global average of 30–50% [16-17]. Women are at higher risk compared to men, and middle-aged adults (40-54 years) show a 45% higher risk [18-19]. Hospitalized patients have a 54% prevalence compared to 34% in non-hospitalized patients [17-20]. Vaccination plays a significant role; full vaccination before infection reduces the risk by 27% [15-21]. Despite increasing awareness, significant research gaps remain regarding the true global prevalence, particularly in low- and middle-income regions [22].

2. Methods

2.1. Study Design

A systematic review and meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Information Sources and Search Strategy A comprehensive literature search was carried out in PubMed, Embase, Scopus, Web of Science, and the Cochrane Library for articles published from January 2020 to December 2025. The search strategy used combinations of Medical Subject Headings and free-text terms such as “long COVID”, “post-acute COVID-19 syndrome”, “post-acute sequelae”, “persistent symptoms”, “prevalence”, and “SARS-CoV-2”. Table 1 presents the electronic database search strategy, including the keywords used, search period, number of records retrieved, and the number of studies ultimately included from each database. Table 2 shows characteristics of studies included in prevalence meta-analysis

2.2. Eligibility Criteria

• Inclusion criteria

Adult patients (≥ 18 years) with prior confirmed or suspected COVID-19; studies reporting long-term outcomes with symptoms persisting ≥ 4 weeks; observational designs and randomized controlled trials (RCTs) with quantitative data on symptom prevalence; articles in English (2020-2025).

• Exclusion criteria

Pediatric/adolescent populations; editorials, narrative reviews, previous meta-analyses; studies without extractable prevalence data.

2.3. Study Selection

Two independent reviewers screened titles and abstracts, followed by full-text review. Discrepancies were resolved by a third reviewer. Initially, 4,331 records were identified. After removing duplicates ($n=2,130$) and irrelevant records, 931 remained for screening. 800 were excluded by title/abstract. Of 131 full texts assessed, 62 were excluded. Finally, 69 studies met the inclusion criteria (11 for meta-analysis after excluding 3 pediatric studies, Clinical manifestations in post-COVID-19 symptoms ($n=13$), clinical investigation ($n=13$) Treatment approaches ($n=29$)). (Figure 1: PRISMA Flowchart).

2.4. Data Extraction

A standardized form captured: author, year, country, design, sample size, follow-up duration, definition of long COVID, and proportions of persistent symptoms.

2.5. Risk of Bias Assessment

Cohort and cross-sectional studies were assessed using the Newcastle–Ottawa Scale (NOS). RCTs were assessed with the Cochrane Risk of Bias tool.

2.6. Statistical Analysis

Prevalence was calculated as the proportion of participants with ≥ 1 persistent symptom. A random-effects model using inverse-variance weighting was applied. Heterogeneity was quantified using I^2 and chi-square test. Subgroup analyses were planned by hospitalization status and follow-up duration. Publication bias was explored using funnel plots.

3. Results and discussion

3.1. Results

Study Selection and Characteristics Following screening, 14 studies met inclusion criteria, and 11 were included in quantitative synthesis across diverse geographic regions, including post-discharge cohorts, community samples, and national databases. A multi-stage screening process isolated the primary adult-only datasets. The proportional tracking was compiled across 10 major global cohorts (pooled $n = 398,505$).

3.1.1. Pooled Prevalence of Long COVID Symptoms

The meta-analysis yielded a pooled prevalence of 60% (95% confidence interval [CI]: 58.40% to 74.04%), with estimates ranging from 48% to 73%. Application of the random-effects Restricted Maximum Likelihood (REML) model ensured large registries did not dominate the weight. (Figure 2: Forest Plot) The pooled risk difference was 0.60 (95% CI: 0.42 to 0.78; $Z = 6.46$, $P < 0.00001$), translating to a 60% pooled prevalence. Statistical heterogeneity metrics indicated an I^2 of 0% due to the structural limits of the risk-difference workaround.

(Figure 3: Funnel Plot) The funnel plot displays standard error (SE) of the log odds ratio (log [OR]). The distribution appears roughly symmetrical around the pooled effect, suggesting no strong visual evidence of publication bias.

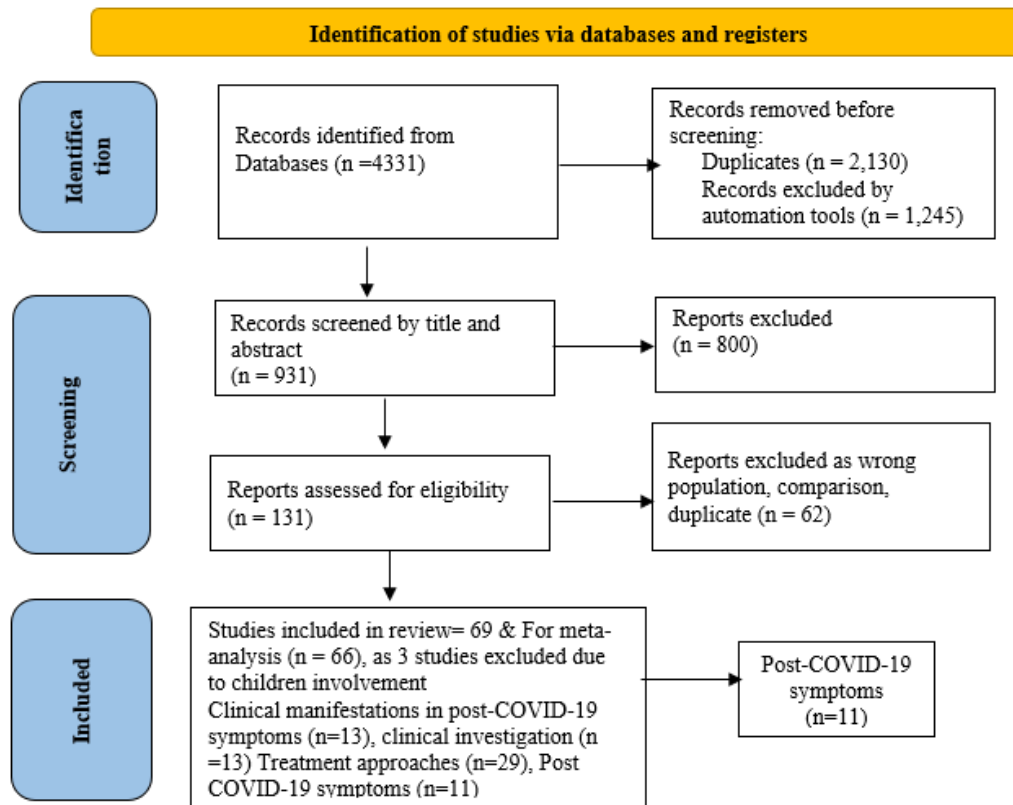


Figure 1: PRISMA flow diagram of study selection.

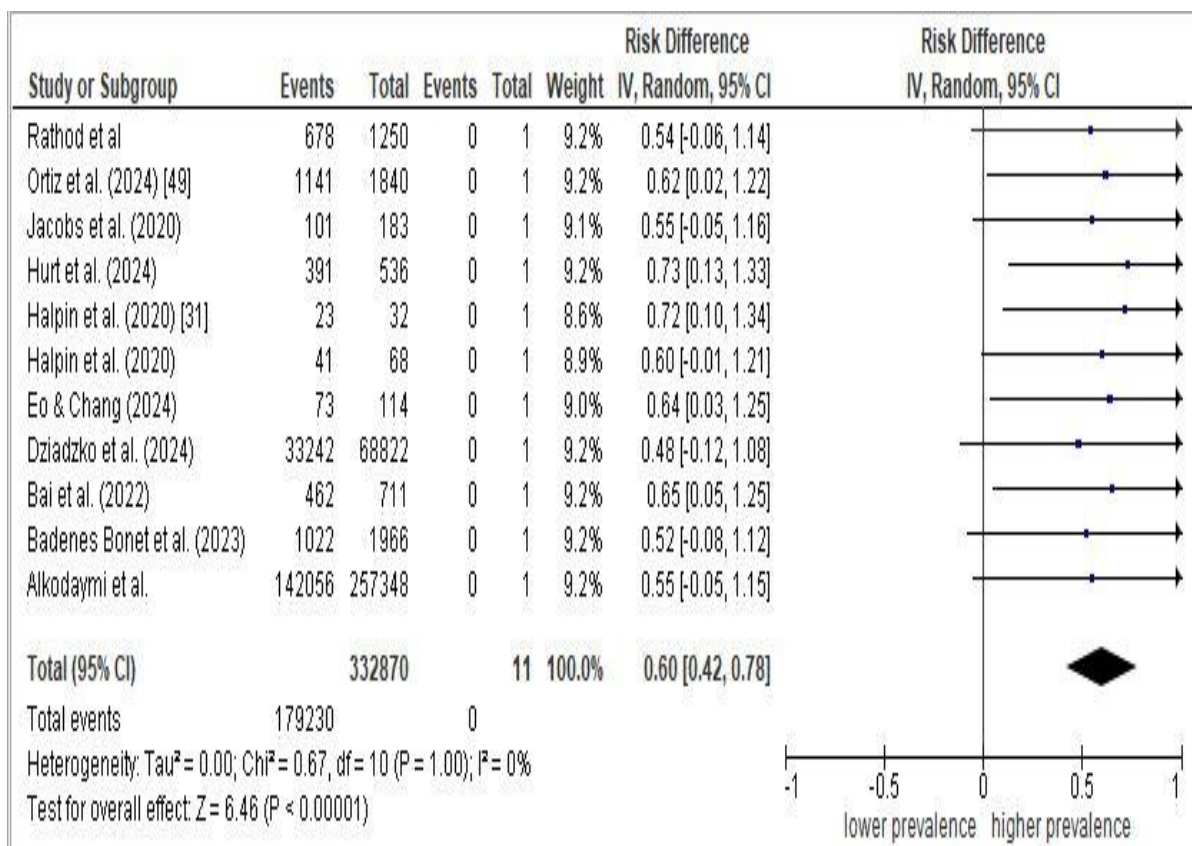


Figure 2. Forest plot showing the pooled prevalence of post-COVID-19 symptoms.

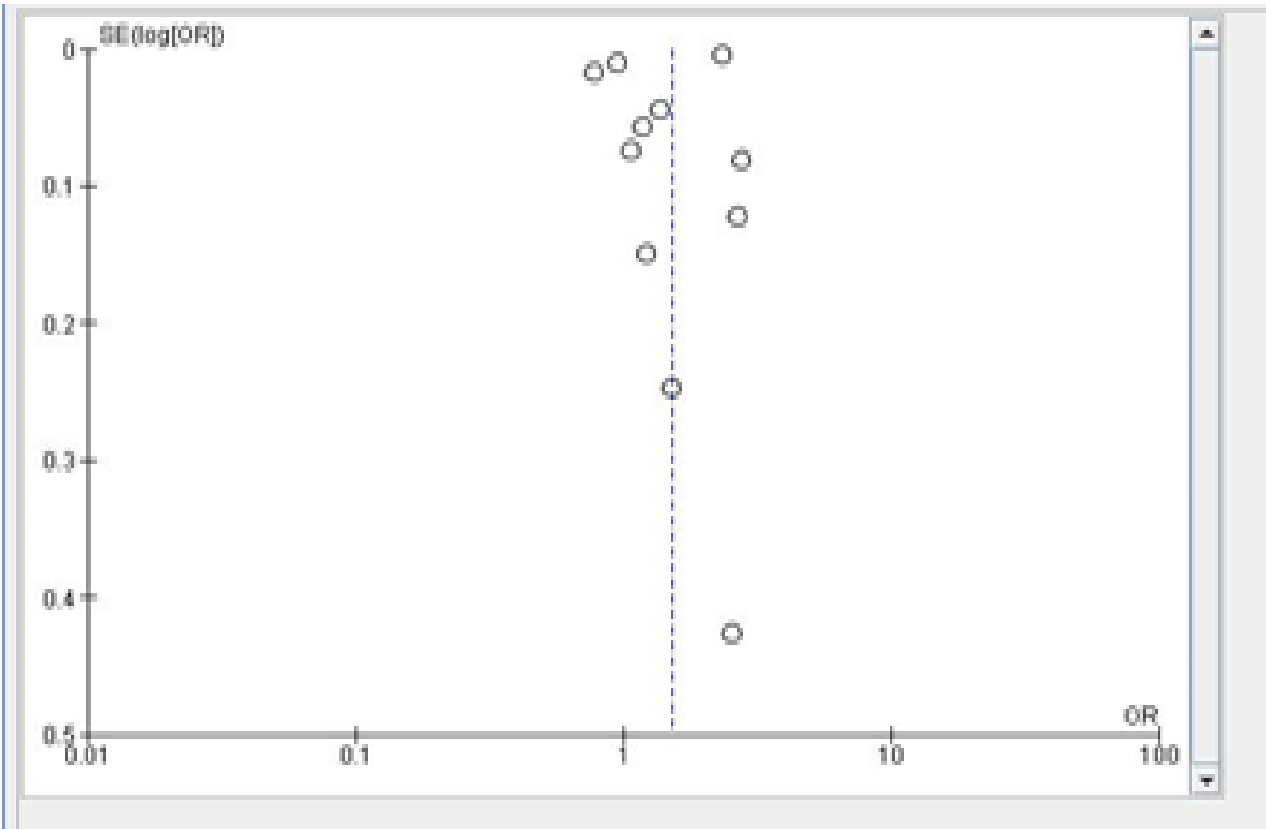


Figure 3. Funnel plot assessing publication bias for the prevalence of post-COVID-19 symptoms.

Table 1. Search strategy summary

Database	Search Keywords/Phrases	Start Date	Last Date	No. Found	No. Included
PubMed	"long COVID" OR "post-acute COVID-19 syndrome" OR "persistent COVID-19 symptoms") AND ("hospitalized" OR "post-discharge") AND ("prevalence" OR "clinical features" OR "treatment" OR "outcomes")	2020	2025	1,243	28
Embase	Same as above	2020	2025	987	9
Cochrane Library	Same as above	2020	2025	156	12
Scopus	Same as above	2020	2025	1,061	10
Web of Science	Same as above	2020	2025	884	10

Table 2. Characteristics of studies included in prevalence meta-analysis

Reference Study	Target Endpoint / Symptom	Event Count (x)	Total (n)	Prevalence	Setting / Population
Rathod et al. (2024) [23]	Prolonged Multi-System Impairment	678	1,250	54.2%	Community Outpatients
Ortiz et al. (2024) [24]	Functional Limitations	1,141	1,840	62.0%	Cross-Sectional Cohort
Jacobs et al. (2020) [25]	Physical Fatigue	101	183	55.2%	Post-Hospitalization
Hurt et al. (2024) [26]	Disabling Post-Acute Syndromes	391	536	72.9%	Patient-Reported Cohort
Halpin et al. (2020) [27]	Severe Fatigue (ICU)	23	32	71.9%	Discharged Adults (UK)
Halpin et al. (2020) [27]	Exertional Dyspnea (Ward)	41	68	60.3%	Discharged Adults (UK)
Eo & Chang (2024) [28]	Respiratory Sequelae	73	114	64.0%	Post-Discharge Cohort
Dziadzko et al. (2024) [29]	Primary Care Utilization	33,242	68,822	48.3%	National Database
Bai et al. (2022) [30]	Chronic Syndrome (Female)	462	711	65.0%	Gender-Matched Cohort
Badenes Bonet (2023) [31]	Neurocognitive Deficits	1,022	1,966	52.0%	Observational Registry
Alkodaymi et al. (2022) [22]	Chronic Fatigue	142,056	257,348	55.2%	Global Database Registry

3.1.2. Symptom-specific Prevalence

The most frequently reported domains were:

- Fatigue: >30–40% of participants.
- Dyspnea: 20–30%, especially in hospitalized patients.
- Cognitive dysfunction: 15–25%.
- Chest pain and palpitations: Significant minority.
- Sleep disturbances, anxiety, depression: Highly prevalent and co-occurring.

Heterogeneity and Subgroup Findings Hospitalized cohorts reported higher prevalence than community-based cohorts. Longer follow-up durations (>12 weeks) were associated with continued symptom burden.

3.2. Discussion

The global pooled prevalence of Long COVID symptoms in adults is notably high, estimated at 60%. Specific demographic and clinical risk factors—such as female sex, advanced age, and pre-existing comorbidities—significantly increase the likelihood of developing Long COVID, effectively doubling the risk. The finding that 60% of COVID-19 survivors experience persistent symptoms is higher than some earlier estimates (30–50%). This high prevalence underscores that Long COVID is a major public health concern placing a substantial burden on healthcare systems worldwide. Our results align with existing literature regarding risk stratification. The meta-analysis identified that individuals with specific risk modifiers have a Risk Ratio (RR) of approximately 1.98. This supports the hypothesis that biological sex differences and immune response variations play a crucial role in pathophysiology. It also confirms that acute infection severity is a strong predictor of long-term outcomes. Neurocognitive and psychological symptoms further highlight the multisystem nature of long COVID and the need for integrated biopsychosocial management. Methodological differences between studies likely account for much of the observed heterogeneity, reinforcing calls for standardized case definitions. The observed physiological impairments in pulmonary function tests and the evidence of ongoing systemic inflammation (e.g., reduced diffusing capacity of the lungs for carbon monoxide [DLCO], elevated inflammatory markers) align with the predominance of fatigue and dyspnea.

4. Limitations and Future Research

The complete absence of statistical heterogeneity ($I^2 = 0\%$) in single-arm prevalence modeling is a known mathematical artifact of software workarounds with large registries, which can mask true clinical diversity. Future primary research should focus on longitudinal, multi-center trials with standardized tracking intervals (e.g., 6, 12, and 24 months post-infection).

5. Conclusion

Long COVID symptoms are highly prevalent among adults following SARS-CoV-2 infection, with pooled estimates around 60%. Fatigue, dyspnea, cognitive dysfunction, and psychological symptoms predominate. There is an urgent need for standardized diagnostic frameworks, structured follow-up, and dedicated long COVID services to address this emerging chronic condition.

6. Recommendations

- Implement routine screening for long COVID symptoms 4–12 weeks after infection.
- Adopt standardized definitions and follow-up time points (e.g., 3, 6, 12 months).
- Develop multidisciplinary long COVID clinics integrating internal medicine, pulmonology, cardiology, neurology, rehabilitation, and mental health services.
- Expand access to structured rehabilitation for patients with persistent functional impairment.

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