Socioeconomic impact of post COVID-19 condition: Effects on return to work

A living review update

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Land Acknowledgement(s)

SPOR Evidence Alliance operates from the St. Michael's Hospital, Unity Health Toronto which is located on the traditional land of the Huron-Wendat, the Seneca, and the Mississaugas of the Credit. Today, this meeting place is still the home to many Indigenous people from across Turtle Island.

COVID-END is housed within McMaster University which is located on the traditional territories of the Mississauga and Haudenosaunee nations, and within the lands protected by the "Dish With One Spoon" wampum, an agreement to peaceably share and care for the resources around the Great Lakes**.**

We are grateful to have the opportunity to work on these lands.

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Project Contributors

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Third-Party Materials

Not applicable.

General Disclaimer

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Table of Contents

Abbreviations and Definitions

CADTH	Canadian Agency for Drugs and Technologies in Health
CIHR	Canadian Institutes of Health Research
DALYs	Disability adjusted life years
HCW	Healthcare workers
ICU	Intensive care unit
OECD	Organization for Economic Cooperation and Development
OR	Odds ratio
PCC	Post COVID-19 condition
PHAC	Public Health Agency of Canada
PRESS	Peer Review of Electronic Search Strategies
QALYs	Quality adjusted life years
RTW	Return to work
SPOR	Strategy for Patient Oriented Research
WAI	Work Ability Index
WC	Workers' Compensation
WHO	World Health Organization

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EXECUTIVE SUMMARY

Objectives: The objective of this rapid scoping review is to provide updated evidence to the Public Health Agency of Canada (PHAC) about the socioeconomic impact of post COVID-19 condition (PCC). In this updated review, we focus upon one specific research question: *What is the impact of PCC on return to work (RTW)?*

Design: Rapid scoping review as part of a living synthesis

Methods: An experienced medical information specialist adapted the search strategies used in the initial version of this review, using an iterative process in consultation with the review team. We searched Ovid MEDLINE® ALL and Embase. We also searched the core database collection of Web of Science. The search was limited to articles published since October 2022. The search strategy was executed on July 14, 2023. The search was rerun on September 26, 2023. A combined search within select grey literature databases was also conducted in July 2023 and re-run in September 2023. We re-deployed the standardized screening form for title and abstract screening and full-text screening used in the initial review; inclusion criteria were limited to articles with RTW outcomes but otherwise unchanged from the initial scoping report. Studies were summarized descriptively using text and tables.

Results: In context of our original rapid scoping review findings, literature on the employment and RTW) impacts of PCC appears to suggest the following:

- There is a growing number of longer-term studies (over 1 year), though the published literature still lags behind the situation on the ground. Continued variation in the operational definition of PCC used by researchers makes formal synthesis of findings difficult.
- New published primary studies continue to demonstrate a wide (and perhaps even larger) range of results across different measures of employment impact; these are likely due to differences in method (e.g., use of different self-report measures of work ability) and study population, rather than to real variation across geography in the impacts of the COVID-19 virus itself.
- Ultimately most individuals with PCC do return to work; nonetheless, absence from work is an important consequence for many. Based on our findings, there continues to be what we see as convergence on two key measures: about 20% of patients with PCC appear to experience long-term absences from the workforce, with about <5% permanently leaving the workforce in consequence.

Conclusion: In conclusion, the economic impact of PCC is substantial. Very little data so far has been published from 2023, which suggests a lag in our knowledge about the evolving situation with respect to PCC. While more time will undoubtedly provide greater confidence in results, our best estimate derived from the existing literature –specifically the largest studies based upon surveys or registries of populations of approximately 1000 or more -- is that just less than 20% of patients with PCC continue to be absent from work for a prolonged period of time (i.e., 6 months). In addition, we observe from the literature that individual ability to work is compromised, although different measurement instruments provide highly different estimates of these impacts.

Introduction

The purpose of this rapid scoping review is to provide evidence to the Public Health Agency of Canada (PHAC) about the socioeconomic impact of Post COVID-19 condition (PCC).

PCC, also referred to as “long COVID” and “long-haul COVID” among other labels, is the term used to describe a proportion of individuals infected with COVID-19 (technically, SARS-CoV-2; we use the shorthand throughout) who experience long-term symptoms. The terms derive initially in large part from the patient experience;[1,2] academic and policy research has begun to address these experiential concerns. Many different definitions of PCC have been and are being used by researchers. The Government of Canada has adopted the World Health Organization (WHO) definition of PCC.[3]

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

Given that the WHO definition is not universally adopted, for the purposes of this review we applied a broader definition of PCC to encompass studies that describe a population of individuals with persistent symptoms of COVID-19 lasting at least 12 weeks that cannot be explained by any other cause, or the explicit use of PCC or a substantially similar term, defined by the authors of an included study.

On October 17, 2022, Statistics Canada released the report “Long-term symptoms in Canadian adults who tested positive for COVID-19 or suspected an infection, January 2020 to August 2022”.[4] The results of this report indicate that, 14.8% of Canadian adults (approximately 1.4 million people) who had or thought they had COVID-19 experienced symptoms at least three months after their intial infection.[4] PCC symptoms are diverse. The Government of Canada includes the following, currently known, common symptoms[5]: fatigue, memory problems, sleep disturbances, shortness of breath, anxiety and depression, general pain and discomfort, difficulty thinking or concentrating and posttraumatic stress disorder. It may be that gender (female), age (older), severity of infection (as indicated by hospitalization), being a member of a vulnerable population, and the presence of pre-existing disability or co-morbidities pose greater risk of experiencing PCC after contracting COVID-19[6,7]. On the other hand, being vaccinated may be a protective factor.[8,9]

Employment-related impacts of PCC might produce substantial economic burden. A handful of estimates for the US context exist. A report published in August 2022 by the Brookings Institute estimated that PCC is responsible for 2-4 million working-age Americans not returning to the work force[10]: “The annual cost of those lost wages alone is around $170 billion a year (and potentially as high as $230 billion)”. Cutler reported survey results estimating that 44% of individuals with PCC

were out of the labour force and approximately half of individuals with PCC worked fewer hours; the total cost of PCC in the US was estimated to be $3.7 trillion[11]. “Fifty-nine percent of this total cost was due to lost quality of life, and the remainder included reduced earnings and a greater rise in medical spending” (Katz, 2023)[7]. Mirin et al estimate the burden of PCC in the form of lost income, giving a range from $101 billion to $430 billion[12]. Their estimations presume that 45% of those with PCC will have to reduce their working hours (assumed from full time to half time), and that 22% will be forced to give up their jobs altogether.

The specific research question for this review was, *What is the impact of PCC on return to work?* The first version of this rapid scoping review, finalized in January 2023, also addressed questions related to the impacts of PCC on productivity as well as the economic burden attributable to the condition and its treatment. This included such subjects as food security and housing. Given that there was a very small body of literature on these other subjects identified in those original seaches, we anticipated that there would be few if any additional studies available at this time. A review published by Katz et al in July 2023 provides the most recent summary of what is known to date[7]. Further update of findings on these topics is thus deferred until possible future iterations of this living review.

Methods

The methods for this updated rapid scoping review were informed by the Joanna Briggs Institute* guidelines for scoping reviews and, except for the limitation to return to work outcome only and new timeframe, remain unchanged from the initial version.

Eligibility Criteria (see Table 1):

Table 1. PICOST

Population	All individuals with PCC defined as persistent symptoms of COVID-19 lasting at least 12 weeks that cannot be explained by any other cause, or who have PCC/long COVID as otherwise defined by the author.
Intervention	Not applicable
Comparator	Not applicable
Outcome	Return to work (e.g., loss of income due to inability to return to work, proportion of individuals returning to work full time/part time/not returning, sick days, long-term disability claims)
Study design	Most study designs (e.g., simulation models, observational studies, systematic reviews, qualitative studies, RCTs) Exclusion: commentaries, case study (single patient), studies not in English
Time frame	Papers published since the completion of the original literature searches in October 2022.

* https://jbi.global/scoping-review-network/resources

Literature Search:

Literature search strategies from the initial iteration of this scoping review were adapted and re-applied for this update. Strategies were prepared by an experienced medical information specialist using an iterative process in consultation with the review team. Another senior information specialist peer reviewed the MEDLINE strategies prior to execution using the PRESS Checklist.[13]

Using the multifile option and deduplication tool available on the OVID platform, we searched Ovid MEDLINE® ALL and Embase. We also searched the core database collection of Web of Science. The search strategy for this updated rapid scoping review was executed on July 14, 2023. The search was rerun on September 26, 2023, to capture any additional articles and to ensure that the contents of this review were as up-to-date as possible.

All strategies utilized a combination of controlled vocabulary (e.g., MeSH) and keywords. For the return-to-work topic, this included controlled subject headings such as “COVID-19”, “Return to Work”, “Efficiency”, and such keywords as “long COVID”, “productivity”, and “workability”. Vocabulary and syntax were adjusted across the databases. No language limits were applied; however, only English language studies were retrieved for analysis. Animal-only records were removed where possible. The search was restricted to publications indexed since the date of the initial searches of October 2022; in other words, a time frame of about 11 months was included. Results were downloaded and deduplicated using EndNote version 9.3.3 (Clarivate Analytics) and uploaded to Excel.

We undertook a single combined search of the grey literature within various COVID meta-databases, including COVID-END, L-OVE, and the WHO COVID-19 Research Database. We also searched Google Scholar and selected economic sites of CADTH’s Grey Matters.[14] Table of Content alerts were received on a weekly (or monthly) basis over the entire review period from the following generalist: British Medical Journal (BMJ), Canadian Journal of Public Health (CJPH), and Journal of the American Medical Association (JAMA) Health Forum. Handsearching included these Content alerts as well as reviewing the reference lists of included peer-reviewed papers. Specific details regarding the strategies appear in Appendix 1.

Study Selection:

We developed a standardized screening form for title and abstract screening and full-text screening. This screening was completed by two reviewers, both of whom had worked on the original iteration of this review and so were familiar with the screening forms and process. Due to time constraints, citations were not extracted in duplicate.

Data Extraction:

We used a standardized form to extract key data, including the following: author, year, country, study design, study population, data collection time frame, population vaccination status, PCC definition, and

return to work outcomes addressed – inability to return to work, reduced hours or job accommodations, permanent exit from the workforce, and perceived reduction in work ability.

Risk of Bias Assessment:

As this was a rapid scoping review, we therefore did not undertake a risk of bias assessment.

Data Synthesis:

Included studies were summarized descriptively using text and tables as needed to reflect the research question.

Results

Based on this updated analysis, in context of our original rapid scoping review findings, we make the following key observations about the evolving state of knowledge on the employment and RTW impacts of PCC.

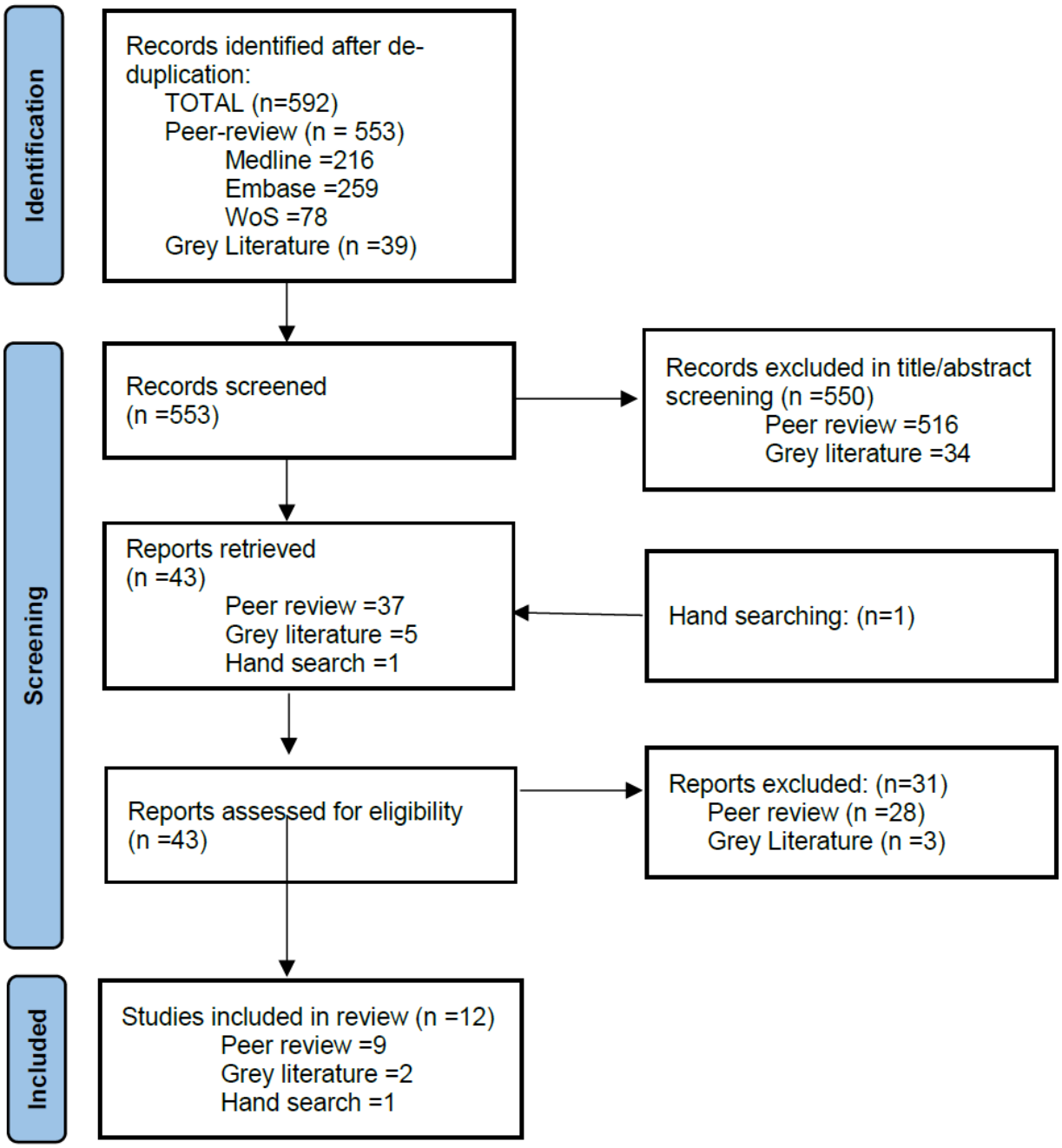
- Extant research issues largely from Western Europe and to a lesser degree from the United States. There is a growing number of longer-term studies (over 1 year), though the published literature still lags behind the situation on the ground.
- Continued variation in the operational definition of PCC used by researchers makes formal synthesis of findings difficult.
- New published primary studies continue to demonstrate a wide (and perhaps even larger) range of results across different measures of employment impact; these are likely due to differences in method (e.g., use of different self-report measures of work ability) and study population, rather than to real variation across geography in the impacts of the COVID-19 virus itself. We await further reviews.
- Ultimately most individuals with PCC do return to work; nonetheless, absence from work is an important consequence for many. Based on our findings, there continues to be what we see as convergence on two key measures: about 20% of patients with PCC appear to experience long-term absences from the workforce, with about <5% permanently leaving the workforce in consequence.

These points are more fully addressed in the sections which follow.

Overview of Studies:

For the initial version of this scoping review, peer-reviewed and grey literature searches retrieved 2803 hits; 344 papers (12%) were obtained for full text review. Of these 68 were ultimately retained (20%). Two papers were included based on hand-searching. In this update, searches of the peer-reviewed bibliographic databases identified 553 citations. Grey literature searches identified 39 citations. From this total, 42 (8%) of the papers were retrieved for full text review, and 11 (26%) ultimately retained. Hand-searching identified an additional 1 citation.

Figure 1. PRISMA diagram for literature searches



Overall then, the original version of this rapid scoping review included synthesized results from 70 papers. For this update, an additional 12 papers met the inclusion criteria – producing a total set of 82. Two of the included new articles were available as pre-print only (i.e., not yet peer-reviewed)—See Appendix 2. Table 2 shows the year of publication. This indicates that the bulk of available evidence still dates to 2022 publications, with data collected up to that time and so might somewhat poorly reflect what is happening on the ground in respect to PCC and employment impacts.

Table 2. Included studies by year of publication

	Original Data Set		Updated Data Set		Cumulative total
Year	N	%	N	%	
2021	17	24	--	--	17 (21%)
2022	53	76	4	33	57 (70%)
2023	--	--	8	67	8 (10%)
Total	70	100	12	100	82 (100%)

All 12 newly identified studies are primary empirical research. Of primary studies, 75% were conducted in Europe: Denmark (n=2), France, Germany, Italy (n=2), the Netherlands, Spain, Switzerland. The remaining 25% of primary studies (n=3), were conducted in the USA. No studies included for this updated review contain Canadian data; however, limiting the analysis to only English-language materials may have missed potential papers from Quebec that may have been published in French. Table 3 shows the total data set by geographical area; data from European countries dominates the published literature, followed distantly by US studies.

Table 3. Geographic area from which PCC data in included studies has been collected and reported

	Original Data Set		Updated Data Set		Cumulative total
Area	N*	%	N	%	
Europe	41	68	9	75	50 (69%)
North America	18	30	3	25	21 (29%)
Australasia	1	0.02	--	--	1 (0.01%)
Total	60	100	12	100	72 (100%)

*some studies report data from multiple countries, so this does not equal the number of publications

In keeping with the methodology of our initial review, as well as the strong prospect that countries with dis-similar social welfare systems may not offer lessons readily transferrable to the Canadian context, we excluded countries from Africa, Asia, and South America, which otherwise met all inclusion criteria, from further consideration for this review (n=1). We acknowledge that this may have excluded some potentially relevant comparator countries, such as Japan. (No Japanese studies otherwise met the inclusion criteria however.)

The most common designs employed in included new primary research were cohort studies; cross-sectional designs (survey research); and large-scale survey and/or registry-based studies. Table 4 provides more detailed information, noting that where studies may have used multiple or mixed methods, they have been categorized by the major or most prominent design employed. The new data suggests continued reliance on cohort and cross-sectional design, and perhaps an increasing proportion of registry or claims-based studies; this may reflect that the length of the pandemic has allowed for the accumulation of larger and more comprehensive databases of COVID-19 and PCC patients. The absence of new reviews or modeling studies may be surprising, although such studies are also intensive and time consuming to undertake, in terms of both data collection and analysis.

Table 4. Main Study Design among Retained Studies

Study Design	Original Data Set (N)	New Data Set (N)	Study Size (PCC population, retained through to end, control groups excluded) -range (median)
Small Cohort Study	14	5	56-1627 (272)
Small Cross-sectional	11	3	54-448 (77)
Large population survey, registry or claims data-based	9	4	977-88,818 (23,206)
Reviews	11	--	
Modeling studies	8	--	
Qualitative	6	--	
Other	5	--	

Sample sizes for cohort and cross-sectional studies were small; out of 8 studies, 3 (38%) had fewer than 100 participants, 3 (38%) had between 100 and 500 participants, and 2 (25%) had more than 500 participants.

Some studies began collecting data from almost the very beginning of the pandemic. For the initial studies identified, the bulk of available reported data was gathered through 2020 into mid-2021. Studies identified for the update to this scoping review now all include data collection into early- to mid- 2022 at least; however, in only 3 of the 10 for which the timeframe is noted is data collected later than July 2022. This still suggests a time lag in our knowledge about the evolving situation with respect to PCC; the peer-reviewed literature is absent of 'real-time' data. Table 5 breaks down studies according to duration (from time of patient enrollment to completion of final follow-up), by year of publication. Not unsurprisingly, there seems to be a tendency for more recent publications to draw upon a longer data collection time frame.

Appendix 3 shows the exact data collection range for each included primary study, where this information is available.

Table 5. Studies by duration and year of publication

		2021	2022	2023
Up to 1 year	1- 3 months	2 (33%)	9 (27%)	--
	4-6 months	--	7 (21%)	2 (33%)
	7-12 months	2 (33%)	7 (21%)	--
1-2 years	13-18 months	2 (33%)	6 (18%)	2 (33%)
	19-24 months	--	2 (6%)	--
2 years+	25+ months	--	2 (6%)	2 (33%)

Since vaccines only began to be available as of December 2020, all data collected before that date is by definition within unvaccinated populations. Some of the new studies identified for this updated review argue that since wide-scale vaccine coverage was largely achieved for developed countries, this may no longer be a useful factor for sub-analyses. As an alternative, Bonham et al[15] used additional shots beyond the initial vaccination as an aspect of their analysis.

In this updated scoping review, we continue to find that empirical studies operationalized the term PCC (or similar) in multiple ways, and quite often poorly. This diversity increases the difficulty of producing meaningful synthesis of the findings (e.g., comparison of outcomes stratified by PCC definition). While the WHO definition appears to be establishing itself as standard for defining PCC, it is unclear whether papers which reference this standard in fact employ it for their empirical work. Explicit time-based definitions as used by the papers in the original and in this updated scoping review are summarized in Table 6 below.

Table 6. Explicit Time-based Definitions of PCC in Retained Papers

Original Synthesis findings (to October 2022)				
14 days (1)	30 days (3) 4 weeks (9) 1 month (3)	4-6 weeks (1) 6 weeks (1) 10 weeks (1)	12 weeks (3) 3 months (6)	3-6 months (2) 6 months (2) 6-8 months (1) 6-12 months (2) 12 months (1)
Updated Synthesis findings (October 2022-September 2023)				
	3 weeks (2) 1 month (1)	60 days (1)	3 months (2) WHO or NICE definition [3 months] (5) *	12 months

Increasing lengths of time →

*several papers cited the WHO or NICE definition of PCC, but it is unclear if this definition was actually applied in identifying PCC patients

For seven papers (six from the original data and one from this update), the definition of PCC appears to be operationalized by the date of data collection or follow-up; for instance, an online survey explicitly targeted at those self-identifying as long COVID survivors reports findings by duration of symptoms (<12 months, 12-<15 months, 15-<18 months, and 18+ months).

Outcomes: Return to Work and Changes in Employment

As was the case in the initial iteration of this review, we report on four main outcomes related to RTW: (i) short- or long-term absence from work (sick days or disability claims); (ii) return to work with reduced hours or other forms of job accommodation; (iii) permanent employment loss/leaving the workforce; (iv) perceived impairment of ability to perform job duties. Sub-section (v) presents additional observations from the literature not otherwise covered by the first four categories. It is important to note that the heterogeneity of outcomes measured, as well as the wide range of results within each category of outcome, makes it difficult to reach a generalized conclusion.

Our initial rapid scoping review included data from three systematic reviews, which addressed PCC and its impact on employment and return to work in some way (Table 6 below). No new reviews were identified for this update. For each following sub-section, we reiterate the findings from the existing systematic reviews, followed by summary of primary studies as identified in October 2022, then in September 2023.

Table 6. Previous Reviews on PCC and RTW

	Gualano et al[16]	Middleton et al[17]	Nittas et al[18]
Primary author country	Italy	UK	Switzerland
Type of review	Systematic review	Systematic review with meta-analysis	Umbrella (review of reviews) + primary study synthesis
Publication date	Jun 2022	Mar 2022 in preprint	Mar 2022
Literature search date limits	Up to Dec 2021	Up to May 31, 2021	Up to July 9, 2021 for reviews, May 2021 for primary papers
#papers included	11 (7 identified in their search and 4 from a previous SR)	49	23 reviews and 102 primary studies
Population(s) included	Hospitalized only	Hospitalized only	All
Themes addressed	RTW, change in employment	RTW	Burden, RTW, change in employment

1. short- or long-term absence from work (sick days or disability claims)

i) Reviews

Nittas et al[18] includes data from eight studies where patients report absence from work due to PCC. Among those who had been hospitalized, absence was reported in between 9-40% of cases (4 studies). For non-hospitalized patients, two studies reported absences by 12-38% of study participants, and in mixed samples, absences were reported by 31-70% of participants (2 studies). Note that data across studies was collected at various follow-up times, between 2 and 7 months. The data from these original studies is extracted in Table 6.

A second substantive systematic review, by Middleton et al (2022)[17], was retrieved as a pre-print. In this case, inclusion was restricted to only studies in which patients had been hospitalized for COVID-19. They found 8 papers which reported proportions of workers returning to work; converting this to on-going absence, these figures ranged from 0% to 79.5%, as well as a paper which calculated the proportion of work time missed; 81.5% at three-month follow up. The data from these original studies is extracted in Table 6.

A third review, that by Gualano et al (2022)[16], includes 11 studies in which return to work is included as an outcome. Two of these studies are from China, and so per the above we exclude them here*. Similar to Middleton et al, only studies in which patients had been hospitalized for COVID-19 were included. These studies report the proportion of patients who had returned to their previous employment at the time of follow-up –again, follow up taking place at varying lengths of time. Converting those figues to on-going absence, to be consistent with the paragraphs above, the reported range is from 22.5% to 90%[1]; median 59.0. The data from these original studies is extracted in Table 6.

Note that the studies included by these 3 reviews overlap to some extent; no study is included more than once in Table 6.

ii) primary studies

We originally identified one primary study in the peer-reviewed literature which included Canadian data on return to work. This study from Alberta involved 81 workers, all of whom had had PCC (some had been hospitalized during their acute phase, others not), and who had completed a particular rehabilitation program described by the authors. Follow up period is not clear. Among study participants, “Only a small majority of the sample returned to work (53%)” (Brehon et al, 2022).[19] This is in the mid-range of results reported across the review papers. This update to the living review did not find any additional Canadian studies on return to work.

In addition to the studies on absence from work mentioned above, RTW outcomes for other primary studies are also incorporated into Table 6 (new editions in this update of the scoping review are bolded).

Table 6. Estimates of Absence from Work due to PCC

Author	Study size (# of COVID-positive patients)	Subject Acuity	% Had not RTW at time of data collection	Follow-up date as of
From SRs*				
Carenzo[20] [G, M]	45	ICU	22.2	6 months
Chopra[21] [G, N]	195	Hosp	23.1	2 months

* The 2 Chinese studies both had exceptionally high rates of return (91 and 100%); this may be suggesting of a different social context and might further justify their exclusion from the analysis here.

Author	Study size (# of COVID-positive patients)	Subject Acuity	% Had not RTW at time of data collection	Follow-up date as of
Garrigues[22] [G, M, N]	41 (Hosp) 15(ICU)	Hosp ICU	24.4 53.3	110 days
Hodgson[23] [G]	114	ICU	11.4	
Lindahl[24] [G]	71	Hosp	12.7	6 months
Monti[25] [G]	28	ICU	67.8	2 months
Robinson-Lane[26] [G]	223	Hosp	25.3	2 months
Van Veenenhahl[27] [G]	30	ICU	43.3	6 months
Evans[28] [M]	1077 (641 previously working)	Hosp	17.3	5-12 months
Frontera[29] [M]	196	Hosp	59.0	6 months
Ghosn[30] [M]	1137	Hosp	29.0	6 months
Latronico[31] [M]	90	Hosp	32.0	3 months
Davis[32] [N]	3762	All	22.3	5 months
Halpin[33] [N]	68 32	Hosp ICU	30.0 90.0	4-8 weeks
Townsend[34] [N]	128	All	31.0	6 weeks
Additional Primary Studies				
Brehon[19]	81	All	47	NR
Wallin[35]	64	ICU	38	6-8 months
Diem[36]	309	All	62.7	13 months on average
O'Brien[37]	55	Hosp	33	One year
Yelin[38]	1027	All	17.8	NR
Harvey-Dunstan[39]	42	Non-hosp	40 of those without major fatigue symptoms, 77 of those with major fatigue	4 weeks
Blitschteyn & Whitelaw[40]	20	Non-hosp	[60% of 85%] =51	6-8 months
Jacobsen[41]	7466	All	18 1.2	4 weeks 6 months
Ziauhuddin[42]	2555	Non-hosp	19.1	NR
Larsson[43]	46	ICU	31.3	12 months
Moskatel[44]	31	All	25.8	NR
Gutierrez-Martinez[45]	87	All	28.6	159 days on average
Delgado-Alonso[46]	**77**	**All**	**50**	**20 months**
Van Wambeke[47]	**54**	**Non-hosp**	**36**	**22 months**
Aben[48]	**31,103**	**All**	**9.4** **5.5**	**6 weeks** **12 weeks**

Author	Study size (# of COVID-positive patients)	Subject Acuity	% Had not RTW at time of data collection	Follow-up date as of
			3.0	**26 weeks**
Mendola[49]	**56**	**Hosp**	**37** **7**	**6 months** **1 year**
NYSIF[50]	**977**	**All**	**59.6** **18**	**60 days** **1 year**

*[Studies reported in previous systematic reviews; G=Gualano; M=Middleton; N=Nittas, respectively]
NR=not reported

The four categories in Table 6 are studies of ICU patients only, hospitalized patients only, non-hospitalized patients only, and studies which include all those with COVID-19 regardless of acuity of infection. The ranges are similar across categories. For ICU patients only, the proportion of previously employed workers who had not returned to work by the study's follow-up period or designated cut-off date ranged from a low of 11.4% to a high of 90%; for hospitalized patients only, the range was 12.7% to 59%, and in mixed or non-hospitalized groups the range was 12% to 62.7%. The median estimate across studies was 40.7%, 27.2% and 28.6%, respectively; this might suggest that return to work is more difficult for those most severely affected, though the heterogeneity of designs and study durations makes it hard to reach a definitive conclusion here. This suggestion also is found in the New York State Insurance Fund's analysis of Workers' Compensation claims[50]. Recent studies which we have identified sometimes include hospitalization status as a patient characteristic, but seldom use this as a variable for sub-analysis anymore; availability of vaccines and other factors have made subsequent waves of COVID-19 less virulent than the initial one. Perhaps there may be growing consensus that a link between severity of illness (as shown by hospitalization) and greater challenges with PCC and/or return to work is adequately established by the body of evidence to date.

If we look in particular at the largest studies from Table 6– those with over 1,000 subjects (Jacobson[41], Ziauhuddin[42], and Yelin[38]) – there appears to be a greater convergence in estimates: 18%, 19.1%, and 17.8%, respectively. The NYSIF study (with 977 PCC patients) similarly gives an estimate of 18%. The paper by Aben et al appears to diverge from this estimate, given a continued absence from work proportion at 12 weeks of 5.5%; however, their estimate for the earliest wave, 12.8% is somewhat closer to this cluster of findings[48]. The more recently published studies, having the advantage of longer periods of time with data, are able to provide estimates for more than one length of absence[48-50 51]; this should be useful in helping to determine return to work trajectories. As data on PCC itself over longer periods is emerging in these recent articles, it can likely serve as the primary source for projections going forward –thus reducing the need to rely on proxy evidence based on other diseases which we noted in the initial iteration of this review.

Other ways in which absence from work is reported includes the proportion of workers with PCC who are on formal sick or disability leaves, or those who report having missed meaningful amounts of time during the period when they suffered their most severe PCC symptoms. For sick leave, various percentage estimates, in decreasing order of magnitude, are noted below (new additions are bolded) –

the additional data continues to reflect the wide range of observation identified in the initial scoping review:

- **Delgado-Alonso[46] (81.8% had needed sick leave at some point due to PCC)**
- **Nielsen[52] (56% sick listed at time of assessment, with 96% accounted for by PCC)**
- Norrefolk[53] (38% sick leave and 13% disability)
- Wahlgren[54] (23% on leave at 4 months)
- Sorenson[55] (12% on leave within 4 weeks vs 7.7% of control)
- Jacob[56] (5.8% on long term disability leave at 4 months)
- Lemhofer[57] (2% found medically unfit for work by a physician)
- Kisiel[58] (1.4% on sick leave of 3+ weeks due explicitly to PCC)

A German model-based study estimated a most likely case scenario, given a starting point of 54,000 annual claims, that PCC would lead to an additional 241 disability claims per year, a net increase of 0.5% per year (with best case and worst case parameters of 0.1%, or 52 additional claims, and 8%, or 4061 additional annual cases, respectively)[59].

In one estimate, as might be expected, the greatest costs are associated with a relatively small number of claims. Thus, Bernicki[60] finds "1) Ninety-five percent of accepted WC [Workers' Compensation] claims were closed within the study period; [that is January 1, 2020 to November 30, 2021] 2) five percent of claims had 30 days or longer of lost time accounting for 65% of total paid WC costs; 3) medical costs increased 8-fold once paid days lost crossed the threshold of 60 days or greater". A newly identified study by Jakobsen et al[61] in Denmark concluded that patients with COVID had a 3.3% higher risk of taking full-time sick leave than those in a test-negative control group over the same period of time.

2. return to work with reduced hours or other forms of job accommodation

i) reviews

For changes to job responsibilities or accommodations, Nittas et al[18] included 2 studies of hospitalized patients, among whom the proportion of those reporting changes to duties ranged from 15-40%. In three studies of patients with more mild initial illness, PCC-related changes to job activities were reported in 8-45% of cases. According to Middleton et al[17]: "The proportion of participants who had a change in their scope of work or part time work ranged from 2.5% to 32% [4 studies]." Gualano et al[16] reported that the proportion of those reporting limitations in job duties or reduced hours ranged from 3.6-13.8% (7 studies).

ii) original primary studies

Ham[62], in a study of 'long-haulers', found that 29.5% of respondents indicated that they had experienced reduced hours and pay. Scherlinger et al[63] found 23.3% (n=30) of participating subjects experienced some financial difficulties due to PCC. Fremsted et al[64] suggest that "The tight labor market has also made employers more willing to provide accommodations to retain employees, including by granting employee requests for time off, flexible working conditions, and remote work"

though they do not cite supporting evidence for this claim. The Alberta study by Brehon et al[19] found that 93% of those who were able to return to work (which was only 53% of the study population) required some form of modified job duties. They conclude that "the availability of modified duties (odds ratio [OR] 3.38, 95% CI 1.26-9.10) and shorter time between infection and admission for rehabilitation (OR 0.99, 95% CI 0.99-1.00) predicted return to work even when controlling for age and gender". They thus emphasize the role of employers in response, as well as the ability of the health system to ensure adequate rehabilitative services, perhaps unsurprising as the study is written by providers of such services.

iii) additional primary studies to this update

Perlis et al[65], in a large-scale US study, reported that those with PCC had a lesser likelihood of working full-time. "In survey-weighted regression models excluding retired respondents, the presence of PCC was associated with lower likelihood of working full time (odds ratio [OR], 0.71 [95%CI, 0.63-0.80]; adjusted OR, 0.84 [95%CI, 0.74-0.96])". Another American study by Bonham et al[15], focused upon the state of Hawaii, found that those with PCC more likely reported having reduced hours or having to receive job accommodations, though the results were not statistically signicant.

Delgado-Alonso et al[46] found that 31.6% of PCC patients reported working reduced hours at the time of follow up assessment, and 23.4% reported that they had received job accommodations (and an additional 10/38 noted that they needed but could not obtain accommodations; reasons not identified). Mendola et al[49] reported a decline in work fitness among patients with PCC; pre-COVID, 69.6% had been able to work without restrictions while 31.4% had some job limitations; post-COVID among those with PCC the proportions were 54.3% and 45.7%, respectively. However, 10/56 patients were lost to follow-up due to job change or retirement, so these data should be interpreted cautiously.

3. permanent employment loss/leaving the workforce

i) reviews

A few studies report some permanent job loss among PCC patients. According to the Nittas et al[18] review, "two studies reported permanent employment loss in relation to deteriorating health, with one reporting that 11% and the other 13.8% of their previously employed participants were unemployed at 2 months after acute disease" (p. 7). The Gaulano et al[16] review reported that, across 7 included studies, between 11.4 and 67.8% of patients reported being unable to return to employment at all.

ii) original primary studies

The budget impact assessment in the US context, offered by Mirin (2022)[12], chose a permanent work loss percentage of 22% for their model based upon the survey results reported in Davis[32]. Among primary studies, Norrefolk et al[53] report 3% of formerly employed patients were now receiving unemployment benefits; Ziauhuddin et al[42]cite a similar proportion of 1.9%. Wallin et al[35] report that, out of 64 patients, the number of unemployed or retired increased from 16 before COVID-19 to 20 afterward (a 25% jump in this category). For the full sample, transition to unemployed is 1.6% (1 person out of 64) though whether or not this can be directly attributable to PCC is not known for certain.

iii) additional primary studies to this update

Kerksiecke[66] found that 1.6% of their study group were out of the workforce at 12-month follow-up; they note that this "proportion is relevantly lower than reported by others, likely due to non-population-based sampling in other studies, but still constitutes a significant burden on economic and healthcare systems on a global scale". Sansone et al[67] report that 3.2% of those in their data set were unable to work at a median 15 month follow up. In new US-based studies, Perlis et al[65] reported that those with PCC had a greater likelihood of being unemployed than those without (12.3% vs 8.7%). Bonham et al[15], found Hawaiians with PCC 6.43% less likely to be employed at first follow up, and 7.07% less likely at second follow up (longitudinal data).*

4. perceived impairment of ability to perform job duties

i) reviews

not addressed

ii) primary studies

Some studies use a formally validated tool, the Work Ability Instrument or WAI[67,69-72], to address impairment in the ability to perform job duties; other studies use a variety of other questions to obtain self-report responses. The variability in the way in which such questions are worded may make it difficult to directly compare these estimates with one another. Studies which report this outcome, in descending order of magnitude are as follows (new additions in this update are bolded):

- **Delgado-Alonso[46] (97.4% of PCC patients said that the illness affected their capacity and career)**
- **Nielsen et al[52] in a Danish study (84% experienced limits in work-related activities of daily life, paid or unpaid)**
- Ziauhuddin[42] (75%)
- Mahony[73] (68% suggest work has been impacted--38% severely, 30% moderately)
- Vaes et al[74] (as cited by Middleton) 59.7% self-reported that their ability to work was impaired, at six-month follow-up
- Norrefalk[53], 47% suggest work has been impacted--severely, 23% and moderately, 24%
- **Sansone[67], at 15-month median follow-up, 33.2% reported limitations using the WAI, lowest scores were among those whose symptoms persisted over 200 days**
- Jacobson, as cited in Gualano[16] (31.8% at 4 months, out of n=22)
- Peter[75] "reduced working capacity" was reported among 10+%

* A study by Goda et al [REF68] .suggests that "the probability of labor force participation falls about 7 percentage points after a [minimum week-long] health related absence [during the pandemic period] relative to similar workers without such absences. These effects are … approximately half as large as the estimates of the share of people with self-reported long COVID not working for health reasons by Davis et al. (2021), Evans et al. (2021), and Ziauddeen et al. (2022)" [see Table 6]. Goda contends that most of those absences would be due to COVID-19; we might expect withdrawal from the workforce after illness to be a result of PCC, but since Goda's work was not designed to make that inference, it did not meet our inclusion criteria and we did not include this paper in the detailed analysis.

- Peters[76] subjective work ability demonstrate significantly worse outcomes for people suffering from PCS [post-COVID syndrome] compared with participants without symptoms at the time of the survey
- Havervall[77], as cited by Brussow and Timmis[78]: 8% of HCW infected with COVID-19, and with symptoms after 2 months "reported that their long-term symptoms moderately to markedly disrupted their work life" (p.2016)
- **Kerksiecke[66], 5.8% self-report that they have been affected occupationally; WAI scores 0.62 points lower on average**

The newly added studies continue to reflect the very wide range in observed results present in our original data set.

5. additional observations from the literature

Several studies focused upon populations drawn from rehabilitation programs. Whether or not such groups represent the typical workers who have experienced PCC is unknown. Muller et al's study specifically addressed the outcomes of a rehabilitation program[72]. They report that patients coming out of rehabilitation had decreased physical symptoms, and increased physical performance and neuropsychology outcomes; "Nevertheless, participants reported poor work ability [little report change in WAI scores], and 72.5% of them were still unable to work after discharge from rehabilitation". These are somewhat worse results than reported by the earlier Brehon et al study[19], of WCB clients in Alberta, which reported 47% unable to return to work after completing the designated rehabilitation program.

Neilsen et al's study in Denmark recruited its participants from an occupational therapy clinic[52]. 90% had been previously employed prior to the pandemic; of these 56% were on sick leave, almost all of them as a result of PCC. Clients were still in the therapy process at the end of the study, and so the effectiveness of treatment here is unknown. The patients in Sansone et al's study were all seen at a dedicated PCC clinic[67]. Using the WAI, only 42.7% reported at the time of second follow -up (median, 15 months) that they had no obstacles to work.

These results suggest that existing rehabilitation, including in programs specific for PCC patients, has only limited success in returning patients to the workforce. It suggests a need to explore what intensity and combinations of support might have the greatest effectiveness, and at what cost.

The existing literature also appears unable to tell us much about the relationships between PCC, return to work, and health equity issues. To begin with, since relevant studies by definition address populations that were very largely in full-time employment before PCC, they already exclude information about vulnerable or marginalized groups poorly represented in the workplace (e.g., persons with physical or mental disability). In many cases as well, the data is drawn from workers who have access to sick leave pay and potentially better access to healthcare services; in other words, the more privileged portion of the workforce. For instance, among newly included studies, both the papers from Denmark as well as those from Germany and Spain remark that the included population is considerably more educated and/or of a higher socioeconomic status than the population as a whole.{Delgado-

Alonso, 2022 #23}{Müller, 2023 #62}{Jakobsen, 2023, Identifying heterogeneity in the effect of Covid-19 on long-term sick leave using causal machine learning.@@shared-groups}{Nielsen, 2022 #90}

Discussion

The information obtained from this updated literature review suggests the following important observations:

- Significant heterogeneity in the definition of PCC across the included studies continues to be identified, despite widespread nods to the WHO criteria. This continues to greatly hamper the ability to stratify the analysis of socioeconomic outcomes by PCC definition.
- Several different return to work outcomes are measured, making it difficult to combine findings and reach generalized conclusions; however, it appears that the majority of those affected with PCC do return to work. Estimates about the length of time when people are absent from work due to PCC vary widely, perhaps due to differences in study contexts and populations. New articles identified for this update continue to produce a wide (and possibly even growing) range of estimates. Follow-up, most typically at 6-12 months, in the largest studies, suggests prolonged absence from work among 17-19% of workers.
- Job changes or accommodations seem to be required, at least in the short-term, for an additional 25% of PCC patients. Estimates of job loss, early retirement or longer-term disability attributable to PCC appear in relatively small-sized studies to be in the 1-3% range.
- Fairly large numbers of patients report – in a variety of differently worded measures – that their ability to work has been compromised in some way. The WAI appears to be the main instrument used, but studies continue to utilize other validated and non-validated instruments as well.
- Papers generally concur in their call for comprehensive, holistic, collaborative and interdisciplinary rehabilitation and supports for those with PCC (per Bardo[79], Middleton[17], Nittas[18] for example). However studies which draw from populations in rehabilitation programs report at best partial success in returning participants to the workforce; this suggests that the characteristics of effective rehabilitation and support need to be investigated in further study.
- Our analysis has not been able to probe – within the articles containing our outcomes of interest -- into determinants or factors which are related to experiencing PCC and experiencing it severely, the specific combinations of physical and mental health symptoms which keep people from returning to their previous employment, or the nature of jobs which have earlier or later degrees of full RTW. Jobs which provide better healthcare benefits and sick leave provisions, or those in which remote working is more possible, might more possibly allow employees to remain off work until they feel fully recovered, for instance. These are additional important topics which several of the papers in the review begin to broach and will be important in understanding the way in which PCC is manifesting itself across affected patient populations. Stratification of risk related to PCC and who is most impacted is key for modeling-related activity to estimate healthcare burden and societal economic costs which may be anticipated from PCC.
- Canadian studies are substantially absent in the peer-reviewed literature; in two rounds of scoping review we found only a single study addressing return to work outcomes (Brehon[19]). Excluding papers in the French language may have missed relevant work from Quebec,

however. The included literature in this review is largely European in origin. These developed nations generally have welfare state policies in healthcare and in labour market supports which should make them comparable to Canada for analysis purposes; however, the overall absence of Canada-specific studies would suggest that caution should be employed with any decision to extrapolate these findings and their implications.

Conclusion

In conclusion, the economic impact of PCC is substantial for the workforce considered as a whole. We do however know little about how those impacts are distributed among sectors or occupations, and the equity impacts thereof. Additionally, very little data so far has been published from 2023, which suggests a lag in our knowledge about the evolving situation with respect to PCC. While more time will undoubtedly provide greater confidence in results, our best estimate derived from the existing literature is that just less than 20% of patients with PCC continue to be absent from work for a prolonged period of time (i.e., 6 months). In addition, we observe from the literature that individual ability to work is compromised for many with PCC, although different measurement instruments provide highly different estimates of these impacts.

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Appendix 1. Search Strategies

Long COVID – Return to Work
Update from 2022 Oct 1
2023 Jul 13
2023 Sept 19

Ovid Multifile

Database: Embase <1974 to 2023 September 13>, Ovid MEDLINE(R) ALL <1946 to September 13, 2023>
Search Strategy:
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1 Post-Acute COVID-19 Syndrome/ (3764)
2 (long adj (COVID or COVID-19 or COVID19 or coronavirus* or corona virus* or 2019-nCoV or 19nCoV or 2019nCoV or nCoV or n-CoV or "CoV 2" or CoV2 or SARS-CoV-2 or SARS-CoV2 or SARSCoV-2 or SARSCoV2 or SARS2 or SARS-2 or severe acute respiratory syndrome coronavirus 2 or 2019-novel CoV or Sars-coronavirus2 or Sars-coronavirus-2 or SARS-like coronavirus* or novel coronavirus* or novel corona virus* or novel CoV or OC43 or NL63 or 229E or HKU1 or HCoV* or Sars-coronavirus*)).tw,kw,kf. (8517)
3 ((longterm or long-term) adj (COVID or COVID-19 or COVID19 or coronavirus* or corona virus* or 2019-nCoV or 19nCoV or 2019nCoV or nCoV or n-CoV or "CoV 2" or CoV2 or SARS-CoV-2 or SARS-CoV2 or SARSCoV-2 or SARSCoV2 or SARS2 or SARS-2 or severe acute respiratory syndrome coronavirus 2 or 2019-novel CoV or Sars-coronavirus2 or Sars-coronavirus-2 or SARS-like coronavirus* or novel coronavirus* or novel corona virus* or novel CoV or OC43 or NL63 or 229E or HKU1 or HCoV* or Sars-coronavirus*)).tw,kw,kf. (534)
4 ((postacute or post-acute) adj (COVID or COVID-19 or COVID19 or coronavirus* or corona virus* or 2019-nCoV or 19nCoV or 2019nCoV or nCoV or n-CoV or "CoV 2" or CoV2 or SARS-CoV-2 or SARS-CoV2 or SARSCoV-2 or SARSCoV2 or SARS2 or SARS-2 or severe acute respiratory syndrome coronavirus 2 or 2019-novel CoV or Sars-coronavirus2 or Sars-coronavirus-2 or SARS-like coronavirus* or novel coronavirus* or novel corona virus* or novel CoV or OC43 or NL63 or 229E or HKU1 or HCoV* or Sars-coronavirus*)).tw,kw,kf. (1612)
5 (chronic* adj2 (COVID or COVID-19 or COVID19 or coronavirus* or corona virus* or 2019-nCoV or 19nCoV or 2019nCoV or nCoV or n-CoV or "CoV 2" or CoV2 or SARS-CoV-2 or SARS-CoV2 or SARSCoV-2 or SARSCoV2 or SARS2 or SARS-2 or severe acute respiratory syndrome coronavirus 2 or 2019-novel CoV or Sars-coronavirus2 or Sars-coronavirus-2 or SARS-like coronavirus* or novel coronavirus* or novel corona virus* or novel CoV or OC43 or NL63 or 229E or HKU1 or HCoV* or Sars-coronavirus*)).tw,kw,kf. (3936)
6 (persist* adj2 (COVID or COVID-19 or COVID19 or coronavirus* or corona virus* or 2019-nCoV or 19nCoV or 2019nCoV or nCoV or n-CoV or "CoV 2" or CoV2 or SARS-CoV-2 or SARS-CoV2 or SARSCoV-2 or SARSCoV2 or SARS2 or SARS-2 or severe acute respiratory syndrome coronavirus 2 or 2019-novel CoV or Sars-coronavirus2 or Sars-coronavirus-2 or SARS-like coronavirus* or novel coronavirus* or novel corona virus* or novel CoV or OC43 or NL63 or 229E or HKU1 or HCoV* or Sars-coronavirus*)).ti,kw,kf. (1217)
7 COVID-19/ and Syndrome/ (393)
8 SARS-CoV-2/ and Syndrome/ (223)
9 or/1-8 [LONG COVID - PT 1] (15474)
10 COVID-19/ (374289)

11 SARS-CoV-2/ (186237)
12 Coronavirus/ (15858)
13 Betacoronavirus/ (40646)
14 Coronavirus Infections/ (57517)
15 (COVID-19 or COVID19).tw,kw,kf. (712726)
16 ((coronavirus* or corona virus*) and (hubei or wuhan or beijing or shanghai)).tw,kw,kf. (14739)
17 (wuhan adj5 virus*).tw,kw,kf. (913)
18 (2019-nCoV or 19nCoV or 2019nCoV).tw,kw,kf. (4598)
19 (nCoV or n-CoV or "CoV 2" or CoV2).tw,kw,kf. (275857)
20 (SARS-CoV-2 or SARS-CoV2 or SARSCoV-2 or SARSCoV2 or SARS2 or SARS-2 or severe acute respiratory syndrome coronavirus 2).tw,kw,kf. (280434)
21 (2019-novel CoV or Sars-coronavirus2 or Sars-coronavirus-2 or SARS-like coronavirus* or ((novel or new or nouveau) adj2 (CoV or nCoV or COVID or coronavirus* or corona virus or Pandemi*2)) or (coronavirus* and pneumonia)).tw,kw,kf. (63698)
22 (novel coronavirus* or novel corona virus* or novel CoV).tw,kw,kf. (28295)
23 ((coronavirus* or corona virus*) adj2 "2019").tw,kw,kf. (134122)
24 ((coronavirus* or corona virus*) adj2 "19").tw,kw,kf. (19718)
25 (coronavirus 2 or corona virus 2).tw,kw,kf. (74575)
26 (OC43 or NL63 or 229E or HKU1 or HCoV* or Sars-coronavirus*).tw,kw,kf. (10548)
27 COVID-19.rx,px,ox. or severe acute respiratory syndrome coronavirus 2.os. (14806)
28 (coronavirus* or corona virus* or COVID).ti. (577606)
29 or/10-28 [COVID-19] (839955)
30 (post adj (COVID or COVID-19 or COVID19 or coronavirus* or corona virus* or 2019-nCoV or 19nCoV or 2019nCoV or nCoV or n-CoV or "CoV 2" or CoV2 or SARS-CoV-2 or SARS-CoV2 or SARSCoV-2 or SARSCoV2 or SARS2 or SARS-2 or severe acute respiratory syndrome coronavirus 2 or 2019-novel CoV or Sars-coronavirus2 or Sars-coronavirus-2 or SARS-like coronavirus* or novel coronavirus* or novel corona virus* or novel CoV or OC43 or NL63 or 229E or HKU1 or HCoV* or Sars-coronavirus*) adj3 (comorbid* or "co morbid*" or condition* or convalescen* or disease* or disorder* or illness* or multimorbid* or "multi morbid*" or sickness* or symptom* or syndrome* or sign or signs or prognos* or recuperat* or survivor* or survival* or risk*)).tw,kw,kf. (5552)
31 (after adj (COVID or COVID-19 or COVID19 or coronavirus* or corona virus* or 2019-nCoV or 19nCoV or 2019nCoV or nCoV or n-CoV or "CoV 2" or CoV2 or SARS-CoV-2 or SARS-CoV2 or SARSCoV-2 or SARSCoV2 or SARS2 or SARS-2 or severe acute respiratory syndrome coronavirus 2 or 2019-novel CoV or Sars-coronavirus2 or Sars-coronavirus-2 or SARS-like coronavirus* or novel coronavirus* or novel corona virus* or novel CoV or OC43 or NL63 or 229E or HKU1 or HCoV* or Sars-coronavirus*) adj3 (comorbid* or "co morbid*" or condition* or convalescen* or disease* or disorder* or illness* or multimorbid* or "multi morbid*" or sickness* or symptom* or syndrome* or sign or signs or prognos* or recuperat* or survivor* or survival* or risk*)).tw,kw,kf. (2691)
32 (following adj (COVID or COVID-19 or COVID19 or coronavirus* or corona virus* or 2019-nCoV or 19nCoV or 2019nCoV or nCoV or n-CoV or "CoV 2" or CoV2 or SARS-CoV-2 or SARS-CoV2 or SARSCoV-2 or SARSCoV2 or SARS2 or SARS-2 or severe acute respiratory syndrome coronavirus 2 or 2019-novel CoV or Sars-coronavirus2 or Sars-coronavirus-2 or SARS-like coronavirus* or novel coronavirus* or novel corona virus* or novel CoV or OC43 or NL63 or 229E or HKU1 or HCoV* or Sars-coronavirus*) adj3 (comorbid* or "co morbid*" or condition* or convalescen* or disease* or disorder* or illness* or multimorbid* or "multi morbid*" or sickness* or symptom* or syndrome* or sign or signs or prognos* or recuperat* or survivor* or survival* or risk*)).tw,kw,kf. (1398)
33 ((chronic* or continuous* or continual* or continuing* or delay* or endur* or extend* or fluctuat* or gradual* or lasting* or legacy* or lengthy* or linger* or long* or "medium* term*" or mediumterm* or multisystem* or "multi system*" or ongoing* or permanent* or persist* or prolong* or protract* or relaps*

or remission* or remit* or residual* or slow* or subacute* or "sub acute*") adj3 recover*).tw,kw,kf. (92026)
34 ((after discharg* or following discharg* or postacute* or "post acute*" or postdischarg* or "post discharge" or "post discharging" or posthospital* or post-hospital* or postinfect* or "post infection" or "post infective*" or postviral* or "post viral*" or postvirus* or "post virus*" or postcritical or post-critical or postintensive or post-intensive or post-ICU) adj3 recover*).tw,kw,kf. (1852)
35 ((chronic* or continuous* or continual* or continuing* or delay* or endur* or extend* or fluctuat* or gradual* or lasting* or legacy* or lengthy* or linger* or long* or "medium* term*" or mediumterm* or multisystem* or "multi system*" or ongoing or permanent* or persist* or prolong* or protract* or relaps* or remission* or remit* or residual* or slow* or subacute* or "sub acute*") adj3 (complication? or consequence? or convalescen* or disabilit* or feature* or illness* or prognos* or sequela* or sign or signs or suffering? or symptom* or recuperat*)).tw,kw,kf. (704202)
36 ((after discharg* or following discharg* or postacute* or "post acute*" or postdischarg* or "post discharge" or "post discharging" or posthospital* or post-hospital* or postinfect* or "post infection" or "post infective*" or postviral* or "post viral*" or postvirus* or "post virus*" or postcritical or post-critical or postintensive or post-intensive or post-ICU) adj3 (complication? or consequence? or convalescen* or disabilit* or feature* or illness* or prognos* or sequela* or sign or signs or suffering? or symptom* or recuperat*)).tw,kw,kf. (8192)
37 (nonrecover* or "non recover*" or "not recover*").tw,kw,kf. (18964)
38 ("long* haul*" or longhaul* or "long* tail*" or longtail* or longduration* or "long duration*" or longlast* or "long last*" or longstanding* or "long standing*" or "medium* term*" or mediumterm*).tw,kw,kf. (305048)
39 or/30-38 [LONG-TERM ILLNESS, PROTRACTED RECOVERY, ETC.] (1102242)
40 29 and 39 [LONG COVID - PT 2] (34518)
41 Long Term Adverse Effects/ (230436)
42 29 and 41 [LONG COVID - PT 3] (3784)
43 9 or 40 or 42 [LONG COVID] (45844)
44 exp Animals/ not Humans/ (16820369)
45 43 not 44 [ANIMAL-ONLY REMOVED] (45483)
46 Employment/ (128182)
47 Return to Work/ (13369)
48 ((assum* or reenter* or re-enter* or reentry or re-entry or restart* or resum* or return* or start*) adj3 (employ* or job or jobs or work*)).tw,kw,kf. (56107)
49 back-to-work.tw,kw,kf. (2248)
50 (employabilit* or workabilit*).tw,kw,kf. (4666)
51 ((able or abilit* or capabl* or incapabl* or capacit* or incapacit* or disable* or disabilit* or inabilit* or unable* or limit*) adj5 (employ* or job or jobs or work*)).tw,kw,kf. (171181)
52 Sick Leave/ (14371)
53 ((disabilt* or sick* or ill or illness* or unwell or "not well") adj5 (days or leave or "time off" or absenc* or absent* or presenc* or present)).tw,kw,kf. (62962)
54 ((shortterm or short-term or longterm or long-term) adj3 (disabl* or disabilit*)).tw,kw,kf. (15095)
55 Absenteeism/ (29716)
56 Presenteeism/ (2978)
57 (absentee* or presentee* or leaveism or leavism).tw,kw,kf. (21479)
58 (work? adj3 ("while on holiday*" or while holiday* or during holiday* or "while on leave" or during leave? or "while on vacation*" or during vacation* or while vacationing*)).tw,kw,kf. (18)
59 Occupational Medicine/ (35902)
60 ((industrial* or occupational*) adj medicine).tw,kw,kf. (17525)
61 Efficiency/ (65795)

62 ((efficien* or productiv*) adj3 (declin* or decreas* or diminish* or less* or lose or losing or loss or losses or low or lower* or reduc*)).tw,kw,kf. (231012)
63 or/46-62 [FUNCTIONALITY/WORK/PRODUCTIVITY] (746880)
64 45 and 63 [LONG COVID - FUNCTIONALITY/WORK/PRODUCTIVITY] (1668)
65 64 use medall [MEDLINE RECORDS] (611)
66 long COVID/ (7852)
67 (long adj (COVID or COVID-19 or COVID19 or coronavirus* or corona virus* or 2019-nCoV or 19nCoV or 2019nCoV or nCoV or n-CoV or "CoV 2" or CoV2 or SARS-CoV-2 or SARS-CoV2 or SARSCoV-2 or SARSCoV2 or SARS2 or SARS-2 or severe acute respiratory syndrome coronavirus 2 or 2019-novel CoV or Sars-coronavirus2 or Sars-coronavirus-2 or SARS-like coronavirus* or novel coronavirus* or novel corona virus* or novel CoV or OC43 or NL63 or 229E or HKU1 or HCoV* or Sars-coronavirus*)).tw,kw,kf. (8517)
68 ((longterm or long-term) adj (COVID or COVID-19 or COVID19 or coronavirus* or corona virus* or 2019-nCoV or 19nCoV or 2019nCoV or nCoV or n-CoV or "CoV 2" or CoV2 or SARS-CoV-2 or SARS-CoV2 or SARSCoV-2 or SARSCoV2 or SARS2 or SARS-2 or severe acute respiratory syndrome coronavirus 2 or 2019-novel CoV or Sars-coronavirus2 or Sars-coronavirus-2 or SARS-like coronavirus* or novel coronavirus* or novel corona virus* or novel CoV or OC43 or NL63 or 229E or HKU1 or HCoV* or Sars-coronavirus*)).tw,kw,kf. (534)
69 ((postacute or post-acute) adj (COVID or COVID-19 or COVID19 or coronavirus* or corona virus* or 2019-nCoV or 19nCoV or 2019nCoV or nCoV or n-CoV or "CoV 2" or CoV2 or SARS-CoV-2 or SARS-CoV2 or SARSCoV-2 or SARSCoV2 or SARS2 or SARS-2 or severe acute respiratory syndrome coronavirus 2 or 2019-novel CoV or Sars-coronavirus2 or Sars-coronavirus-2 or SARS-like coronavirus* or novel coronavirus* or novel corona virus* or novel CoV or OC43 or NL63 or 229E or HKU1 or HCoV* or Sars-coronavirus*)).tw,kw,kf. (1612)
70 (chronic* adj2 (COVID or COVID-19 or COVID19 or coronavirus* or corona virus* or 2019-nCoV or 19nCoV or 2019nCoV or nCoV or n-CoV or "CoV 2" or CoV2 or SARS-CoV-2 or SARS-CoV2 or SARSCoV-2 or SARSCoV2 or SARS2 or SARS-2 or severe acute respiratory syndrome coronavirus 2 or 2019-novel CoV or Sars-coronavirus2 or Sars-coronavirus-2 or SARS-like coronavirus* or novel coronavirus* or novel corona virus* or novel CoV or OC43 or NL63 or 229E or HKU1 or HCoV* or Sars-coronavirus*)).tw,kw,kf. (3936)
71 (persist* adj2 (COVID or COVID-19 or COVID19 or coronavirus* or corona virus* or 2019-nCoV or 19nCoV or 2019nCoV or nCoV or n-CoV or "CoV 2" or CoV2 or SARS-CoV-2 or SARS-CoV2 or SARSCoV-2 or SARSCoV2 or SARS2 or SARS-2 or severe acute respiratory syndrome coronavirus 2 or 2019-novel CoV or Sars-coronavirus2 or Sars-coronavirus-2 or SARS-like coronavirus* or novel coronavirus* or novel corona virus* or novel CoV or OC43 or NL63 or 229E or HKU1 or HCoV* or Sars-coronavirus*)).ti,kw,kf. (1217)
72 or/66-71 [LONG COVID - PT 1] (16614)
73 coronavirus disease 2019/ (584536)
74 severe acute respiratory syndrome coronavirus 2/ (254168)
75 Coronavirinae/ (6888)
76 Betacoronavirus/ (40646)
77 coronavirus infection/ (58418)
78 (COVID-19 or COVID19).tw,kw,kf. (712726)
79 ((coronavirus* or corona virus*) and (hubei or wuhan or beijing or shanghai)).tw,kw,kf. (14739)
80 (wuhan adj5 virus*).tw,kw,kf. (913)
81 (2019-nCoV or 19nCoV or 2019nCoV).tw,kw,kf. (4598)
82 (nCoV or n-CoV or "CoV 2" or CoV2).tw,kw,kf. (275857)
83 (SARS-CoV-2 or SARS-CoV2 or SARSCoV-2 or SARSCoV2 or SARS2 or SARS-2 or severe acute respiratory syndrome coronavirus 2).tw,kw,kf. (280434)

84 (2019-novel CoV or Sars-coronavirus2 or Sars-coronavirus-2 or SARS-like coronavirus* or ((novel or new or nouveau) adj2 (CoV or nCoV or COVID or coronavirus* or corona virus or Pandemi*2)) or (coronavirus* and pneumonia)).tw,kw,kf. (63698)
85 (novel coronavirus* or novel corona virus* or novel CoV).tw,kw,kf. (28295)
86 ((coronavirus* or corona virus*) adj2 "2019").tw,kw,kf. (134122)
87 ((coronavirus* or corona virus*) adj2 "19").tw,kw,kf. (19718)
88 (coronavirus 2 or corona virus 2).tw,kw,kf. (74575)
89 (OC43 or NL63 or 229E or HKU1 or HCoV* or Sars-coronavirus*).tw,kw,kf. (10548)
90 (coronavirus* or corona virus* or COVID).ti. (577606)
91 or/73-90 [COVID-19] (858914)
92 (post adj (COVID or COVID-19 or COVID19 or coronavirus* or corona virus* or 2019-nCoV or 19nCoV or 2019nCoV or nCoV or n-CoV or "CoV 2" or CoV2 or SARS-CoV-2 or SARS-CoV2 or SARSCoV-2 or SARSCoV2 or SARS2 or SARS-2 or severe acute respiratory syndrome coronavirus 2 or 2019-novel CoV or Sars-coronavirus2 or Sars-coronavirus-2 or SARS-like coronavirus* or novel coronavirus* or novel corona virus* or novel CoV or OC43 or NL63 or 229E or HKU1 or HCoV* or Sars-coronavirus*) adj3 (comorbid* or "co morbid*" or condition* or convalescen* or disease* or disorder* or illness* or multimorbid* or "multi morbid*" or sickness* or symptom* or syndrome* or sign or signs or prognos* or recuperat* or survivor* or survival* or risk*)).tw,kw,kf. (5552)
93 (after adj (COVID or COVID-19 or COVID19 or coronavirus* or corona virus* or 2019-nCoV or 19nCoV or 2019nCoV or nCoV or n-CoV or "CoV 2" or CoV2 or SARS-CoV-2 or SARS-CoV2 or SARSCoV-2 or SARSCoV2 or SARS2 or SARS-2 or severe acute respiratory syndrome coronavirus 2 or 2019-novel CoV or Sars-coronavirus2 or Sars-coronavirus-2 or SARS-like coronavirus* or novel coronavirus* or novel corona virus* or novel CoV or OC43 or NL63 or 229E or HKU1 or HCoV* or Sars-coronavirus*) adj3 (comorbid* or "co morbid*" or condition* or convalescen* or disease* or disorder* or illness* or multimorbid* or "multi morbid*" or sickness* or symptom* or syndrome* or sign or signs or prognos* or recuperat* or survivor* or survival* or risk*)).tw,kw,kf. (2691)
94 (following adj (COVID or COVID-19 or COVID19 or coronavirus* or corona virus* or 2019-nCoV or 19nCoV or 2019nCoV or nCoV or n-CoV or "CoV 2" or CoV2 or SARS-CoV-2 or SARS-CoV2 or SARSCoV-2 or SARSCoV2 or SARS2 or SARS-2 or severe acute respiratory syndrome coronavirus 2 or 2019-novel CoV or Sars-coronavirus2 or Sars-coronavirus-2 or SARS-like coronavirus* or novel coronavirus* or novel corona virus* or novel CoV or OC43 or NL63 or 229E or HKU1 or HCoV* or Sars-coronavirus*) adj3 (comorbid* or "co morbid*" or condition* or convalescen* or disease* or disorder* or illness* or multimorbid* or "multi morbid*" or sickness* or symptom* or syndrome* or sign or signs or prognos* or recuperat* or survivor* or survival* or risk*)).tw,kw,kf. (1398)
95 ((chronic* or continuous* or continual* or continuing* or delay* or endur* or extend* or fluctuat* or gradual* or lasting* or legacy* or lengthy* or linger* or long* or "medium* term*" or mediumterm* or multisystem* or "multi system*" or ongoing* or permanent* or persist* or prolong* or protract* or relaps* or remission* or remit* or residual* or slow* or subacute* or "sub acute*") adj3 recover*).tw,kw,kf. (92026)
96 ((after discharg* or following discharg* or postacute* or "post acute*" or postdischarg* or "post discharge" or "post discharging" or posthospital* or post-hospital* or postinfect* or "post infection" or "post infective*" or postviral* or "post viral*" or postvirus* or "post virus*" or postcritical or post-critical or postintensive or post-intensive or post-ICU) adj3 recover*).tw,kw,kf. (1852)
97 ((chronic* or continuous* or continual* or continuing* or delay* or endur* or extend* or fluctuat* or gradual* or lasting* or legacy* or lengthy* or linger* or long* or "medium* term*" or mediumterm* or multisystem* or "multi system*" or ongoing or permanent* or persist* or prolong* or protract* or relaps* or remission* or remit* or residual* or slow* or subacute* or "sub acute*") adj3 (complication? or consequence? or convalescen* or disabilit* or feature* or illness* or prognos* or sequela* or sign or signs or suffering? or symptom* or recuperat*)).tw,kw,kf. (704202)

98 ((after discharg* or following discharg* or postacute* or "post acute*" or postdischarg* or "post discharge" or "post discharging" or posthospital* or post-hospital* or postinfect* or "post infection" or "post infective*" or postviral* or "post viral*" or postvirus* or "post virus*" or postcritical or post-critical or postintensive or post-intensive or post-ICU) adj3 (complication? or consequence? or convalescen* or disabilit* or feature* or illness* or prognos* or sequela* or sign or signs or suffering? or symptom* or recuperat*)).tw,kw,kf. (8192)
99 (nonrecover* or "non recover*" or "not recover*").tw,kw,kf. (18964)
100 ("long* haul*" or longhaul* or "long* tail*" or longtail* or longduration* or "long duration*" or longlast* or "long last*" or longstanding* or "long standing*" or "medium* term*" or mediumterm*).tw,kw,kf. (305048)
101 or/92-100 [LONG-TERM ILLNESS, PROTRACTED RECOVERY, ETC.] (1102242)
102 91 and 101 [LONG COVID - PT 2] (34719)
103 72 or 102 [LONG COVID] (43018)
104 (exp animal/ or exp animal experimentation/ or exp animal model/ or exp animal experiment/ or nonhuman/ or exp vertebrate/) not (exp human/ or exp human experimentation/ or exp human experiment/) (12418342)
105 103 not 104 [ANIMAL-ONLY REMOVED] (42547)
106 exp employment/ (226620)
107 return to work/ (13369)
108 work resumption/ (3605)
109 ((assum* or reenter* or re-enter* or reentry or re-entry or restart* or resum* or return* or start*) adj3 (employ* or job or jobs or work*)).tw,kw,kf. (56107)
110 back-to-work.tw,kw,kf. (2248)
111 employability/ (1834)
112 work capacity/ (13793)
113 (employabilit* or workabilit*).tw,kw,kf. (4666)
114 ((able or abilit* or capabl* or incapabl* or capacit* or incapacit* or disable* or disabilit* or inabilit* or unable* or limit*) adj5 (employ* or job or jobs or work*)).tw,kw,kf. (171181)
115 medical leave/ (8666)
116 ((disabilt* or sick* or ill or illness* or unwell or "not well") adj5 (days or leave or "time off" or absenc* or absent* or presenc* or present)).tw,kw,kf. (62962)
117 ((shortterm or short-term or longterm or long-term) adj3 (disabl* or disabilit*)).tw,kw,kf. (15095)
118 absenteeism/ (29716)
119 presenteeism/ (2978)
120 (absentee* or presentee* or leaveism or leavism).tw,kw,kf. (21479)
121 (work? adj3 ("while on holiday*" or while holiday* or during holiday* or "while on leave" or during leave? or "while on vacation*" or during vacation* or while vacationing*)).tw,kw,kf. (18)
122 occupational medicine/ (35902)
123 ((industrial* or occupational*) adj medicine).tw,kw,kf. (17525)
124 productivity/ (65795)
125 ((efficien* or productiv*) adj3 (declin* or decreas* or diminish* or less* or lose or losing or loss or losses or low or lower* or reduc*)).tw,kw,kf. (231012)
126 or/106-125 [FUNCTIONALITY/WORK/PRODUCTIVITY] (837533)
127 105 and 126 [LONG COVID - FUNCTIONALITY/WORK/PRODUCTIVITY] (1837)
128 127 use oemezd [EMBASE RECORDS] (1198)
129 65 or 128 [BOTH DATABASES] (1809)
130 (2023071* or 2023072* or 2023073* or 202308* or 202309*).dc,dt. (791824)
131 129 and 130 [UPDATE PERIOD] (137)
132 remove duplicates from 131 (116)

133 132 use medall [MEDLINE UNIQUE RECORDS - UPDATE PERIOD] (32)
134 132 use oemezd [EMBASE UNIQUE RECORDS - UPDATE PERIOD] (84)

****

Web of Science

Set #	Search Query	Results
1	long NEAR/0 (COVID or "COVID-19" or COVID19 or coronavirus* or "corona virus" or "corona viruses" or "2019-nCoV" or 19nCoV or 2019nCoV or nCoV or "n-CoV" or "CoV 2" or CoV2 or "SARS-CoV-2" or "SARS-CoV2" or "SARSCoV-2" or SARSCoV2 or SARS2 or "SARS-2" or "severe acute respiratory syndrome coronavirus 2" or "2019-novel CoV" or "SARS-coronavirus2" or "SARS-coronavirus-2" or "SARS-like coronavirus" or "SARS-like coronaviruses" or "novel coronavirus" or "novel coronaviruses" or "novel corona virus" or "novel corona viruses" or "novel CoV" or OC43 or NL63 or 229E or HKU1 or HCoV* or "SARS-coronavirus" or "SARS-coronaviruses") (Topic) OR longterm NEAR/0 (COVID or "COVID-19" or COVID19 or coronavirus* or "corona virus" or "corona viruses" or "2019-nCoV" or 19nCoV or 2019nCoV or nCoV or "n-CoV" or "CoV 2" or CoV2 or "SARS-CoV-2" or "SARS-CoV2" or "SARSCoV-2" or SARSCoV2 or SARS2 or "SARS-2" or "severe acute respiratory syndrome coronavirus 2" or "2019-novel CoV" or "SARS-coronavirus2" or "SARS-coronavirus-2" or "SARS-like coronavirus" or "SARS-like coronaviruses" or "novel coronavirus" or "novel coronaviruses" or "novel corona virus" or "novel corona viruses" or "novel CoV" or OC43 or NL63 or 229E or HKU1 or HCoV* or "SARS-coronavirus" or "SARS-coronaviruses") (Topic) OR "long-term" NEAR/0 (COVID or "COVID-19" or COVID19 or coronavirus* or "corona virus" or "corona viruses" or "2019-nCoV" or 19nCoV or 2019nCoV or nCoV or "n-CoV" or "CoV 2" or CoV2 or "SARS-CoV-2" or "SARS-CoV2" or "SARSCoV-2" or SARSCoV2 or SARS2 or "SARS-2" or "severe acute respiratory syndrome coronavirus 2" or "2019-novel CoV" or "SARS-coronavirus2" or "SARS-coronavirus-2" or "SARS-like coronavirus" or "SARS-like coronaviruses" or "novel coronavirus" or "novel coronaviruses" or "novel corona virus" or "novel corona viruses" or "novel CoV" or OC43 or NL63 or 229E or HKU1 or HCoV* or "SARS-coronavirus" or "SARS-coronaviruses") (Topic) OR postacute NEAR/0 (COVID or "COVID-19" or COVID19 or coronavirus* or "corona virus" or "corona viruses" or "2019-nCoV" or 19nCoV or 2019nCoV or nCoV or "n-CoV" or "CoV 2" or CoV2 or "SARS-CoV-2" or "SARS-CoV2" or "SARSCoV-2" or SARSCoV2 or SARS2 or "SARS-2" or "severe acute respiratory syndrome coronavirus 2" or "2019-novel CoV" or "SARS-coronavirus2" or "SARS-coronavirus-2" or "SARS-like coronavirus" or "SARS-like coronaviruses" or "novel coronavirus" or "novel coronaviruses" or "novel corona virus" or "novel corona viruses" or "novel CoV" or OC43	5261

or NL63 or 229E or HKU1 or HCoV* or "SARS-coronavirus" or "SARS-coronaviruses") (Topic) OR "post-acute" NEAR/0 (COVID or "COVID-19" or COVID19 or coronavirus* or "corona virus" or "corona viruses" or "2019-nCoV" or 19nCoV or 2019nCoV or nCoV or "n-CoV" or "CoV 2" or CoV2 or "SARS-CoV-2" or "SARS-CoV2" or "SARSCoV-2" or SARSCoV2 or SARS2 or "SARS-2" or "severe acute respiratory syndrome coronavirus 2" or "2019-novel CoV" or "SARS-coronavirus2" or "SARS-coronavirus-2" or "SARS-like coronavirus" or "SARS-like coronaviruses" or "novel coronavirus" or "novel coronaviruses" or "novel corona virus" or "novel corona viruses" or "novel CoV" or OC43 or NL63 or 229E or HKU1 or HCoV* or "SARS-coronavirus" or "SARS-coronaviruses") (Topic) OR chronic* NEAR/0 (COVID or "COVID-19" or COVID19 or coronavirus* or "corona virus" or "corona viruses" or "2019-nCoV" or 19nCoV or 2019nCoV or nCoV or "n-CoV" or "CoV 2" or CoV2 or "SARS-CoV-2" or "SARS-CoV2" or "SARSCoV-2" or SARSCoV2 or SARS2 or "SARS-2" or "severe acute respiratory syndrome coronavirus 2" or "2019-novel CoV" or "SARS-coronavirus2" or "SARS-coronavirus-2" or "SARS-like coronavirus" or "SARS-like coronaviruses" or "novel coronavirus" or "novel coronaviruses" or "novel corona virus" or "novel corona viruses" or "novel CoV" or OC43 or NL63 or 229E or HKU1 or HCoV* or "SARS-coronavirus" or "SARS-coronaviruses") (Topic) OR persist* NEAR/0 (COVID or "COVID-19" or COVID19 or coronavirus* or "corona virus" or "corona viruses" or "2019-nCoV" or 19nCoV or 2019nCoV or nCoV or "n-CoV" or "CoV 2" or CoV2 or "SARS-CoV-2" or "SARS-CoV2" or "SARSCoV-2" or SARSCoV2 or SARS2 or "SARS-2" or "severe acute respiratory syndrome coronavirus 2" or "2019-novel CoV" or "SARS-coronavirus2" or "SARS-coronavirus-2" or "SARS-like coronavirus" or "SARS-like coronaviruses" or "novel coronavirus" or "novel coronaviruses" or "novel corona virus" or "novel corona viruses" or "novel CoV" or OC43 or NL63 or 229E or HKU1 or HCoV* or "SARS-coronavirus" or "SARS-coronaviruses") (Topic)

2	COVID or "COVID-19" or COVID19 or coronavirus* or "corona virus" or "corona viruses" or "2019-nCoV" or 19nCoV or 2019nCoV or nCoV or "n-CoV" or "CoV 2" or CoV2 or "SARS-CoV-2" or "SARS-CoV2" or "SARSCoV-2" or SARSCoV2 or SARS2 or "SARS-2" or "severe acute respiratory syndrome coronavirus 2" or "2019-novel CoV" or "SARS-coronavirus2" or "SARS-coronavirus-2" or "SARS-like coronavirus" or "SARS-like coronaviruses" or "novel coronavirus" or "novel coronaviruses" or "novel corona virus" or "novel corona viruses" or "novel CoV" or OC43 or NL63 or 229E or HKU1 or HCoV* or "SARS-coronavirus" or "SARS-coronaviruses" (Topic) OR (coronavirus* or "corona virus" or "corona viruses") and (hubei or wuhan or beijing or shanghai) (Topic) OR wuhan NEAR/5 virus* (Topic) OR coronavirus* and pneumonia (Topic) OR (novel or new or nouveau) NEAR/2 (CoV or nCoV or COVID or coronavirus* or "corona virus" or "Pandemic 2") (Topic) OR (coronavirus* or "corona virus" or "corona viruses") NEAR/2 "2019" (Topic) OR (coronavirus* or "corona virus" or "corona viruses") NEAR/2 "19" (Topic) OR coronavirus* or "corona virus" or "corona viruses" or COVID (Title)	503055
3	("post-COVID" or "post-COVID-19" or "post-COVID19" or "post-coronavirus" or "post-coronaviruses" or "post-corona virus" or "post-corona viruses" or "post-2019-nCoV" or "post-19nCoV" or "post-2019nCoV" or "post-nCoV" or "post-n-CoV" or "post-CoV 2" or "post-CoV2" or "post-SARS-CoV-2" or "post-SARS-CoV2" or "post-SARSCoV-2" or "post-SARSCoV2" or "post-SARS2" or "post-SARS-2" or "post-severe acute respiratory syndrome coronavirus 2" or "post-2019-novel CoV" or "post-SARS-coronavirus2" or "post-SARS-coronavirus-2" or "post-SARS-like coronavirus" or "post-SARS-like coronaviruses" or "post-novel coronavirus" or "post-novel coronaviruses" or "post-novel corona virus" or "post-novel corona viruses" or "post-novel CoV" or "post-OC43" or "post-NL63" or "post-229E" or "post-HKU1" or "post-HCoV" or "post-SARS-coronavirus" or "post-SARS-coronaviruses") NEAR/3 (comorbid* or "co-morbid" or "co-morbidity" or "co-morbidities" or condition* or convalescen* or disease* or disorder* or illness* or multimorbid* or "multi-morbid" or "multi-morbidity" or "multi-morbidities" or sickness* or symptom* or syndrome* or sign or signs or prognos* or recuperat* or survivor* or survival* or risk*) (Topic)	2736

4	("after COVID" or "after COVID-19" or "after COVID19" or "after coronavirus" or "after coronaviruses" or "after corona virus" or "after corona viruses" or "after 2019-nCoV" or "after 19nCoV" or "after 2019nCoV" or "after nCoV" or "after n-CoV" or "after CoV 2" or "after CoV2" or "after SARS-CoV-2" or "after SARS-CoV2" or "after SARSCoV-2" or "after SARSCoV2" or "after SARS2" or "after SARS-2" or "after severe acute respiratory syndrome coronavirus 2" or "after 2019-novel CoV" or "after SARS-coronavirus2" or "after SARS-coronavirus-2" or "after SARS-like coronavirus" or "after SARS-like coronaviruses" or "after novel coronavirus" or "after novel coronaviruses" or "after novel corona virus" or "after novel corona viruses" or "after novel CoV" or "after OC43" or "after NL63" or "after 229E" or "after HKU1" or "after HCoV" or "after SARS-coronavirus" or "after SARS-coronaviruses") NEAR/3 (comorbid* or "co-morbid" or "co-morbidity" or "co-morbidities" or condition* or convalescen* or disease* or disorder* or illness* or multimorbid* or "multi-morbid" or "multi-morbidity" or "multi-morbidities" or sickness* or symptom* or syndrome* or sign or signs or prognos* or recuperat* or survivor* or survival* or risk*) (Topic)	1922
5	("following COVID" or "following COVID-19" or "following COVID19" or "following coronavirus" or "following coronaviruses" or "following corona virus" or "following corona viruses" or "following 2019-nCoV" or "following 19nCoV" or "following 2019nCoV" or "following nCoV" or "following n-CoV" or "following CoV 2" or "following CoV2" or "following SARS-CoV-2" or "following SARS-CoV2" or "following SARSCoV-2" or "following SARSCoV2" or "following SARS2" or "following SARS-2" or "following severe acute respiratory syndrome coronavirus 2" or "following 2019-novel CoV" or "following SARS-coronavirus2" or "following SARS-coronavirus-2" or "following SARS-like coronavirus" or "following SARS-like coronaviruses" or "following novel coronavirus" or "following novel coronaviruses" or "following novel corona virus" or "following novel corona viruses" or "following novel CoV" or "following OC43" or "following NL63" or "following 229E" or "following HKU1" or "following HCoV" or "following SARS-coronavirus" or "following SARS-coronaviruses") NEAR/3 (comorbid* or "co-morbid" or "co-morbidity" or "co-morbidities" or condition* or convalescen* or disease* or disorder* or illness* or multimorbid* or "multi-morbid" or "multi-morbidity" or "multi-morbidities" or sickness* or symptom* or syndrome* or sign or signs or prognos* or recuperat* or survivor* or survival* or risk*) (Topic)	996

6	(chronic* or continuous* or continual* or continuing* or delay* or endur* or extend* or fluctuat* or gradual* or lasting* or legacy* or lengthy* or linger* or long* or "medium* term*" or mediumterm* or multisystem* or "multi system" or ongoing* or permanent* or persist* or prolong* or protract* or relaps* or remission* or remit* or residual* or slow* or subacute* or "sub acute*") NEAR/3 recover* (Topic)	57475
7	("after discharge" or "after discharging" or "following discharge" or "following discharging" or postacute* or "post acute*" or postdischarge or postdischarging or "post discharge" or "post discharging" or posthospital* or "post-hospital" or "post-hospitalisation" or "post-hospitalization" or postinfect* or "post infection" or "post infective" or postviral* or "post viral" or postvirus* or "post virus" or postcritical or "post-critical" or postintensive or "post-intensive" or "post-ICU") NEAR/3 recover* (Topic)	915
8	(chronic* or continuous* or continual* or continuing* or delay* or endur* or extend* or fluctuat* or gradual* or lasting* or legacy* or lengthy* or linger* or long* or "medium term" or mediumterm* or multisystem* or "multi-system" or ongoing or permanent* or persist* or prolong* or protract* or relaps* or remission* or remit* or residual* or slow* or subacute* or "sub acute") NEAR/3 (complication* or consequence* or convalescen* or disabilit* or feature* or illness* or prognos* or sequela* or sign or signs or suffering* or symptom* or recuperat*) (Topic)	339816
9	("after discharge" or "after discharging" or "following discharge" or "following discharging" or postacute* or "post acute*" or postdischarge or postdischarging or "post discharge" or "post discharging" or posthospital* or "post-hospital" or "post-hospitalisation" or "post-hospitalization" or postinfect* or "post infection" or "post infective" or postviral* or "post viral" or postvirus* or "post virus" or postcritical or "post-critical" or postintensive or "post-intensive" or "post-ICU") NEAR/3 (complication* or consequence* or convalescen* or disabilit* or feature* or illness* or prognos* or sequela* or sign or signs or suffering* or symptom* or recuperat*) (Topic)	3610
10	nonrecover* or (non NEAR/0 recover*) or "not recover" or "not recovered" or "not recovering" (Topic)	10497
11	"long haul" or "long hauler" or "long haulers" or longhaul* or (long NEAR/0 tail*) or longtail* or longduration* or "long duration" or "long durations" or longlast* or (long NEAR/0 last*) or longstanding* or "long standing" or "medium term*" or mediumterm* (Topic)	206536
12	#11 OR #10 OR #9 OR #8 OR #7 OR #6 OR #5 OR #4 OR #3	606102

13	#12 AND #2	18319
14	#13 OR #1	20695
15	(assum* or reenter* or "re-enter" or "re-enters" or "re-entered" or "re-entering" or reentry or "re-entry" or restart* or resum* or return* or start*) NEAR/3 (employ* or job or jobs or work*) (Topic) OR "back-to-work" or employabilit* or workabilit* (Topic) OR (able or abilit* or capabl* or incapabl* or capacit* or incapacit* or disable* or disabilit* or inabilit* or unable* or limit*) NEAR/5 (employ* or job or jobs or work*) (Topic)	259265
16	(disabilt* or sick* or ill or illness* or unwell or "not well") NEAR/5 (days or leave or "time off" or absenc* or absent* or presenc* or present) (Topic) OR (shortterm or short-term or longterm or long-term) NEAR/3 (disabl* or disabilit*) (Topic) OR absentee* or presentee* or leaveism or leavism (Topic)	58092
17	(disabilt* or sick* or ill or illness* or unwell or "not well") NEAR/5 (days or leave or "time off" or absenc* or absent* or presenc* or present) (Topic) OR (shortterm or short-term or longterm or long-term) NEAR/3 (disabl* or disabilit*) (Topic)	48168
18	work* NEAR/3 ("while on holiday" or "while on holidays" or "while holidaying" or "during holiday" or "during holidays" or "while on leave" or "during leave" or "during leaves" or "while on vacation" or "while on vacations" or "during vacation" or "during vacations" or "while vacationing") (Topic) OR (industrial* or occupational*) NEAR/0 medicine (Topic)	4503
19	(efficien* or productiv*) NEAR/3 (declin* or decreas* or diminish* or less* or lose or losing or loss or losses or low or lower* or reduc*) (Topic)	384485
20	#19 OR #18 OR #17 OR #16 OR #15	694682
21	#20 AND #14	747
22	#20 AND #14 and 2023 (Publication Years)	163

Database: Web of Science Core Collection

Entitlements:

- WOS.SCI: 1900 to 2023
- WOS.AHCI: 1975 to 2023
- WOS.ESCI: 2018 to 2023
- WOS.ISTP: 1990 to 2023
- WOS.SSCI: 1956 to 2023
- WOS.ISSHP: 1990 to 2023

Long COVID
Grey Literature
2023 Sep 19

COVID-END
https://www.mcmasterforum.org/networks/COVID-end/resources-to-support-decision-makers/inventory-of-evidence-syntheses

Direct search (all synthesis):
“long COVID” (29 results – nothing relevant); “post COVID” (29 results – nothing relevant); “longterm COVID” – no results; “long-term COVID” (3 results – nothing relevant); “postacute COVID” (1 result - not relevant); “post-acute COVID” (8 results – nothing relevant); “chronic COVID” (1 result – not relevant)

Living Overviews of Evidence (L.OVE) Platform
https://iloveevidence.com

"long COVID" or "post COVID" or "longterm COVID" or "long-term COVID" or "postacute COVID" or "post-acute COVID" or "chronic COVID" or "long haul" or "long hauler" or "long haulers" or longhaul or longhauler or longhaulers
AND
employment or "return to work" or "resume work" or "reenter work" or "re-enter work" or "back to work" or employability or workability or sick leave or disability or absentee or absenteeism or presentee or presenteeism or leaveism or leavism
3 results (nothing new)

"long COVID" or "post COVID" or "longterm COVID" or "long-term COVID" or "postacute COVID" or "post-acute COVID" or "chronic COVID" or "long haul" or "long hauler" or "long haulers" or longhaul or longhauler or longhaulers
AND
efficiency or efficiencies or efficient or productive or productively or productivity or productivities
3 results (nothing new)

Google Scholar
2023 Jul 24 - "long COVID"|"post COVID"|"longterm COVID"|"long-term COVID"|"postacute COVID"|"post-acute COVID"|"chronic COVID"+employment|"return to work"|"back to work"|"sick leave"|"disability leave" – since 2023
11,300 results – reviewed first 200 – 13 records downloaded/entered

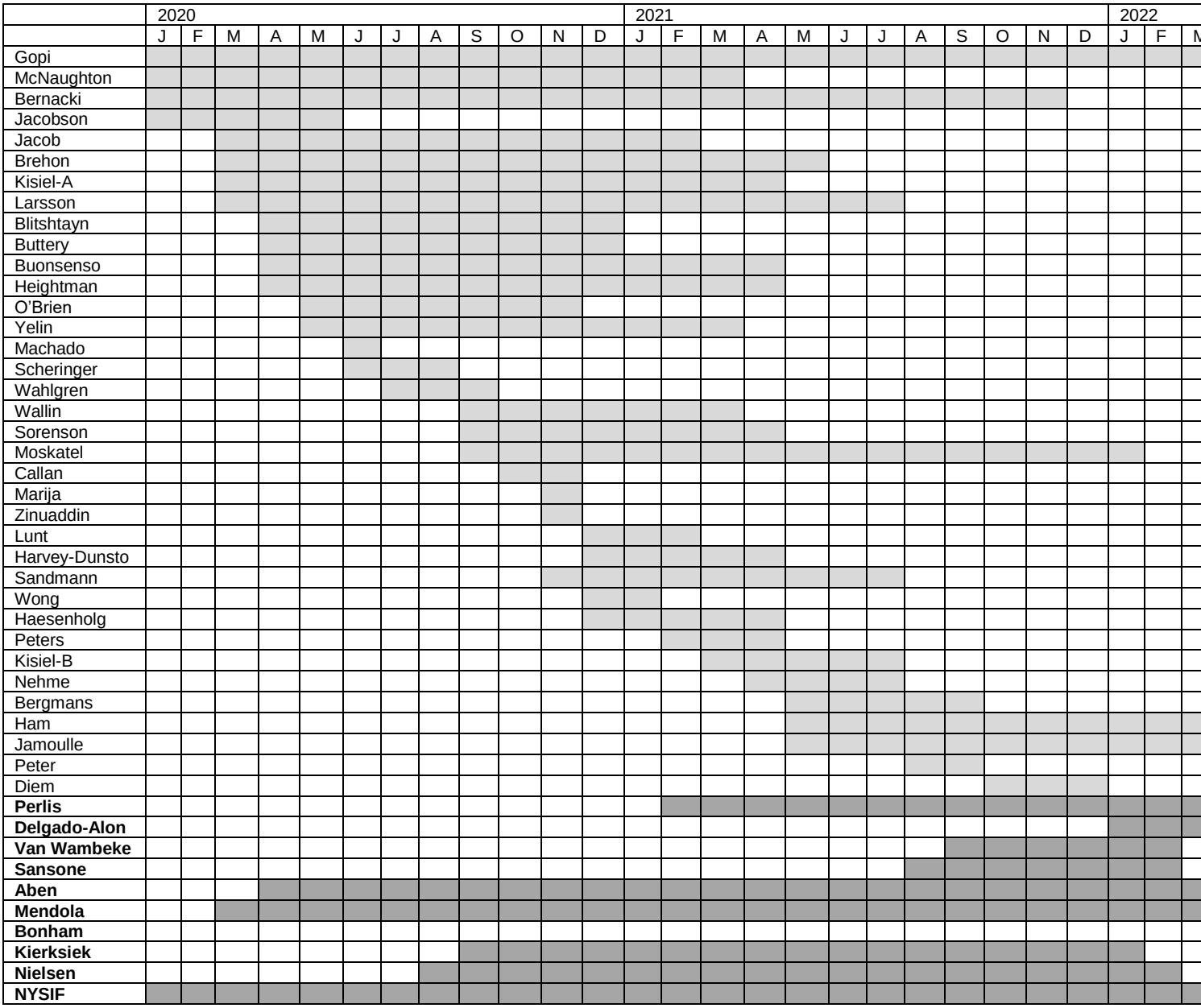
See also CADTH Grey Matters (selected economic sites) – 5 new records

Appendix 2. New studies included in this Scoping Review update

Authors	Year	Title	Journal	Country
Sansone, D., Tassinari, A., Valentinotti, R., Kontogiannis, D., Ronchese, F., Centonze, S., Maggiore, A., Cegolon, L.//Filon, F.L.	2022	Persistence of Symptoms 15 Months since COVID-19 Diagnosis: Prevalence, Risk Factors and Residual Work Ability	Life (Basel, Switzerland)	Italy
Delgado-Alonso, C., Cuevas, C., Oliver-Mas, S., Diez-Cirarda, M., Delgado-Alvarez, A., Gil-Moreno, M.J., Matias-Guiu, J.//Matias-Guiu, J.A.	2022	Fatigue and Cognitive Dysfunction Are Associated with Occupational Status in Post-COVID Syndrome	International journal of environmental research and public health	Spain
Kerksieck, P., Ballouz, T., Haile, S.R., Schumacher, C., Lacy, J., Domenghino, A., Fehr, J.S., Bauer, G.F., Dressel, H., Puhan, M.A.//Menges, D.	2023	Post COVID-19 Condition, Work Ability and Occupational Changes: Results from a Population-based Cohort	Preprint medRxiv	Switzerlan
Perlis, R.H., Lunz Trujillo, K., Safarpour, A., Santillana, M., Ognyanova, K., Druckman, J.//Lazer, D.	2023	Association of Post-COVID-19 Condition Symptoms and Employment Status	JAMA network open	USA
Van Wambeke, E., Bezler, C., Kasprowicz, A.-M., Charles, A.-L., Andres, E.//Geny, B.	2023	Two-Years Follow-Up of Symptoms and Return to Work in Complex Post-COVID-19 Patients	Journal of clinical medicine	France
Aben, B., Kok, R.N.//de Wind, A.	2023	Return-to-work rates and predictors of absence duration after COVID-19 over the course of the pandemic	Scandinavian Journal of Work, Environment and Health	Netherlan
Bonham C, Juarez R, Siegal N	2023	Long COVID and Unemployment in Hawaii	International journal of environmental research and public health	USA
Mendola, M., Leoni, M., Cozzi, Y., Manzari, A., Tonelli, F., Metruccio, F., Tosti, L., Battini, V., Cucchi, I., Costa, M.C.//Carrer, P.	2022	Long-term COVID symptoms, work ability and fitness to work in healthcare workers hospitalized for Sars-CoV-2 infection	La Medicina del lavoro	Italy
Muller, K., Poppele, I., Ottiger, M., Zwingmann, K., Berger, I., Thomas, A., Wastlhuber, A., Ortwein, F., Schultz, A.-L., Weghofer, A., Wilhelm, E., Weber, R.-C., Meder, S., Stegbauer, M.//Schlesinger, T.	2023	Impact of Rehabilitation on Physical and Neuropsychological Health of Patients Who Acquired COVID-19 in the Workplace	International journal of environmental research and public health	Germany

Nielsen TB , Leth S , Pedersen M, Harbo HD, Nielsen CV , Laursen CH, Schiøttz-Christensen B, Oestergaard LG	2022	Mental Fatigue, Activities of Daily Living, Sick Leave and Functional Status among Patients with Long COVID: A Cross-Sectional Study	International journal of environmental research and public health	Denmark
Jakobsen KD, O'Regan E, Bech Svalgaard I, Hviid A	2023	Identifying heterogeneity in the effect of COVID-19 on long-term sick leave using causal machine learning	Lancet Pre-Print https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4444437	Denmark
New York State Insurance Fund	2023	SHINING A LIGHT ON LONG COVID: An Analysis of Workers' Compensation Data		USA

Appendix 3. Data collection dates, from patient enrolment to final follow-up, for primary empirical studies (excludes reviews and models)*



*Data collection dates not reported for 8 studies