

Post COVID-19 Condition in Healthcare Workers in Quebec: Frequency, progression, and risk factors

Phase 1: May–July 2023

VIGIE AND SURVEILLANCE

JUNE 2024

EPIDEMIOLOGICAL INVESTIGATION REPORT

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The reviewers were asked to provide comments on the pre-final version of this document; they have neither reviewed nor endorsed the final content.

The authors, scientific committee members, and reviewers have duly completed their declarations of conflicts of interest. The situations that pose a risk of conflict of interest and the measures taken are presented in [Appendix 1](#).

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Legal deposit – 2nd Quarter 2026

Bibliothèque et Archives nationales du Québec

ISBN: 978-2-550-98380-4 (PDF)

DOI : <https://doi.org/10.64490/ZURP1116>

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ACKNOWLEDGEMENTS

We would like to express our gratitude to Josiane Rivard of the CHU de Québec Research Center, who contributed to the development and supervision of the electronic questionnaire. We would also like to thank Lauriane Padet from the Institut national de santé publique du Québec for her assistance in the bibliographic search. We would also like to thank the team members who contacted the participants (Christiane Audet, Myriam Landry, Amel Saim-Mamoun, Charles Bellavance, Catherine Boucher, Claudia Côté, Joannie Bélanger-Pelletier, Lucie Deschênes, Mylhen Cain, Martine Perry, Romuald Brice Babou Kammoe, Simon Deloye, Sarah Shakibaian, Zohra Berrehail, and Gabrielle Guilbault), as well as Yannick Lemaréchal from Université Laval and Leonardo Di Schiavi Trotta from the Centre Hospitalier de l'Université Laval for their valuable IT support.

Finally, we would like to express our gratitude to all the healthcare workers who generously gave their time to participate in this study.

FOREWORD

The Institut national de santé publique du Québec (INSPQ) is Québec's public health expertise and reference centre. Its mission is to support the Ministère de la Santé et des Services sociaux, Québec's Minister of Health and Social Services, in carrying out their public health responsibilities. The Institute's mission also includes, to the extent determined by its mandate from the Minister, supporting Santé Québec, the Nunavik Regional Board of Health and Social Services, the Cree Board of Health and Social Services of James Bay, and other institutions in the exercise of their public health mission.

The *Vigie* and Surveillance series brings together, under one banner, a variety of scientific works aimed at characterizing the health of the population and its determinants, as well as analyzing threats and risks to health and well-being.

This epidemiological investigation report focuses on the frequency and risk factors of post COVID-19 condition, as well as the medical care received by patients with post COVID-19 condition.

This investigation, carried out in three phases (2023, 2024, 2025), was conducted by the INSPQ under a legal mandate for an epidemiological investigation issued by Dr. Luc Boileau, Quebec's public health director. This report was produced with funding from Quebec's Ministère de la Santé et des Services sociaux.

This document presents some of the results from the first phase and is intended for public health professionals, clinicians and health service providers, patient partner groups, and members of the general public interested in the consequences of COVID-19.

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LIST OF ACRONYMS AND ABBREVIATIONS

95% CI	95% confidence interval
COVID-19	coronavirus disease 2019
HR	health region
HCW	healthcare worker
INSPQ	Institut national de santé publique du Québec
MSSS	Ministère de la Santé et des Services sociaux
NAAT	nucleic acid amplification test
PCC	post COVID-19 condition
QICDSS	Quebec Integrated Chronic Disease Surveillance System
RADT	COVID-19 rapid antigen detection test
SARS-CoV-2	severe acute respiratory syndrome coronavirus 2
WHO	World Health Organization

HIGHLIGHTS

This report presents the results of the epidemiological investigation conducted during the summer of 2023 among healthcare workers (HCWs) in Quebec, aimed at estimating the frequency of post COVID-19 condition (PCC), as well as its risk factors and the healthcare wanted and received. PCC is defined as the persistence of symptoms for at least 12 weeks following an acute COVID-19 episode.

Over three-quarters of HCWs reported having experienced at least one episode of COVID-19 between the start of the pandemic and summer 2023.

- Among HCWs who reported having had COVID-19, around 15% experienced symptoms that persisted for 12 weeks or longer after the initial infection. At the time of the investigation, we estimate that 6% of all HCWs in Quebec were still experiencing PCC symptoms;
- The cumulative risk increases with the number of infections, rising from 13% after one infection to 24% after two infections, and reaching 37% after three infections;
- One-quarter of PCC cases with symptoms at the time of the investigation had only mild symptoms, 42% had at least one moderate symptom without severe symptoms, and one-third had at least one severe symptom;
- The most common symptoms among PCC cases experiencing symptoms at the time of the investigation were fatigue (72%), shortness of breath (53%), concentration or memory problems (50% and 48%), and brain fog (44%);
- PCC risk was higher among certain groups of HCWs: women; people aged 40 to 59 compared to older or younger individuals; HCWs with chronic respiratory disease, depressive disorders, or obesity; economically disadvantaged individuals; those belonging to certain racial/ethnic minorities; individuals who had had severe COVID-19 (hospitalized cases or outpatient cases with at least three severe symptoms); and those who had been infected early in the pandemic during the circulation of the ancestral SARS-CoV-2 strain;
- Medical care was wanted by 67% of PCC cases but received by 48% of them, while rehabilitation and psychological follow-up services were wanted by one-third of cases, but received by only 12%;
- The demand for medical care, rehabilitation and occupational therapy services, and psychological follow-up was two to three times higher among individuals with severe PCC symptoms compared to those with mild symptoms.

SUMMARY

Context and objectives

Post COVID-19 condition (PCC) is a complex and prolonged condition that occurs in some individuals following an acute SARS-CoV-2 infection. It is characterized by persistent symptoms such as fatigue, breathing difficulties, muscle and joint pain, neurological disorders, and impaired cognitive function.

A study conducted at the start of the pandemic (2020–21) showed a high risk of PCC among healthcare workers (HCWs) in Quebec who had had COVID-19. It is critically important to estimate the frequency of PCC and its consequences among HCWs, given the magnitude of the population infected and reinfected with SARS-CoV-2 since the start of the pandemic.

Quebec's National Director of Public Health at the Ministère de la Santé et des Services sociaux (MSSS) gave the Institut national de santé publique du Québec (INSPQ) a legal mandate to conduct an epidemiological investigation of HCWs in Quebec to assess the risk of PCC and its impacts.

The objectives of the investigation were the following:

1. Estimate the frequency and severity of PCC and its progression from the start of the pandemic to June 2023;
2. Identify the risk and recovery factors of PCC;
3. Evaluate the care received by HCWs affected by PCC;
4. Assess the impact of PCC on HCWs' ability to perform their professional activities;
5. Assess the prognostic factors for PCC using a two-year prospective follow-up (2024 and 2025).

This report presents the results related to the first three objectives (Phase 1 of the project).

Methodology

This investigation will be conducted over three years from 2023 to 2025. In Phase 1, which is the focus of this report, data was collected from May to August 2023. The participants from Phase 1 will be recontacted in June 2024 (Phase 2) and June 2025 (Phase 3) for one- and two-year follow-ups to address Objective 5.

The target population consisted of HCWs who were working or had worked during the pandemic in the health and social services network (including administrative staff, maintenance staff, etc.) in public or private healthcare facilities, and who were either listed on the payroll of MSSS healthcare facilities or registered with one of six professional orders (physicians, nurses, licensed practical nurses, respiratory therapists, pharmacists, and midwives), totalling approximately 400,000 individuals.

Recruitment was initially carried out through an email sent to all HCWs with an email address, inviting them to complete a long electronic questionnaire (email survey, 30–40 minutes). Subsequently, a random sample of 7,500 non-respondents to the email invitation and 3,000 unvaccinated HCWs for whom no email address was available were contacted by telephone and invited to answer six short questions verbally (telephone survey).

Several medical administrative databases were combined to obtain information on sociodemographic characteristics (including social and material deprivation indices), comorbidities, vaccination status, and nucleic acid amplification tests for COVID-19.

Respondents who had experienced at least one episode of COVID-19 were asked to report their symptoms (from a list of 21 symptoms and an open “other” category) and their level of severity during the acute episode, the duration of the episode, and any symptoms that had persisted since the acute episode up to the time of responding to the questionnaire.

PCC cases were defined as HCWs who had had at least one confirmed or probable episode of COVID-19 and reported symptoms lasting at least 12 weeks following a COVID-19 episode. For these cases, the questionnaire collected information on the care wanted and received for their persistent symptoms.

Results

Among the 397,222 HCWs who received an email invitation, 21,518 completed the electronic questionnaire, representing a response rate of 5%. Of these respondents, 16,319 (76%) had had at least one episode of COVID-19. Among the 15,926 HCWs who were followed up with at 12 weeks or more after their COVID-19 episode, 17% (2,700) had symptoms lasting at least 12 weeks, meeting the definition of PCC. At the time of the questionnaire, 2,360 still had PCC symptoms (prevalent PCC), representing 15% of HCWs who had had COVID-19 and 11% of all respondents.

Of the 7,500 non-respondents targeted by the telephone survey, 5,795 (77%) were reached and 3,978 (69%) agreed to participate: 79% had had at least one episode of COVID-19, 16% of whom had symptoms lasting at least 12 weeks, and 6% of all respondents had prevalent PCC at the time of the questionnaire.

According to the email survey, the risks of PCC and of prevalent PCC at the time of the survey increased with the number of COVID-19 episodes from 13% and 11%, respectively, with a single episode, to 23% and 20% with two episodes, and 37% and 32% with three episodes. Among prevalent PCC cases, the most frequently reported symptoms were: fatigue (72%), shortness of breath (53%), problems with concentration (50%) and memory (48%), brain fog (44%), muscle pain (38%), anxiety/nervousness (38%), post-exertional malaise (38%), headache (37%), and insomnia (37%). Among these PCC cases, 24% had only mild symptoms, 42% had at least one moderate symptom without any severe symptoms, and 33% reported at least one severe symptom (about half of whom reported three or more severe symptoms).

The risk of PCC was about twice as high among individuals infected during the circulation of the ancestral strain of SARS-CoV-2, compared with those infected during the periods of Alpha, Delta, or Omicron circulation. That said, since more than 85% of COVID-19 episodes occurred during the circulation of the Omicron variant, this variant is associated with the majority of PCC cases.

PCC risk was linked to the severity of the initial infection, at 21% among patients hospitalized during an acute episode of COVID-19 and 13% among outpatient cases. However, among COVID-19 outpatient cases, the risk of PCC was 23% for those who reported three or more severe symptoms during the acute phase of infection. Overall, 84% of all PCC cases occurred in individuals who had had an episode as an outpatient with at least one severe COVID-19 symptom.

In the multivariate analysis, PCC risk was higher in individuals aged 40 to 59 compared with younger or older individuals. This risk was also higher in women; individuals with a chronic respiratory disease, depressive disorder, or obesity; those belonging to certain racial or ethnic minorities or experiencing material deprivation; individuals infected with ancestral SARS-CoV-2; and those whose COVID-19 infection was severe. Among all PCC cases, 67% reported that they would have liked to receive medical care for their condition, and 48% received it. Rehabilitation or occupational therapy services were wanted by 35% of cases and received by 12%, while psychological follow-up was wanted by 32% and received by 12%. Finally, 32% of PCC cases would have liked to receive services to address memory, concentration, and attention problems, but only 2% received such services.

Discussion and conclusion

Despite certain limitations, the PCC situation among HCWs is likely representative of the situation of all adults in Quebec. With a prevalence of approximately 6% among HCWs in summer 2023, the number of adults in Quebec affected by PCC is already high. This number could increase with the ongoing transmission of SARS-CoV-2 and a PCC risk that rises with the number of infections. Affected individuals perceive that access to care does not meet their needs, especially for rehabilitation services and care to address cognitive problems. PCC management poses major challenges for the health and social services system and for Quebec society more broadly.

1 INTRODUCTION

1.1 Context

Post COVID-19 condition (PCC), also known as post COVID-19 syndrome or long COVID, is a complex and prolonged condition that occurs in some individuals following an acute infection with the SARS-CoV-2 virus (1). According to the World Health Organization (WHO), post COVID-19 condition is characterized by a constellation of clinical symptoms that persist beyond three months following an acute infection and that fluctuate over time, including severe fatigue, breathing difficulties, post-exertional malaise, muscle and joint pain, neurological disorders, and cognitive dysfunction (such as confusion and lack of concentration or mental clarity). The symptoms are present three months from the onset of the acute episode, have a minimum duration of eight weeks, cannot be explained by an alternative medical diagnosis, and have a general impact on everyday functioning (2). In accordance with WHO, the term "post COVID-19 condition" will be used in this report (2).

Among individuals who have been infected with SARS-CoV-2, the scientific literature shows significant variations in PCC prevalence from one study to another, partly due to differences in methodologies and the lack of a clearly established definition of this syndrome (3,4). According to the results of three large systematic reviews and meta-analyses of studies mainly conducted with patients hospitalized for COVID-19, approximately half of these patients reported experiencing at least one persistent symptom for more than three months after recovering from the acute infection (5–7). In the United States, a cross-sectional survey of more than 16,000 adults infected with COVID-19 found that 15% reported symptoms persisting beyond two months after the onset of acute COVID-19 symptoms (8). In Canada, the Canadian COVID-19 Antibody and Health Survey found that 16% (follow-up questionnaire, conducted in June 2023) to 17% (second cycle, conducted between April and August 2022) of adults who had had COVID-19 self-reported symptoms lasting three months or more (9,10).

In Quebec, the National Director of Public Health of the Ministère de la Santé et des Services sociaux (MSSS) mandated the Institut national de santé publique du Québec (INSPQ) to conduct an epidemiological investigation in 2020 to assess the consequences of COVID-19 among healthcare workers (HCWs). This study, conducted between the start of the pandemic and the arrival of the Delta variant at the end of 2021, showed that 40% of HCWs who had had COVID-19 as outpatients and 68% of those hospitalized due to the illness reported persistent symptoms beyond 12 weeks after the initial appearance of their symptoms (11,12). Estimating the prevalence and describing the consequences of PCC among HCWs who have had COVID-19 is of critical importance, given the magnitude of the population infected since the start of the pandemic and the labour shortage in the health network, exacerbated by the health crisis and potentially resulting in a reduction of services available to the population (13). PCC could have considerable implications for society if severe PCC symptoms persist and lead to long-term disabilities that cause major disruptions to daily activities in both personal and professional spheres. The impact of PCC on work has been shown in a Canadian scoping review, which

reported that nearly 20% of people with PCC were absent from work for more than six months (14).

On December 20, 2022, Quebec's National Director of Public Health gave the INSPQ the mandate to conduct an epidemiological investigation to determine the risk of PCC among HCWs in Quebec who had been infected since the start of the pandemic, and to assess the condition's progression, functional consequences, and the healthcare wanted and received.

This report presents the results on the frequency of PCC, as well as associated risk factors and healthcare. The results regarding the functional impact of PCC, particularly on work ability, will be presented in a second report.

2 OBJECTIVES

2.1 General objective

The overall objective of this investigation was to estimate, in summer 2023 (Phase 1), the risk of PCC among HCWs in Quebec who had been infected since the start of the pandemic, its functional impact on work ability, and the healthcare wanted and received by affected individuals, as well as to assess its progression through one-year (2024, Phase 2) and two-year (2025, Phase 3) follow-ups.

2.2 Specific objectives

1. Estimate the frequency and severity of PCC and its progression over time, by variant, among health and social services network staff infected with SARS-CoV-2 between the start of the pandemic and June 2023;
2. Identify the risk and recovery factors of PCC;
3. Describe the care wanted and received by HCWs affected by PCC;
4. Assess the impact of PCC in terms of functional impairment in the professional activities of HCWs;
5. Assess the prognostic factors for PCC using a one-year (2024) and two-year (2025) prospective follow-up.

Although Phase 1 of the study collected information to address the first four objectives, this report presents only the results for objectives 1, 2, and 3. The results for Objective 4 (functional impairments at work) will be addressed in a separate publication.

3 METHODOLOGY

3.1 Design

This study is an epidemiological investigation comprising three distinct phases.

In the first phase, data were collected from May to August 2023. These data were analyzed using a retrospective cohort approach to assess the frequency and progression of PCC among infected HCWs, by SARS-CoV-2 variant, since the start of the pandemic. PCC symptoms and severity were assessed among HCWs reporting persistent symptoms at the time of completing the survey (cross-sectional design).

For Phase 2, participants from Phase 1 will be recontacted in June 2024 for a one-year follow-up, and for Phase 3, they will be recontacted in June 2025 for a two-year follow-up. This prospective cohort will make it possible to assess the progression and prognostic factors of patients with PCC identified in the first phase (Objective 5), as well as the risk and progression of PCC associated with variants circulating between June 2023 and June 2025.

3.2 Study population

3.2.1 Population

The study population consisted of HCWs, defined as anyone working or having worked during the pandemic in the health and social services network (including administrative staff, maintenance staff, etc.) or in public or private healthcare facilities (including home care, seniors' residences, intermediate care facilities, etc.), totalling approximately 400,000 people.

To be eligible to participate, HCWs needed to:

- Be at least 18 years old at the time of the survey;
- Be able to communicate in French or English;
- Reside in Quebec;
- Be listed or have been listed, from early 2020, on the payroll of MSSS healthcare facilities, or be registered with one of six professional orders for physicians, nurses, licensed practical nurses, respiratory therapists, pharmacists, or midwives. Other professional bodies were included only if their staff worked in public facilities.

All HCWs in Quebec who met these inclusion criteria and had a valid email address in the Clic Santé database were invited by email (recruitment by electronic invitation) to respond to an electronic questionnaire, which required approximately 30 minutes to complete.

3.2.2 Validation of representativeness

Due to the possibility that respondents may have been more affected by COVID-19 and its consequences than non-respondents, the representativeness of the online survey respondents relative to the targeted cohort of Quebec HCWs was assessed using a telephone questionnaire conducted with a subsample of 7,500 individuals randomly selected from among the non-respondents to the electronic invitation.

Since unvaccinated HCWs generally did not have an email address on Clic Santé—because they had not scheduled a vaccination appointment—they did not receive an electronic invitation. To validate the representativeness of unvaccinated respondents, a second random sample of 3,000 individuals was selected from over 13,000 unvaccinated HCWs and contacted to participate in the telephone questionnaire.

In the telephone survey, the participants were asked to respond to a short six-question questionnaire on SARS-CoV-2 infection since the beginning of the pandemic and on the persistence of symptoms. All individuals who agreed to participate in the telephone survey were also invited to complete the longer online electronic questionnaire (recruitment by telephone).

3.3 Data collection and study procedure

3.3.1 Data sources

Several medical administrative databases were combined to obtain information on sociodemographic characteristics, comorbidities, vaccination status, and nucleic acid amplification tests (i.e. NAAT/PCR tests) for COVID-19:

- The provincial vaccination registry (*Système d'information pour la protection en maladies infectieuses* or SI-PMI);
- The Quebec Integrated Chronic Disease Surveillance System (QICDSS);
- The provincial laboratory registry of NAATs used to detect SARS-CoV-2 in Quebec since the start of the pandemic.

Specific sociodemographic data, along with information on COVID-19 episodes, persistent symptoms, and access to healthcare, were collected through a self-administered electronic questionnaire on the REDCap platform.

For the validation survey, the short questionnaire was conducted over the phone by an interviewer.

3.3.2 Information collected

The following information relating to the first three objectives was collected from administrative data and/or the electronic questionnaire:

Sociodemographic data:

Age, sex, health region (HR) of residence, place of birth, race/ethnicity, employment details, material deprivation index, and social deprivation index were collected. Material and social deprivation indices are ecological indicators based on the socioeconomic characteristics of small geographic areas, used to determine an individual's deprivation level (across five quintiles) according to their postal code (15). The estimated average annual income for each employment category was calculated based on the minimum and maximum possible hourly rates listed for each category on the 2021–23 salary scale from the database of the Comité patronal de négociation du secteur de la santé et des services sociaux, which is Quebec's management bargaining committee for the health and social services sector (16).

1. Clinical data:

The electronic questionnaire collected information on the number of COVID-19 episodes and details about each episode (up to the fourth episode), including date of onset, date of recovery, symptom duration, and severity of the acute episode, including hospitalization.

The SARS-CoV-2 variant was determined based on the period during which each of the different variants was dominant in Quebec: ancestral virus before the appearance of variants of concern (March 2020 to January 2021), Alpha/Gamma (February to November 2021), Delta (November and December 2021), Omicron BA.1 (December 2021 to March 2022), Omicron BA.2 (April to June 2022), Omicron BA.5 (July to November 2022), Omicron BQ.1 (November 2022 to February 2023), and Omicron XBB (February to August 2023) (17).

Respondents who had experienced at least one COVID-19 episode were asked to report their symptoms (from a list of 21 symptoms identified in the literature (18), plus an open “other” category), as well as those that had persisted since the acute episode up to the time of responding to the electronic questionnaire. The severity levels of each symptom were rated on a three-point Likert scale (mild, moderate, or severe).

Several PCC symptoms are nonspecific and can be present due to other health conditions. To estimate the prevalence of symptoms unrelated to PCC, respondents who had no known episode of COVID-19 and those who had had COVID-19 episodes without persistent symptoms were asked to report whether they had been experiencing any of the 21 COVID-19–related symptoms for at least two weeks at the time they completed their questionnaire.

Information on comorbidities was obtained from QICDSS, based on medical administrative data up to March 31, 2021, and therefore preceding the COVID-19 episodes in most cases.

2. Healthcare:

For the HCWs who experienced persistent symptoms for more than three months after their acute episode of COVID-19, the electronic questionnaire collected information on the types of care they would have wanted to receive (from a list of 14 services), the care they actually received, and whether it had improved their condition.

For all participants, the electronic questionnaire also collected information on their perceived overall health status, absenteeism, perceived work ability, difficulty with exertion and daily activities, psychological distress, and psychosocial risks in the workplace. These data will be presented in a second report.

3.3.3 Study procedure

An initial pilot phase was conducted between December 2022 and January 2023 with 504 participants, followed by a second phase between February and March 2023 with 1,500 participants. These pilot phases made it possible to test comprehension of the questionnaire, make adjustments as needed, and determine the most effective recruitment strategy.

For the survey using electronic recruitment, the main data collection took place primarily between May 16 and June 15, 2023 (98% of responses). An invitation email containing a link to the online questionnaire was sent to 397,222 HCWs to solicit their participation in the study. Two email reminders, sent three days apart, were sent to those who had not yet responded to encourage them to complete the questionnaire.

The telephone survey calls were conducted by trained interviewers, starting with unvaccinated HCWs who had not received an email invitation (between May 8 and July 4, 2023), followed by HCWs who had not responded to the online survey (starting June 5).

3.4 Statistical analysis

3.4.1 Representativeness of participants

Representativeness was assessed by comparing sociodemographic characteristics, employment characteristics, and the temporal distribution of positive tests (NAATs) for SARS-CoV-2, between the target population of HCWs and those who responded to the online questionnaire after receiving the email invitation (recruitment by electronic invitation), respondents to the telephone questionnaire (recruitment by telephone), and those who completed the electronic questionnaire after having first completing the telephone questionnaire.

3.4.2 Frequency and severity of PCC

Based on the data collected, HCWs were classified as follows:

- Non-COVID controls, defined as HCWs reporting no positive result (either by NAAT or by rapid antigen detection test [RADT]) for SARS-CoV-2 infection and not suspecting that they had contracted COVID-19;
- COVID controls, defined as HCWs who had had at least one episode of COVID-19 (confirmed by a positive NAAT or RADT, or a self-reported episode following contact with a test-confirmed case) but who did not report any persistent symptoms lasting at least 12 weeks ($\geq$ 84 days) after each episode;
- PCC cases were defined as HCWs who had had at least one episode of COVID-19 (as previously defined) and reported symptoms lasting at least 12 weeks following one of the COVID-19 episodes. The minimum duration of eight weeks, as per the WHO definition, was not collected in the questionnaire (2).

PCC cases were classified according to the presence of symptoms at the time of completing the questionnaire:

1. Resolved PCC: the respondent had had post COVID-19 symptoms that persisted for at least 12 weeks, but no longer had symptoms at the time of completing the questionnaire;
2. Prevalent PCC at the time of the survey: the respondent had post COVID-19 symptoms that had persisted for at least 12 weeks and were still present at the time of completing the questionnaire;
3. Undetermined PCC: the responses were insufficient to determine with certainty whether symptoms were still present at the time of completing the questionnaire.

PCC severity was defined according to the severity of the reported symptoms:

1. Mild: presence of mild symptoms only;
2. Moderate: presence of at least one moderate symptom and no severe symptoms;
3. Severe: presence of at least one severe symptom.

PCC frequency was assessed using two measures:

1. The **risk among individuals infected with SARS-CoV-2**, that is, the total number of PCC cases (resolved, prevalent, or undetermined) divided by the number of respondents with at least one episode of COVID-19 that began 84 days (12 weeks) or more prior the survey participation date;
and,
2. The **prevalence** at the time of the questionnaire (May–June 2023), that is, the number of prevalent PCC cases divided by the total number of survey respondents (prevalence in the target population) or divided by the number of respondents who had had COVID-19 (prevalence among individuals infected with SARS-CoV-2).

The risk and prevalence were calculated separately for respondents to the electronic and telephone questionnaires and stratified by recruitment method (invitation by email and invitation by telephone call).

For the risk and prevalence estimates, weighting by the calibration method was used to account for differences in the distribution of sociodemographic and employment characteristics of respondents to the electronic survey compared with that of the target population of HCWs. These 95% confidence intervals (CIs) were estimated using a bootstrap method.

Finally, the frequency and severity of each PCC symptom among the prevalent cases at the time of the survey were compared with the symptoms reported by each of the two control groups.

3.4.3 PCC risk factors

Univariate and multivariate analyses were performed on sociodemographic factors and the frequency of PCC. Relative risks were estimated using odds ratios. The risks of PCC, stratified according to the severity of the acute episode, vaccination status, and SARS-CoV-2 variant, were calculated by including only respondents with a single episode of COVID-19 or PCC cases who attributed their post COVID-19 symptoms to their first (or only) episode of COVID-19.

The multivariate analyses were conducted using logistic regression models to measure the association between the risk of PCC and sociodemographic characteristics, vaccination, SARS-CoV-2 variant, severity of the acute episode, and treatment of the COVID-19 episode (outpatient or hospitalization). The variables included in the model were defined a priori. Compliance with the assumptions of linearity, independence, multicollinearity, and overdispersion were verified for each regression model. These associations were expressed by odds ratios (ORs) and their 95% CIs.

3.4.4 Healthcare

Among PCC cases, the percentage who expressed a need for each of the healthcare services on the list and the percentage of those who received these services were calculated overall and stratified according to sociodemographic characteristics, deprivation indices, and employment type.

3.5 Ethics

This study was conducted by the INSPQ in collaboration with the CHU de Québec–Université Laval Research Center as part of an epidemiological investigation mandate from Quebec's National Director of Public Health under Quebec's Public Health Act. The project was also submitted to the research ethics committee of the CHU de Québec–Université Laval.

An electronic consent form was signed by all participants who completed the self-administered electronic questionnaire, and verbal consent was obtained from those who responded to the telephone questionnaire. To encourage participation, the email invitation mentioned a draw for 40 prizes of \$250 among HCWs who completed the electronic questionnaire.

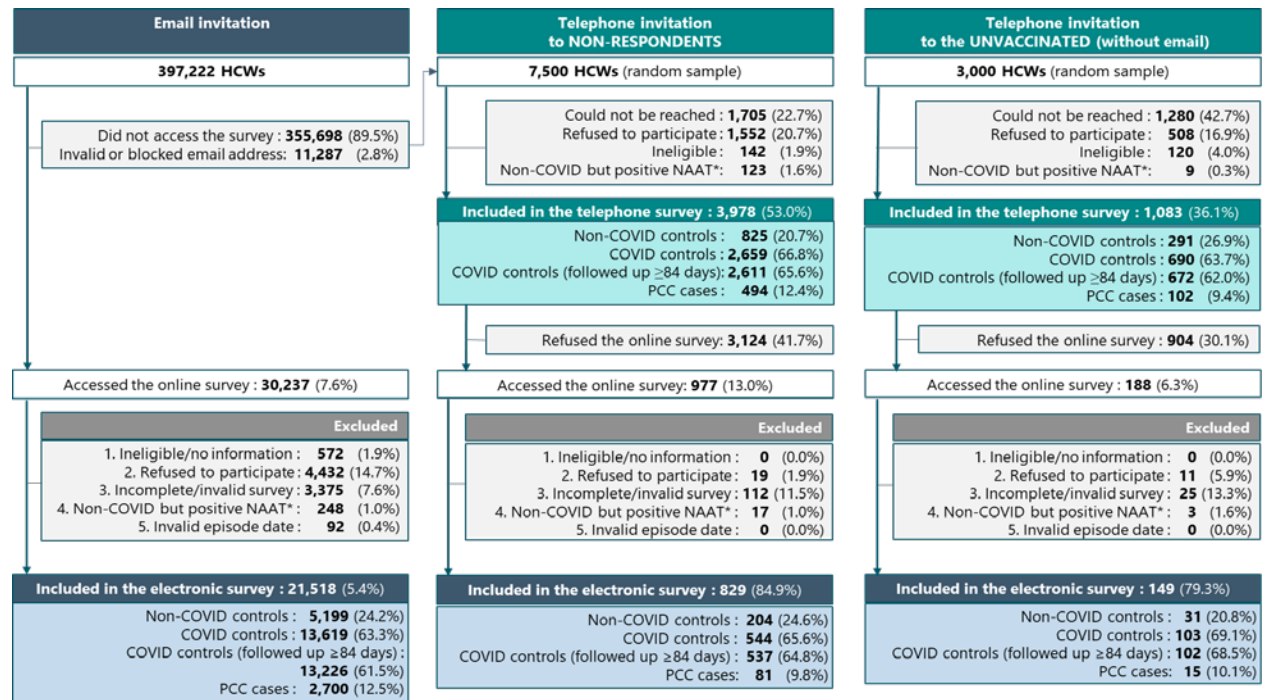
4 RESULTS

4.1 Population

4.1.1 Electronic survey

Among the 397,222 HCWs who were sent an electronic invitation, 30,237 (7.6%) accessed the online questionnaire using the link included in the email (Figure 1). Of these, 572 (1.9%) did not meet the eligibility criteria, 4,432 (14.7%) refused to participate, 3,375 (7.6%) submitted incomplete questionnaires or provided invalid or inconsistent responses, 248 (1.0%) reported not having contracted COVID-19 while the provincial laboratory registry indicated a positive NAAT result for SARS-CoV-2, and 92 (0.4%) had invalid episode dates. In total, 21,518 eligible HCWs (5.7%) completed the questionnaire.

Figure 1 Participation diagram



* HCWs reporting not having contracted COVID-19, but whose records in the provincial laboratory registry indicated a positive NAAT result for SARS-CoV-2.

Abbreviations: PCC: post COVID-19 condition; NAAT: nucleic acid amplification test; HCW: healthcare worker

4.1.2 Telephone survey

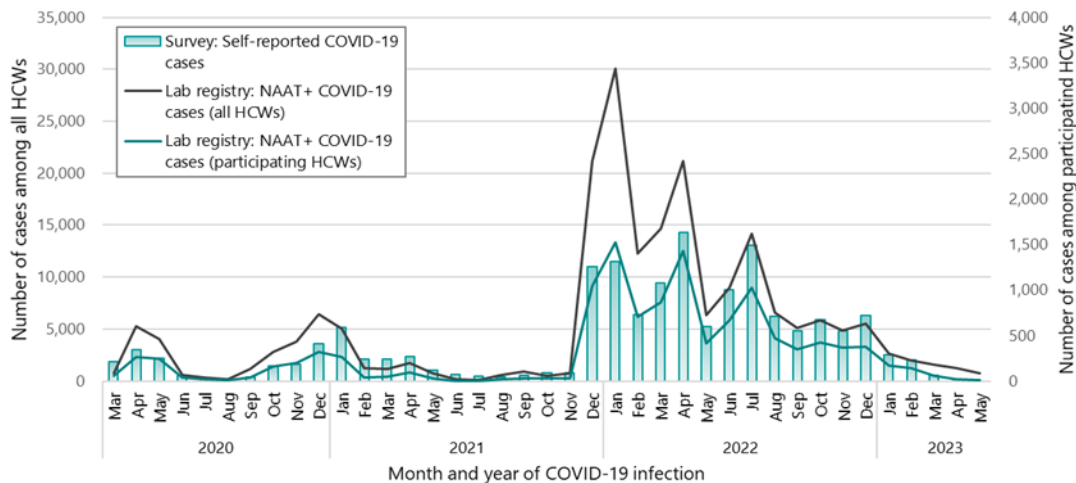
Among the subsample of 7,500 individuals randomly selected from the non-respondents who were called, 1,705 (22.7%) could not be reached, 1,552 (20.7%) refused to participate, 142 (1.9%) were not eligible, and 3,978 (53.0%) responded to the short telephone questionnaire (Figure 1). Among the 3,978 telephone questionnaire participants, 977 (13.0%) agreed to also participate in the electronic questionnaire, and 829 (84.9%) of them did so.

Among the subsample of 3,000 individuals randomly selected among unvaccinated HCWs who were called, 1,083 (36.1%) responded to the short telephone questionnaire, while 1,280 (42.7%) could not be reached, 508 (16.9%) refused to participate, and 4.0% (n = 120) did not meet the inclusion criteria (Figure 1). Among the 1,083 HCWs who responded to the short survey, 188 (6.3%) also agreed to complete the electronic questionnaire, and 149 (79.3%) of them did so.

4.2 Representativeness of participants

Compared with the 397,222 HCWs in the target population, the 22,496 respondents to the electronic questionnaire (21,518 following the email invitation and 978 following the telephone call) showed a similar distribution of sociodemographic characteristics, such as sex, region of residence, and comorbidities (Appendix 2 – Table 7). In terms of employment categories, paratechnical staff (for example, patient attendants) were underrepresented among study participants (16.6% vs 27.9%), while technical and professional staff (for example, medical laboratory or pharmacy technicians) were slightly overrepresented (26.2% vs 19.1%). In addition, participants were generally older (65.8% were 40 years of age or older, vs 55.0%) and had received three or more doses of vaccine more frequently than the target population (84.4% vs 70.7%).

Figure 2 Monthly number of COVID-19 cases diagnosed by NAAT (first positive test) among the target population of health workers in Quebec and among survey participants, and number of self-reported cases (first episode) among participants



Abbreviations: NAAT: nucleic acid amplification test; HCW: healthcare worker

Among the HCWs who participated in the electronic questionnaire, the first episode of COVID-19, either diagnosed by NAAT or self-reported, followed a monthly progression similar to that of the target population of all HCWs in the province over the course of the pandemic (Figure 2).

Among the subsample of non-respondents to the email invitation, the 3,978 participants in the short telephone questionnaire were comparable to the target population across all studied sociodemographic characteristics, including age, sex, region of residence, presence of comorbidities, employment type, and vaccination status ([Appendix 2– Table 7](#)).

4.3 Sociodemographic and employment characteristics

Among all respondents to the electronic questionnaire, more than 80% of participants were women, and the average age was 45.9 years ([Table 1](#)). The HCWs recruited by telephone were younger than those recruited by email (42% vs 34% were under 40 years of age). Approximately 83% reported being born in Canada, and French was the native language of 92% and 99% of participants recruited by email and by telephone, respectively. Participants largely identified their race/ethnicity as white (84%–85%), followed by Black (5%–7%). With respect to employment type, nursing staff (including licensed practical nurses) made up about 25% of the sample regardless of recruitment method, patient attendants represented 7% of those recruited by email but 14% of those recruited by telephone, and the corresponding proportions for physicians were 5% and 4%, respectively. The most common health region (HR) of residence was Montréal (23%), followed by Montérégie (18%) and Capitale-Nationale (12%) among participants recruited by email, with a higher representation of other HRs among participants recruited by telephone. Finally, around 42% of participants had at least one comorbidity.

Among the 4,995 participants in the short telephone questionnaire, a similar proportion to that of the electronic questionnaire participants were women (79%), with an average age of 42.4 years and higher participation among younger HCWs (47% were under 40 years of age). The proportion with comorbidities was similar (41%) to that of participants in the electronic questionnaire. Information on country of origin, race/ethnicity, HR, and employment details was not available for these participants.

Table 1 Sociodemographic and employment characteristics of participants and PCC cases, by questionnaire type and recruitment method

	Electronic questionnaire participants								Telephone questionnaire participants ^a			
	Recruitment by email				Recruitment by telephone				Recruitment by telephone			
	Total		PCC cases		Total		PCC cases		Total		PCC cases	
	N	%	N	%	N	%	N	%	N	%	N	%
N	21,125		2,700		970		96		4,995		596	
Age (years)												
Average (SD)	45.9	(12.3)	46.0	(11.0)	44.4	(13.3)	46.6	(12.1)	42.4	(13.2)	43.6	(12.4)
18–39	7,155	33.9	800	26.9	405	41.8	27	28.1	2,344	46.9	243	40.8
40–49	6,034	28.6	919	34.0	230	23.7	32	33.3	1,144	22.9	162	27.2
50–59	4,809	22.8	688	25.5	178	18.4	21	21.9	927	18.6	128	21.5
≥ 60	3,127	14.8	293	10.9	157	16.2	16	16.7	580	11.6	63	10.6
Sex (Female)	17,034	80.6	2,294	85.0	801	82.6	80	83.3	3,942	78.9	495	83.1
Born in Canada	17,631	83.5	2,218	82.1	810	83.5	81	84.4	NA	NA	NA	NA
Race/ethnicity												
White	17,802	84.3	2,214	82.0	825	85.1	82	85.4	NA	NA	NA	NA
Black	1,128	5.3	151	5.6	68	7.0	6	6.3	NA	NA	NA	NA
Asian	580	2.7	63	2.3	13	1.3	0	0.0	NA	NA	NA	NA
Arab	419	2.0	59	2.2	20	2.1	2	2.1	NA	NA	NA	NA
Hispanic	401	1.9	77	2.9	15	1.5	1	1.0	NA	NA	NA	NA
Other/DK/NR	795	3.8	136	5.0	29	3.0	5	5.2	NA	NA	NA	NA
HR												
Montréal	4,884	23.1	602	22.3	161	16.6	15	15.6	NA	NA	NA	NA
Montréalégie	3,781	17.9	529	19.6	165	17.0	20	20.8	NA	NA	NA	NA
Capitale-Nationale	2,601	12.3	289	10.7	101	10.4	11	11.5	NA	NA	NA	NA
Laurentides	1,518	7.2	195	7.2	74	7.6	3	3.1	NA	NA	NA	NA
Estrie	1,478	7.0	194	7.2	76	7.8	5	5.2	NA	NA	NA	NA
Other	6,863	32.5	891	33.0	393	40.5	42	43.8	NA	NA	NA	NA
Employment type												
Nursing staff	4,278	20.3	600	22.2	188	19.4	17	17.7	1332	26.7	177	29.7
Licensed practical nursing staff	943	4.5	183	6.8	66	6.8	10	10.4	NA	NA	NA	NA
PA/Nurse aide	1,554	7.4	312	11.6	139	14.3	21	21.9	1,436	28.7	193	32.4
Physician	1,143	5.4	96	3.6	41	4.2	2	2.1	184	3.7	9	1.5
Social services	1,919	9.1	252	9.3	87	9.0	6	6.3	NA	NA	NA	NA
Admin/Management	4,343	20.6	474	17.6	182	18.8	19	19.8	999	20.0	116	19.5
Other	6,380	30.2	718	26.6	267	27.5	21	21.9	972	19.5	95	15.9
Comorbidities ^b												
None	12,151	54.5	1,358	50.3	555	57.2	40	41.7	2,923	58.5	311	52.2
At least one	8,974	42.5	1,342	49.7	415	42.8	56	58.3	2,072	41.5	285	47.8
At least two	3,435	16.3	572	21.2	162	16.7	21	21.9	735	14.7	111	18.6

Table 1 Sociodemographic and employment characteristics of participants and PCC cases, by questionnaire type and recruitment method (continued)

	Electronic questionnaire participants				Telephone questionnaire participants ^a			
	Recruitment by email		Recruitment by telephone		Recruitment by telephone			
	Total		PCC cases		Total		PCC cases	
	N	%	N	%	N	%	N	%
N	21,125		2,700		970		96	
No. of COVID-19 episodes								
0	5,199	24.6	NA	NA	235	24.2	NA	NA
1	11,146	52.8	1,455	53.9	493	50.8	50	52.1
2 or more	4,780	22.6	1,245	46.1	242	24.9	46	47.9

- a For the telephone questionnaire participants, information on country of origin, race/ethnicity, and HR was unavailable. For job type, nurse and licensed practical nurse were reported together (nursing and cardiorespiratory care), and PAs were included in the paratechnical, ancillary services, and trades staff group. They were only asked about the presence or absence of at least one episode of COVID-19.
- b The included comorbidities are: depressive disorder, alcohol abuse, drug abuse, hypertension, chronic lung disease, hypothyroidism, kidney disease, fluid and electrolyte disorders, peripheral vascular disorders, obesity, dementia, cerebrovascular disease, neurological disorders, liver disease, psychosis, pulmonary vascular disorders, rheumatoid arthritis, coagulopathy, weight loss, paralysis, ulcer disease, AIDS/HIV, anaemia, cardiovascular disease, diabetes, immune system problems, cancer.

Abbreviations: Admin/Management: administrative staff and managers; PCC: post COVID-19 condition; SD: standard deviation; NA: not applicable; DK: don't know; NR: no response; PA: patient attendant; HR: health region

Note: Participants with a single episode occurring less than 84 days before the questionnaire were not included, as their PCC status could not be confirmed (393, 8, and 66 people, respectively, from the three populations).

4.4 PCC risk and prevalence

Among the 21,518 respondents to the electronic questionnaire following an email invitation, 16,319 HCWs reported having had at least one episode of COVID-19, and 5,199 (24.2%) reported never having had it.

Among those who had had COVID-19, 2,360 experienced symptoms that persisted for 12 weeks or more after the initial infection, corresponding to an overall PCC risk (resolved or still present at the time of the questionnaire) of 17.0% (95% CI: 16.3 to 17.6) and a weighted risk of 17.2% (95% CI: 16.6 to 17.8). PCC prevalence at the time of the questionnaire was 14.8% (95% CI: 14.3 to 15.4).

Among all respondents, PCC prevalence at the time of the questionnaire was 11.0% (95% CI: 10.5 to 11.4), and the weighted prevalence was 11.1% (95% CI: 10.7 to 11.6) ([Table 2](#)).

Among the 4,995 respondents to the short telephone questionnaire (non-respondents to the email invitation or unvaccinated), the risk of PCC after COVID-19 infection was similar to that of the electronic questionnaire: 15.9% (95% CI: 14.6 to 17.2) among non-respondents to the email

invitation and 13.2% (95% CI: 10.8 to 15.6) among the unvaccinated. However, PCC prevalence at the time of the telephone questionnaire was half that reported in the electronic questionnaire (5.6% and 5.3% of all respondents), as a higher proportion of HCWs reported that their symptoms persisting 12 weeks or more had resolved by the time of the questionnaire.

Table 2 Post COVID-19 condition risk and prevalence by participant recruitment method and data collection mode

Collection mode	Electronic questionnaire						Telephone questionnaire	
Recruitment type	By email		By telephone call to non-respondents		By telephone call to the unvaccinated		By telephone call to non-respondents	By telephone call to the unvaccinated
	N	%	N	%	N	%	N	%
Total number of participants	21,518		829		149		3,978	1,083
HCWs without COVID-19 episodes	5,199	24.2	204	24.6	31	20.8	825	26.9
HCWs with COVID-19 episode(s) (total)	16,319	75.8	625	75.4	118	79.2	3,153	79.3
HCWs with COVID-19 episode(s) followed up with ≥ 84 days after the episode	15,926	74.0	618	74.5	117	78.5	3,105	78.1
PCC cases (total)	2,700	12.5	81	9.8	15	10.1	494	12.4
Prevalent PCC cases at time of questionnaire	2,360	11.0	66	8.0	11	7.4	221	5.6
Risk (95% CI) among participants with COVID-19 episodes ^a	17.0 (16.3 – 17.6)		13.1 (10.4 – 16.2)		12.8 (7.4 – 20.6)		15.9 (14.6 – 17.2)	13.2 (10.8 – 15.6)
Prevalence (95% CI) among participants with COVID-19 episodes ^b	14.8 (14.3 – 15.4)		10.7 (8.2 – 13.1)		9.4 (4.1 – 14.7)		7.1 (6.2 – 8.0)	7.2 (5.4 – 9.1)
Prevalence (95% CI) among all participants ^c	11.0 (10.5 – 11.4)		8.0 (6.2 – 10.0)		7.4 (3.8 – 12.8)		5.6 (4.9 – 6.3)	5.3 (3.9 – 6.6)

^a Risk (95% CI) among participants with COVID-19: PCC cases (prevalent or resolved) / HCWs with COVID-19 followed up with ≥ 84 days after.

^b Prevalence (95% CI) among participants with COVID-19: prevalent PCC cases / HCWs with COVID-19 followed up with ≥ 84 days after.

^c Prevalence (95% CI) among all participants: prevalent PCC cases / all participants.

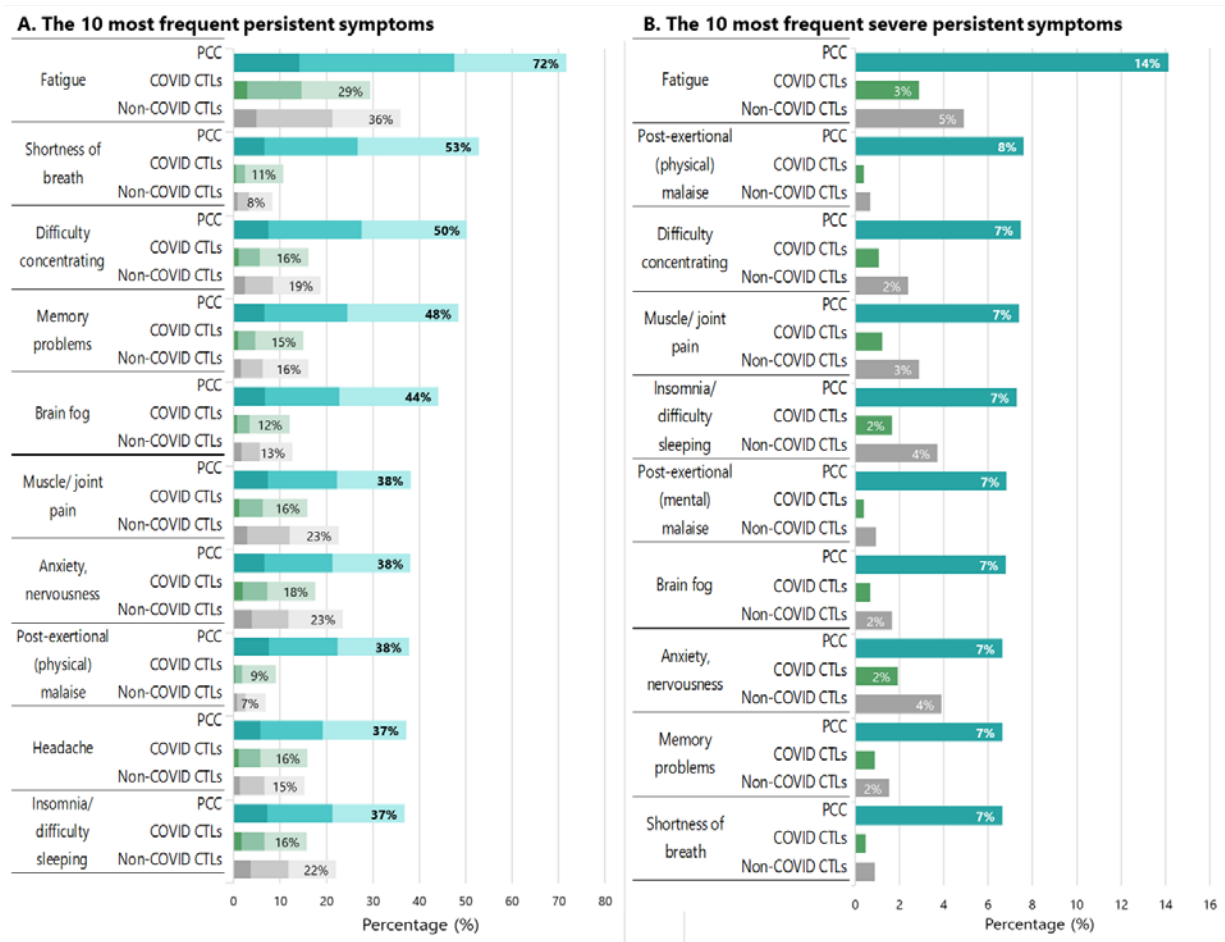
Abbreviations: PCC: post COVID-19 condition; CI: confidence interval; HCW: healthcare worker

4.5 PCC symptoms and severity

Among participants with prevalent PCC who responded to the electronic questionnaire, 14% reported a single symptom lasting 12 weeks or more, 12% reported two symptoms, and 74% reported three or more symptoms. The number of symptoms increased with the severity of the PCC, and 91% of severe PCC cases reported three or more symptoms. The most frequently reported symptoms were: fatigue (72%), shortness of breath (53%), problems with

concentration/memory (50% and 48%, respectively), brain fog (44%), muscle pain (38%), anxiety/nervousness (38%), post-exertional malaise (38%), headache (37%), and insomnia (37%) (Figure 3A).

Figure 3 Most frequently reported persistent symptoms at the time of the electronic questionnaire among prevalent PCC cases (lasting ≥ 12 weeks), COVID controls, and non-COVID controls (lasting ≥ 2 weeks), by level of severity



Note: The percentages in the figure represent the number of participants who reported each symptom (A) or each severe symptom (B) out of the total number of participants in each group (PCC cases, COVID controls, or non-COVID controls).

Abbreviations: PCC: post COVID-19 condition; CTLs: controls

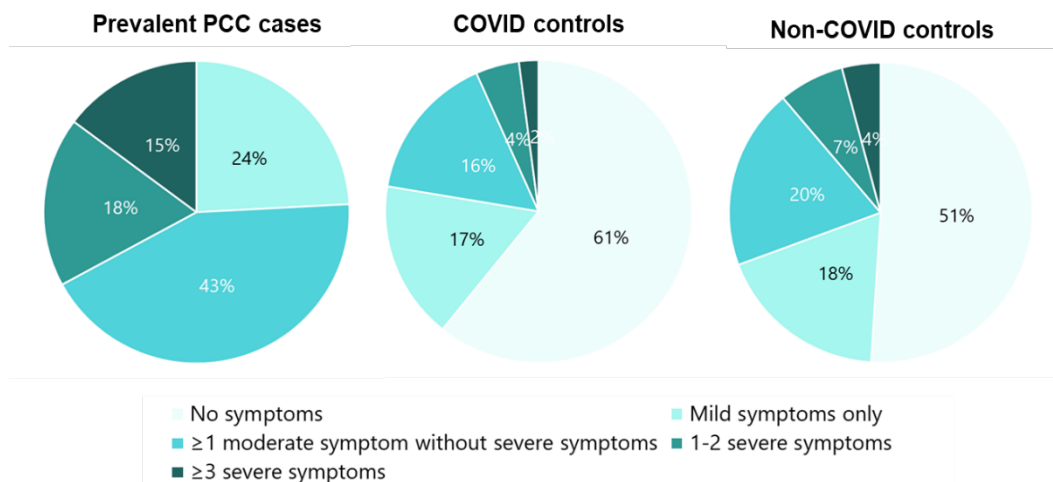
Among the COVID controls and non-COVID controls, 61% and 51%, respectively, reported no symptoms lasting at least two weeks and present at the time of the questionnaire (Figure 4). The most frequently reported symptom was fatigue (30% of COVID controls and 36% of non-COVID controls), followed by anxiety/nervousness, muscle pain, concentration/memory problems, and insomnia (ranging from 15% to 24%) (Figure 3A).

The frequency of symptoms among PCC cases was between two and seven times higher than among controls (Figure 5). Shortness of breath; malaise after physical activity; malaise after mental, intellectual, or emotional exertion; impaired sense of smell and/or taste; brain fog; and chest pain or tightness were the symptoms with the highest relative risk (three to five times higher than among COVID controls and four to seven times higher than among non-COVID controls).

In terms of severity, 33% of PCC cases reported at least one severe symptom (45% of whom reported three or more severe symptoms), while 24% had only mild symptoms and 42% had at least one moderate symptom without any severe symptoms (Figure 4). Severe fatigue was the most frequently reported severe symptom (14%) among PCC cases (Figure 3). Between 6% and 7% of cases reported at least one of the following severe symptoms: anxiety/nervousness; brain fog; muscle pain; shortness of breath; insomnia; headache; malaise after physical activity; malaise after mental, intellectual, or emotional exertion; concentration problems; memory problems.

Among COVID controls, 3% reported severe fatigue, while fewer than 2% reported any other severe symptom (Figure 3B). Non-COVID controls reported severe symptoms more frequently than COVID controls: 5% for fatigue, 4% for insomnia, and 4% for anxiety.

Figure 4 Distribution of participants according to the severity of symptoms reported at the time of the electronic questionnaire for prevalent PCC cases (lasting ≥ 12 weeks), COVID controls, and non-COVID controls (lasting ≥ 2 weeks)



Abbreviations: PCC: post COVID-19 condition

Compared with the COVID controls, PCC cases showed approximately 20 times the prevalence of severe post-exertional malaise following physical activity (7.6% vs 0.4%) and alterations in taste and/or smell (5.0% vs 0.2%), and 17 times the prevalence of severe post-exertional malaise following mental, intellectual, or emotional exertion (6.8% vs 0.4%) (Figure 5). Shortness of breath and chest pain/tightness were also reported much more frequently as severe symptoms among PCC cases than among COVID controls (14 and 13 times higher, respectively), while severe instances of fever, depressed mood, and anxiety were reported around three times more often by PCC cases.

Figure 5 Prevalence ratios comparing the frequency of each symptom in prevalent PCC cases at the time of the electronic questionnaire (lasting ≥ 12 weeks) with COVID and non-COVID controls (lasting ≥ 2 weeks), by severity level

Symptoms assessed:		PR PCC cases vs COVID CTLs				PR PCC cases vs Non-COVID CTLs			
		Overall	Severe symp.	Moderate symp.	Mild symp.	Overall	Severe symp.	Moderate symp.	Mild symp.
1	Fatigue	2.4	4.9	2.8	1.6	2.0	2.9	2.0	1.6
2	Shortness of breath	4.9	14.3	10.3	3.1	6.4	7.6	8.2	5.2
3	Difficulty concentrating	3.1	7.0	4.4	2.2	2.7	3.1	3.3	2.2
4	Memory problems	3.2	7.4	4.7	2.3	3.0	4.3	3.8	2.4
5	Brain fog	3.7	9.8	5.9	2.5	3.5	4.1	4.1	3.1
6	Muscle or joint pain	2.4	6.1	3.0	1.6	1.7	2.6	1.6	1.5
7	Anxiety, nervousness	2.2	3.5	2.8	1.6	1.6	1.7	1.8	1.4
8	Post-exertional (physical) malaise	4.1	19.8	10.1	2.1	5.5	11.3	8.0	3.5
9	Headache	2.3	5.5	2.8	1.8	2.4	4.3	2.5	2.1
10	Insomnia	2.3	4.4	2.8	1.7	1.7	2.0	1.7	1.5
11	Impaired smell and/or taste	4.3	21.5	19.3	2.7	6.8	9.1	14.9	5.1
12	Depressed mood/Depression	2.4	3.4	3.1	2.0	2.0	1.6	2.1	2.1
13	Post-exertional (mental or emotional) malaise	3.8	17.0	9.6	2.1	4.2	7.3	4.5	3.4
14	Cough	2.8	4.5	4.3	2.4	3.5	3.0	3.8	3.4
15	Runny nose/Congestion	2.0	5.3	3.0	1.6	2.1	2.9	2.0	2.0
16	Chest pain/tightness	3.0	12.9	8.4	2.3	4.3	4.5	4.7	4.1
17	Abdominal pain	2.4	10.3	6.1	1.9	3.2	5.4	3.0	3.1
18	Sore throat	2.1	6.2	2.9	1.8	2.8	3.0	3.1	2.7
19	Diarrhea	2.2	6.8	4.5	1.7	3.2	4.5	2.8	3.3
20	Fever	2.1	2.6	3.6	2.0	3.5	2.1	3.7	3.5

Abbreviations: PCC: post COVID-19 condition; CTLs: controls; PR: prevalence ratio

Note: Colour intensity increases with the value of the prevalence ratio (PR), divided into six categories: [< 2], [$2 - < 3$], [$3 - < 4$], [$4 - < 5$], [$5 - < 6$], [6 and above]. The symptoms are presented in order of frequency among PCC cases.

Among PCC cases with only one episode of COVID-19, the average duration of symptoms was 7 months for those whose PCC had resolved and 15 months for those whose PCC was ongoing at the time of the questionnaire (Table 3). Among cases whose PCC had resolved, 62% had had symptoms lasting between 3 and 6 months, 15% between 12 and 23 months, and 4% for 24 months or more. For cases whose PCC was still ongoing at the time of the questionnaire, 11% had experienced symptoms for less than 6 months, 36% for 6 to 11 months, 33% for 12 to 23 months, and 19% for 24 months or more.

Table 3 Duration of post COVID-19 condition symptoms in cases reporting a single episode of COVID-19

	Prevalent PCC cases		Resolved PCC cases	
	N	%	N	%
Number of cases	1,329		151	
Average duration (months)	15.1		7.3	
Duration:				
3–5 months	152	11.4	93	61.6
6–11 months	484	36.4	29	19.2
12–23 months	439	33.0	23	15.2
24–35 months	171	12.9	5	3.3
≥ 36 months	83	6.2	1	0.7

Abbreviations: PCC: post COVID-19 condition

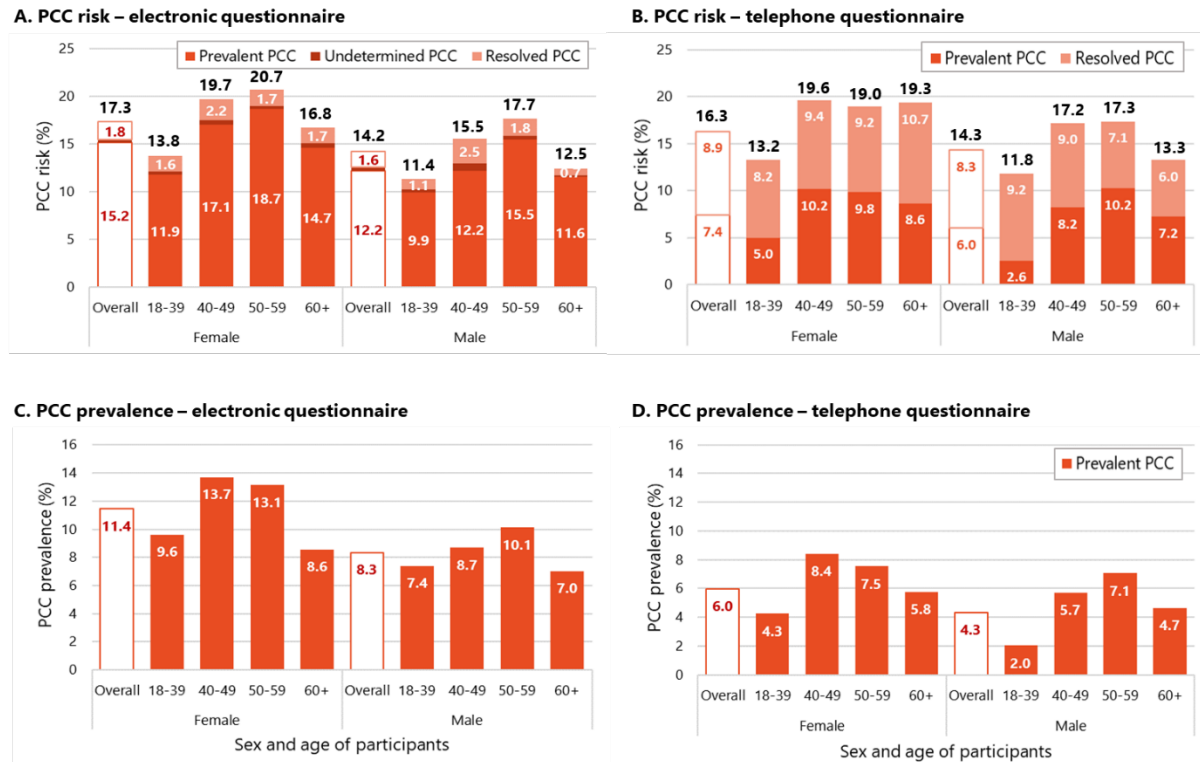
4.6 PCC risk factors

4.6.1 PCC frequency by sociodemographic characteristics

Among respondents who had experienced at least one episode of COVID-19, the risk of symptoms lasting 12 weeks or more was higher among women and among individuals aged 40 to 59 years ([Figure 6](#)). The risk was similar between respondents to the electronic questionnaire and respondents to the telephone questionnaire. However, the proportion reporting that their persistent symptoms had resolved by the time of the questionnaire (resolved PCC) was much smaller among electronic questionnaire respondents (~ 10%) compared with telephone respondents (~ 50%), across all age and sex groups.

PCC prevalence at the time of the questionnaire among the 22,496 respondents to the electronic questionnaire (recruitment by email or telephone) was highest among women aged 40 to 59 years (~ 13%) and lowest among men aged 18 to 39 years and 60 years or older (7%) ([Figure 6](#)). Among the 3,930 respondents to the telephone questionnaire, prevalence was also highest among women aged 40 to 59 years (~ 8%), but lower than in the electronic questionnaire for all age groups, particularly men aged 18 to 39 years (2% vs 7%).

Figure 6 PCC risk and prevalence by age and sex in respondents to the electronic and telephone questionnaires



Note: PCC risk = Number of respondents with PCC / number of respondents with at least one episode of COVID-19. PCC prevalence = Number of respondents with prevalent PCC / number of questionnaire respondents. The numbers above the bars represent the overall risk of PCC (prevalent or resolved) for each sex and age category.

Abbreviations: PCC: post COVID-19 condition

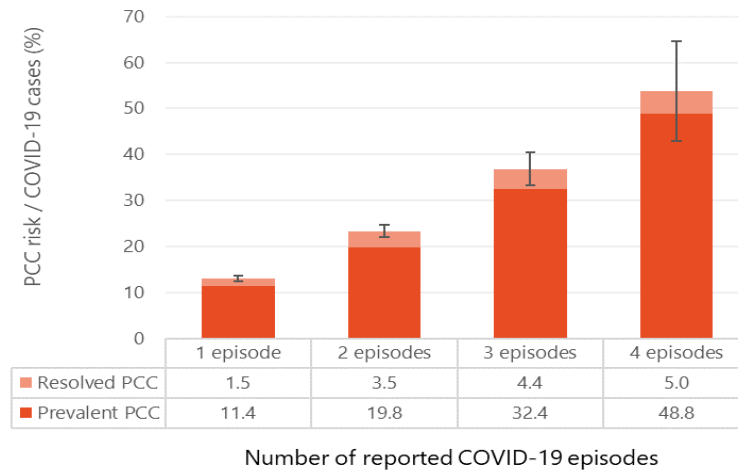
4.6.2 PCC risk by number of COVID-19 infections

Among respondents who had had COVID-19, 11,639 (69.9%) reported having a single episode, 4,233 (25.4%) reported two distinct episodes, and 789 (4.7%) reported three episodes or more.

The cumulative risk of PCC and of prevalent PCC at the time of the survey increased with the number of infections, rising from 12.9% and 11.4% for one infection to 23.3% and 19.8% for two infections, and 36.8% and 32.4% for three infections, respectively (Figure 7). The absolute difference in PCC risk between those who had had two episodes of COVID-19 versus those who had had one episode was 10.4 percentage points (23.3%–12.9%), and 13.5 percentage points (36.8%–23.3%) for those who had had three episodes compared to two.

With a prevalent PCC risk of 11.4% following the first episode (as observed in participants with a single episode), 78% (1,902) of prevalent PCC cases can be attributed to the first infection, and 22% to reinfection.

Figure 7 PCC risk (prevalent or resolved) by number of COVID-19 infections in electronic questionnaire respondents



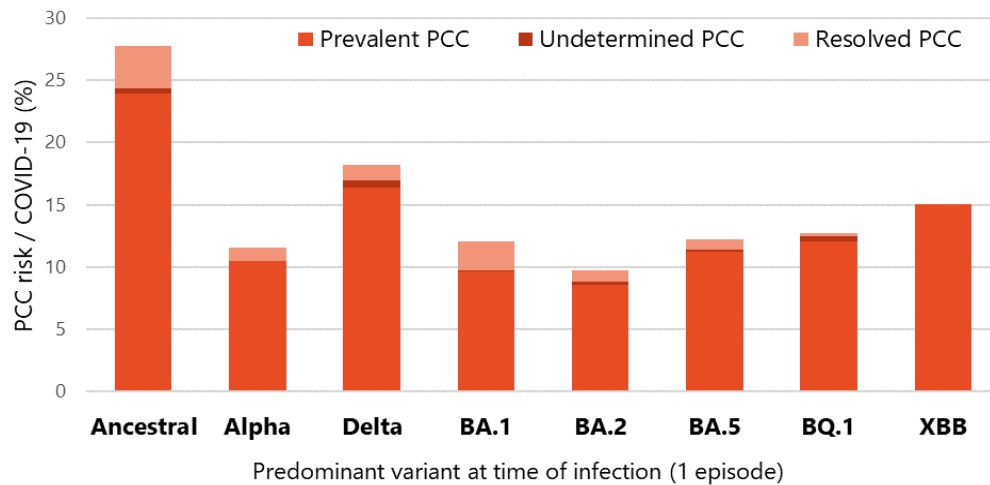
Abbreviations: PCC: post COVID-19 condition

Note: The error bars represent 95% confidence intervals for the total PPC risk.

4.6.3 PCC risk by SARS-CoV-2 variant

Among the 11,639 participants who reported having had a single episode of COVID-19 (1,505 PCC cases and 10,134 COVID controls), the risk of PCC was approximately twice as high among those infected with the ancestral strain of SARS-CoV-2 (27.8%) than among those infected during the periods of Alpha, Delta, and Omicron circulation (risk ranging from 9.8% to 18.2%) ([Figure 8](#)). However, since the Omicron variant accounted for 86.2% of all COVID-19 episodes (10,035 of 11,639), 77.6% of PCC cases among those who had had a single episode of COVID-19 occurred following an Omicron infection.

Figure 8 PCC risk by SARS-CoV-2 variant

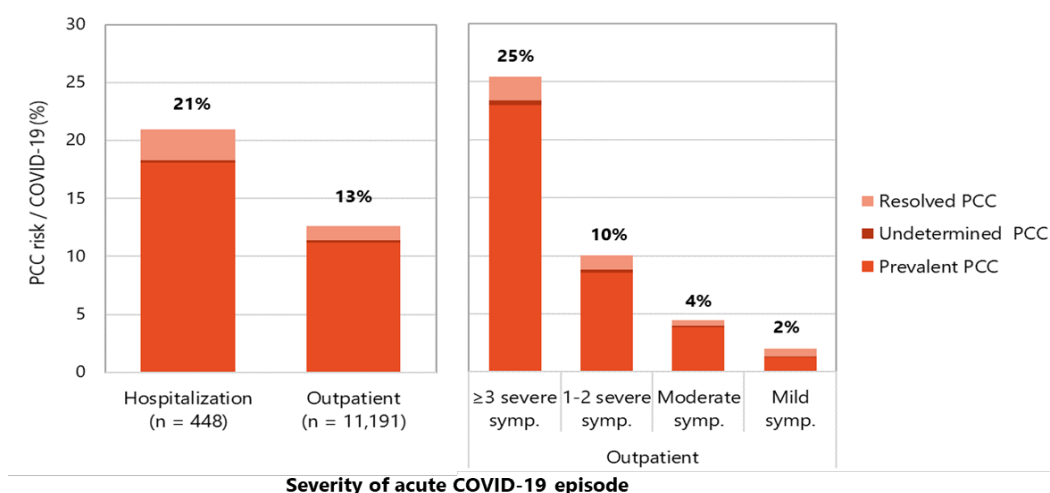


Abbreviations: PCC: post COVID-19 condition

4.6.4 Risk of PCC by severity of acute episode

The risk of PCC was associated with the severity of the initial infection. Among the 448 HCWs who required hospitalization during an acute episode of COVID-19 (cases with a single episode), 21% developed PCC compared with 13% of the 11,191 outpatient cases ([Figure 9](#)). However, among outpatient COVID-19 cases who reported three or more severe symptoms during the acute phase of the infection, the risk of PCC was at least as high (25%) as that of hospitalized cases. Overall, 84% of all PCC cases ($n = 1,114$) occurred in individuals who had experienced a COVID-19 episode with severe symptoms as outpatients.

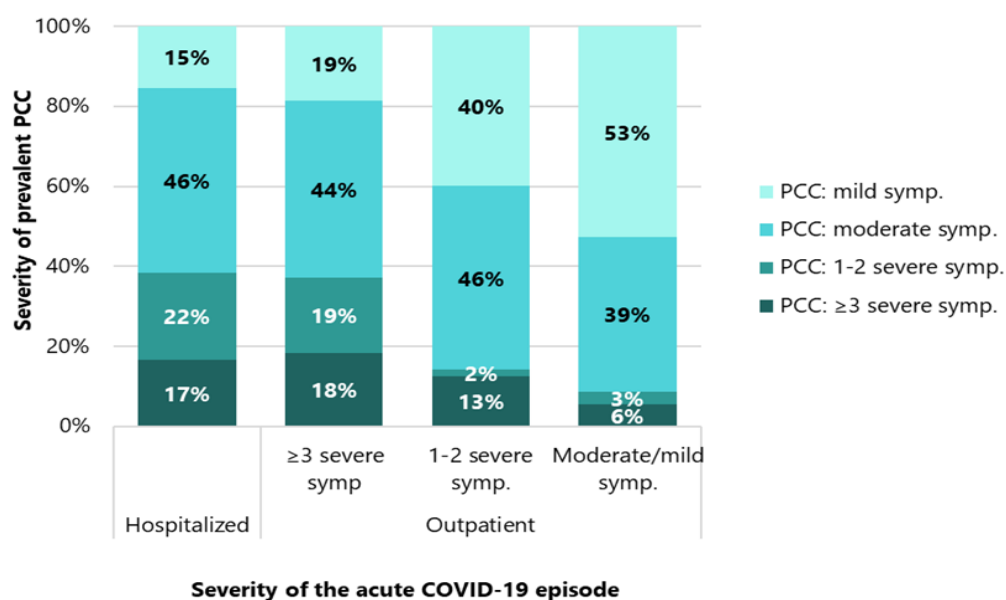
Figure 9 Risk of PCC according to severity observed during the initial acute episode



Abbreviations: PCC: post COVID-19 condition; symp.: symptoms

The severity of persistent PCC symptoms (among prevalent cases) also increases with the severity of symptoms observed during the acute episode ([Figure 10](#)). The proportion reporting severe PCC symptoms was 38% of hospitalized patients and 37% of outpatients with three or more severe symptoms, compared with 14% of outpatients with one or two severe symptoms and 9% of those with moderate or mild symptoms.

Figure 10 Severity of PCC symptoms according to severity observed during the acute episode



Abbreviations: PCC: post COVID-19 condition; symp.: symptoms

4.6.5 Risk of PCC by deprivation level and race/ethnicity

Compared with the expected distribution of material deprivation quintiles in Quebec's general population (20% of individuals in each quintile), HCWs who responded to the questionnaire were more often (26%) in the first quintile (Q1, representing the most materially advantaged) and less often (13%) in the fifth quintile (Q5, representing the least advantaged) ([Appendix 2 – Table 8](#)). However, the distribution of respondents across social deprivation quintiles was 20% per quintile, as expected in the general population. The risk of PCC increased with the material deprivation quintile, from 14.1% for those in Q1 to 19.6% for those in Q5. The risk of severe PCC (defined by the presence of at least one severe symptom) was more strongly correlated with the material deprivation index, increasing from 3.4% for those in Q1 to 4.7% in Q3 and 6.3% in Q5. The relative increase in risk was similar between women and men. Differences according to average annual income were even wider. Among individuals with an annual income of CAD 80,000 or higher, the risk of PCC was 11.0% and of severe PCC was 2.2%, compared with 23.9% and 9.8% for those with an annual income less than CAD 60,000. PCC risk was not associated with social deprivation.

By self-reported race/ethnicity, the lowest risk was observed among white and Asian respondents, while higher risk was seen among Indigenous, Hispanic, Black, and Arab respondents ([Appendix 2 – Table 8](#)).

4.6.6 Multivariate analysis of factors associated with PCC risk

Sociodemographic and clinical characteristics of 2,335 PCC cases associated with their first episode (and 664 severe PCC cases) were compared with those of 13,773 COVID controls who did not report persistent symptoms ([Table 4](#)).

In the multivariate analysis, age was associated with increased PCC risk, which was higher for those aged 40 to 49 years (OR = 1.7) and 50 to 59 years (OR = 1.8) than for those aged 60 or older (OR = 1.5), relative to the risk for those 18 to 39 years old. Among comorbidities, chronic respiratory diseases and depressive disorder were most strongly associated with PCC risk (OR = 1.6 and 1.4, respectively) and severe PCC risk (OR = 1.8 and 1.4), while obesity was primarily associated with severe PCC risk (OR = 1.2 and 1.5). Compared with respondents identifying as white or Asian, the risks of PCC and of severe PCC were higher for Arab respondents (OR = 1.5 and 2.2, respectively) and Hispanic respondents (OR = 1.4 and 1.5, respectively). There was no association with being born outside Canada or language preference (English vs French). PCC risk was higher among those experiencing material deprivation, but no association was observed with social deprivation.

Compared with HCWs infected with the Omicron variant, the risk of PCC and severe PCC was approximately three times higher for those infected with the ancestral strain and around 1.5 times higher for those infected during the periods where Alpha and Delta were circulating ([Table 4](#)). In the analysis restricted to the Omicron period, the observed risk was similar across all Omicron subvariants (BA.1 to XBB) ([Appendix 2 – Table 9](#)).

The effect of age and variant on PCC risk was more pronounced in hospitalized individuals than in COVID-19 outpatients, but the number of hospitalized patients was insufficient to draw conclusions regarding other factors ([Appendix 2 – Table 10](#)). During the circulation period of the ancestral virus, the highest risk was observed in those aged 60 years or older (2.4 times that of individuals aged 18 to 39 years) and in those with chronic respiratory diseases (OR = 1.8) and obesity (OR = 1.6) ([Appendix 2 – Table 9](#)). Analysis of the Omicron circulation period shows similar associations to those observed in all participants.

After adjustment for sociodemographic characteristics, acute episode severity was strongly associated with PCC risk, with a 15-fold higher risk for hospitalized individuals and an 18-fold higher risk for outpatient cases with three or more severe symptoms, compared with outpatients with less severe COVID-19 infections ([Table 5](#)). Before the Omicron period, the highest risk was observed in hospitalized cases (OR = 22.5 during the pre-variants of concern period and 17.4 during the Alpha/Delta period), whereas during the Omicron period, the risk appeared highest among outpatients with three or more severe symptoms (OR = 19.0), although the difference between the two categories is not significant.

Table 4 Multivariate analysis of risk factors associated with the likelihood of developing post COVID-19 condition (PCC) (n = 16,108) or severe PCC (n = 14,437)

				OVERALL		SEVERE	
	PCC cases (N)	Severe PCC cases (N)	COVID controls (N)	Crude OR (95% CI)	Adjusted OR ^a (95% CI)	Crude OR (95% CI)	Adjusted OR ^a (95% CI)
N	2,335	664	13,773				
Age (years)							
18–39	658	179	5,263	1 [ref]	1 [ref]	1 [ref]	1 [ref]
40–49	800	223	4,016	1.6 (1.4–1.8)	1.7 (1.5–1.9)	1.6 (1.3–2.0)	1.6 (1.3–2.0)
50–59	614	182	2,816	1.7 (1.5–2.0)	1.8 (1.6–2.1)	1.9 (1.5–2.3)	1.9 (1.5–2.4)
≥ 60	263	80	1,678	1.3 (1.1–1.5)	1.5 (1.2–1.8)	1.4 (1.1–1.8)	1.6 (1.2–2.2)
Sex							
Female	1,975	554	11,268	1 [ref]	1 [ref]	1 [ref]	1 [ref]
Male	360	110	2,505	0.8 (0.7–0.9)	0.9 (0.7–1.1)	0.9 (0.7–1.1)	0.9 (0.6–1.4)
Language							
French	2,152	616	12,765	1 [ref]	1 [ref]	1 [ref]	1 [ref]
English	183	48	1,008	1.1 (0.9–1.3)	1.1 (0.9–1.3)	1.0 (0.7–1.3)	1.1 (0.8–1.5)
Place of birth							
Born in Canada	1,924	551	11,878	1 [ref]	1 [ref]	1 [ref]	1 [ref]
Born outside Canada	411	113	1,895	1.3 (1.2–1.5)	1.0 (0.9–1.2)	1.3 (1.0–1.6)	1.0 (0.7–1.4)

Table 4 Multivariate analysis of risk factors associated with the likelihood of developing post COVID-19 condition (PCC) (n = 16,108) or severe PCC (n = 14,437) (continued)

				ALL		SEVERE	
	PCC cases (N)	Severe PCC cases (N)	COVID controls (N)	Crude OR (95% CI)	Adjusted OR ^a (95% CI)	Crude OR (95% CI)	Adjusted OR ^a (95% CI)
N	2,335	664	13,773				
Race/ethnicity							
White	1,919	548	12,014	1 [ref]	1 [ref]	1 [ref]	1 [ref]
Asian	54	12	355	0.9 (0.7–1.3)	1.1 (0.8–1.5)	0.7 (0.4–1.3)	1.0 (0.5–1.9)
Hispanic	64	18	252	1.6 (1.2–2.1)	1.4 (1.0–1.9)	1.6 (0.9–2.5)	1.5 (0.8–2.6)
Black	126	29	516	1.5 (1.2–1.9)	1.3 (1.0–1.7)	1.2 (0.8–1.8)	1.0 (0.6–1.6)
Other/DK	118	35	423	1.7 (1.4–2.1)	1.8 (1.4–2.2)	1.8 (1.3–2.6)	1.9 (1.3–2.8)
Comorbidities (vs absence of the comorbidity)							
Chron. resp. disease (vs without)	289	107	1,056	1.7 (1.4–2.0)	1.6 (1.3–1.8)	2.3 (1.9–2.9)	1.8 (1.4–2.3)
Cardiovas. disease (vs without)	133	50	539	1.4 (1.1–1.8)	1.3 (1.0–1.6)	2.0 (1.4–2.7)	1.4 (1.0–2.0)
Obesity (vs without)	172	71	684	1.5 (1.3–1.8)	1.2 (1.0–1.5)	2.3 (1.8–2.9)	1.5 (1.1–2.0)
Diabetes (vs without)	108	42	436	1.4 (1.2–1.8)	1.1 (0.9–1.4)	2.1 (1.5–2.9)	1.3 (0.9–1.8)
Hypertension (vs without)	207	67	987	1.3 (1.1–1.5)	1.1 (0.9–1.3)	1.4 (1.1–1.9)	1.0 (0.7–1.3)
Depressive disorder (vs without)	415	132	1,771	1.5 (1.3–1.6)	1.4 (1.2–1.6)	1.7 (1.4–2.0)	1.4 (1.1–1.7)
≥ 2 comorbidities ^b (vs < 2)	492	185	2,048	1.5 (1.3–1.7)	1.0 (0.9–1.2)	2.2 (1.8–2.6)	1.3 (1.0–1.7)
Material deprivation index							
Q1 (very advantaged)	470	113	3,490	1 [ref]	1 [ref]	1 [ref]	1 [ref]
Q2–Q3–Q4	1,429	407	8,136	1.3 (1.2–1.5)	1.2 (1.1–1.4)	1.5 (1.2–1.9)	1.4 (1.1–1.7)
Q5 (very deprived)	342	111	1,663	1.5 (1.3–1.8)	1.4 (1.2–1.6)	2.0 (1.6–2.7)	1.7 (1.3–2.3)
Social deprivation index							
Q1 (very advantaged)	419	116	2,802	1 [ref]	1 [ref]	1 [ref]	1 [ref]
Q2–Q3–Q4	1,390	397	8,007	1.2 (1.0–1.3)	1.2 (1.0–1.3)	1.2 (1.0–1.5)	1.2 (1.0–1.5)
Q5 (very deprived)	432	118	2,480	1.2 (1.0–1.3)	1.2 (1.0–1.4)	1.1 (0.9–1.5)	1.2 (0.9–1.6)
Vaccination status^c							
Unvaccinated or 1 dose	793	260	2,540	1 [ref]	1 [ref]	1 [ref]	1 [ref]
≥ 2 doses, last ≥ 6 mo prior	677	176	4,029	0.5 (0.5–0.6)	1.4 (1.0–1.8)	0.4 (0.4–0.5)	1.0 (0.6–1.7)
≥ 2 doses, last < 6 mo prior	865	228	7,204	0.4 (0.3–0.4)	1.0 (0.7–1.3)	0.3 (0.2–0.4)	0.7 (0.4–1.1)
Variants							
Ancestral strain	645	205	1,660	2.9 (2.6–3.2)	3.1 (2.3–4.2)	3.5 (2.9–4.2)	2.8 (1.7–4.6)
Alpha, Delta	214	73	1,203	1.3 (1.1–1.5)	1.4 (1.1–1.8)	1.7 (1.3–2.2)	1.5 (1.0–2.3)
Omicron	1,476	386	10,910	1 [ref]	1 [ref]	1 [ref]	1 [ref]

^a Odds ratio adjusted for the variables presented in the table and health regions.

^b Comorbidities: depressive disorder, alcohol abuse, drug abuse, hypertension, chronic lung disease, hypothyroidism, kidney disease, fluid and electrolyte disorders, peripheral vascular disorders, obesity, dementia, cerebrovascular disease, neurological disorders, liver disease, psychosis, pulmonary vascular disorders, rheumatoid arthritis, coagulopathy, weight loss, paralysis, ulcer disease, AIDS/HIV, anaemia, cardiovascular disease, diabetes, immune system problems, cancer.

^c Vaccination status at the onset of the acute episode of COVID-19 infection.

Note: Analysis among respondents who attributed their PCC to their first episode of COVID-19 (cases) and COVID controls. Values in blue indicate statistically significant multivariate associations (p < 0.05).

Abbreviations: PCC: post COVID-19 condition; CI: confidence interval; Chron. resp. disease: chronic respiratory disease; Cardiovas. disease: cardiovascular disease.

Table 5 Multivariate analysis of the association between acute episode severity and the likelihood of developing a post COVID-19 condition, stratified by circulation period of each variant (n = 16,108)

	Overall	Pre-variants of concern period	Alpha, Delta period	Omicron period
	Adjusted OR ^a (95% CI)	Adjusted OR ^a (95% CI)	Adjusted OR ^a (95% CI)	Adjusted OR ^a (95% CI)
Severity of the acute episode				
Hospitalization	14.6 (10.0–21.4)	22.5 (10.2–49.3)	17.4 (6.0–50.7)	12.2 (7.5–19.7)
Outpatient with ≥ 3 severe symptoms	18.2 (13.1–25.5)	19.8 (9.6–40.8)	14.7 (5.8–37.2)	19.0 (12.6–28.7)
Outpatient with 1–2 severe symptoms	6.2 (4.4–8.7)	8.3 (3.9–17.3)	4.1 (1.5–10.8)	6.1 (4.0–9.3)
Outpatient with moderate symptoms	2.6 (1.8–3.7)	2.4 (1.1–5.3)	1.3 (0.4–3.8)	2.8 (1.8–4.3)
Outpatient with mild symptoms	1 [ref]	1 [ref]	1 [ref]	1 [ref]

^a Odds ratios adjusted for age, sex, language, country of birth, race/ethnicity, comorbidities, material and social deprivation indices, vaccination status, health region, and period of circulation (only for the overall analysis).

Note: Analysis among respondents who attributed their post-COVID-19 condition to their first episode of COVID-19 (cases) and COVID controls. **Values in blue indicate statistically significant multivariate associations (p < 0.05).**

Abbreviations: CI: confidence interval; OR: odds ratio.

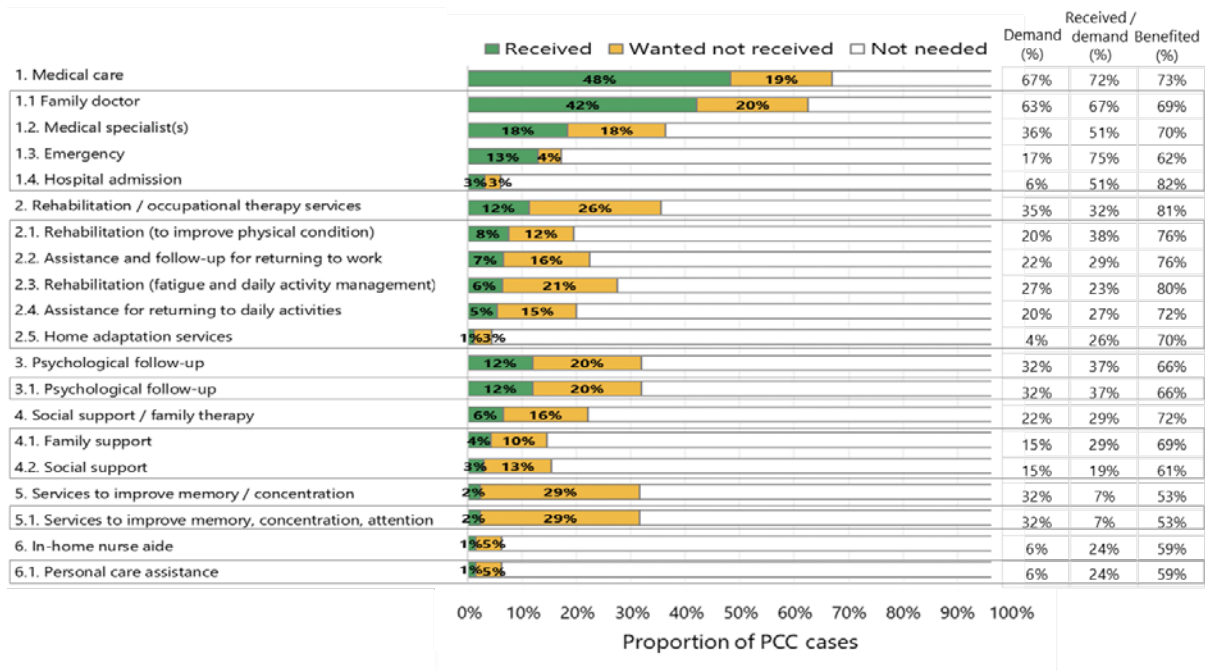
4.7 Medical care to treat PCC symptoms

4.7.1 Care received and care wanted

The questions related to medical care were answered by 2,718 (97.2%) of PCC cases. Two-thirds (67%) reported having wanted medical care, primarily consultations with family doctors (63%) and medical specialists (36%) (Figure 11). About one-third indicated having wanted rehabilitation and occupational therapy services (35%), psychological follow-up (32%), or services to improve memory, concentration, and attention (32%). PCC cases most often received medical care (48%), mainly consultations with their family doctor (42%) followed by consultations with medical specialists (18%), and approximately 70% reported having benefited from these services. However, among PCC cases who reported wanting medical care, one-third did not have access to a family doctor and half did not have access to a medical specialist.

Rehabilitation and occupational therapy services were received by 12% of PCC cases, representing 32% of those who wanted such care. These services were identified as the most beneficial by the majority of participants (81%), especially rehabilitation services to help manage fatigue and daily activities. Psychological follow-up was received by 12% of cases, representing 37% of those who wanted this service. Finally, services aimed at improving memory, concentration, and attention were the least frequently received (2% of PCC cases and 7% of those who wanted them) and were also reported as beneficial by the fewest participants (53%).

Figure 11 Medical care received and care wanted to treat symptoms of post COVID-19 condition



Note: 1) Demand (%) = $n(\text{received} + \text{wanted not received}) / \text{total PCC cases} * 100$
 2) Received / demand (%) = $n(\text{received}) / n(\text{received} + \text{wanted not received}) * 100$
 3) Benefit (%) = $n(\text{received and benefited}) / n(\text{received}) * 100$

Abbreviations: PCC: post COVID-19 condition.

4.7.2 Factors associated with demand for and receipt of medical care

The expressed demand for and receipt of medical care were stratified by the clinical characteristics ([Table 4](#)) and sociodemographic characteristics ([Appendix 2 Table 11](#)) of PCC cases.

The expressed demand for medical care, rehabilitation and occupational therapy services, and psychological follow-up increased with PCC severity. This demand was two to three times higher in cases with severe symptoms (85% and 63% reported wanting medical care and rehabilitation services, respectively) than in those with mild symptoms (48% and 22%, respectively) ([Table 6](#)). Despite this increased demand, the proportion of individuals who reported receiving care among those who wanted it remained similar regardless of PCC severity.

Table 6 Medical care wanted and received according to clinical characteristics of post COVID-19 condition cases

Clinical and socioeconomic characteristics	Total	Medical care				Rehabilitation/occupational therapy services				Psychological follow-up			
		Wanted/ Total	Received/ Total	Received/ Wanted	Benefited/ Received	Wanted/ Total	Received/ Total	Received/ Wanted	Benefited/ Received	Wanted/ Total	Received/ Total	Received/ Wanted	Benefited/ Received
	N	%	%	%	%	%	%	%	%	%	%	%	%
Severity of prevalent PCC symptoms^a	2,310												
Mild	552	47.6%	33.5%	70.3%	75.7%	21.6%	7.2%	33.6%	92.5%	16.8%	6.7%	39.8%	91.9%
Moderate	995	65.2%	45.4%	69.6%	69.2%	38.2%	14.0%	36.6%	81.3%	29.4%	10.2%	34.5%	86.1%
Severe	763	85.1%	63.6%	74.7%	74.4%	63.0%	26.3%	41.8%	80.6%	49.3%	19.0%	38.6%	80.0%
Duration of PCC^b	2,279												
3 – < 12 months	908	60.1%	41.5%	69.0%	74.0%	35.5%	13.3%	37.6%	81.0%	26.9%	10.6%	39.3%	78.1%
12 – < 24 months	729	66.5%	47.9%	72.0%	75.9%	41.2%	13.6%	33.0%	85.9%	30.5%	10.6%	34.7%	85.7%
≥ 24 months	642	79.8%	60.4%	75.8%	69.1%	51.7%	23.1%	44.6%	78.4%	42.7%	15.9%	37.2%	82.4%
Severity of the acute episode^c	2,242												
Hospitalization	154	81.2%	68.2%	84.0%	48.8%	55.2%	24.7%	44.7%	81.6%	39.6%	13.6%	34.4%	66.7%
Outpatient:													
≥ 3 severe symp.	1,483	74.5%	53.2%	71.4%	72.9%	49.2%	18.2%	37.0%	81.1%	37.1%	13.6%	36.5%	83.1%
1–2 severe symp.	431	49.0%	34.3%	70.1%	67.6%	23.0%	10.2%	44.4%	81.8%	20.4%	7.9%	38.6%	79.4%
Mild or moderate symp.	211	48.3%	34.1%	70.6%	66.7%	19.0%	7.6%	40.0%	81.3%	19.4%	9.0%	46.3%	89.5%
Material deprivation index^d	2,609												
Q1 (very advantaged)	563	62.5%	44.0%	70.5%	73.4%	37.8%	15.6%	41.3%	83.0%	31.1%	12.8%	41.1%	81.9%
Q2	628	68.0%	49.8%	73.3%	70.9%	39.5%	15.9%	40.3%	81.0%	31.4%	13.2%	42.1%	81.9%
Q3	553	66.7%	49.4%	74.0%	71.1%	42.9%	14.3%	33.3%	86.1%	34.5%	10.1%	29.3%	87.5%
Q4	469	69.7%	51.4%	73.7%	72.6%	42.0%	15.8%	37.6%	79.7%	30.5%	12.2%	39.9%	75.4%
Q5 (very deprived)	396	68.7%	47.2%	68.8%	74.3%	42.9%	15.7%	36.5%	74.2%	30.6%	10.1%	33.1%	77.5%
Social deprivation index^d	2,609												
Q1 (very advantaged)	494	67.8%	50.6%	74.6%	68.8%	46.0%	15.0%	32.6%	82.4%	33.6%	11.7%	34.9%	79.3%
Q2	545	68.8%	51.9%	75.5%	80.9%	40.9%	16.3%	39.9%	88.8%	29.2%	10.6%	36.5%	82.8%
Q3	535	64.7%	44.7%	69.1%	69.0%	37.4%	15.5%	41.5%	75.9%	28.8%	10.7%	37.0%	86.0%
Q4	542	65.9%	46.7%	70.9%	74.3%	40.2%	15.7%	39.0%	77.6%	33.2%	12.2%	36.7%	80.3%
Q5 (very deprived)	493	67.7%	48.1%	71.0%	66.7%	40.0%	14.6%	36.5%	80.6%	34.1%	14.0%	41.1%	78.3%
Average annual income^e	2,382												
< CAD 60,000	673	72.4%	51.6%	71.3%	72.0%	45.2%	15.3%	33.9%	75.7%	38.0%	12.8%	33.6%	79.1%
CAD 60,000 – < 70,000	692	63.4%	46.4%	73.1%	71.0%	36.3%	13.7%	37.8%	80.0%	28.5%	9.2%	32.5%	81.3%
CAD 70,000 – < 80,000	922	66.8%	49.9%	74.7%	72.4%	41.9%	15.9%	38.1%	84.4%	31.3%	12.5%	39.8%	83.5%
CAD 80,000+	95	51.6%	36.8%	71.4%	85.7%	36.8%	18.9%	51.4%	88.9%	27.4%	15.8%	57.7%	93.3%

^a Among prevalent PCC cases with information on symptom severity

^b Among PCC cases (prevalent or resolved) associated with the first episode

^c Among PCC cases (prevalent or resolved) associated with the first episode and with information on the severity of the acute episode

^d Among PCC cases with information on the deprivation indices

^e Among PCC cases with a job title allowing for estimation of average annual income

Note: Values in blue indicate statistically significant bivariate associations ($p < 0.05$).

Abbreviations: PCC: post COVID-19 condition; symp.: symptoms; Q1–Q5: deprivation quintiles

Regarding PCC duration, the total proportion reporting receipt of care increased only among those with symptoms lasting two years or more (for example, 23% of participants with a duration of two years or more had received rehabilitation services, compared to 13%–14% among those with a duration of less than two years).

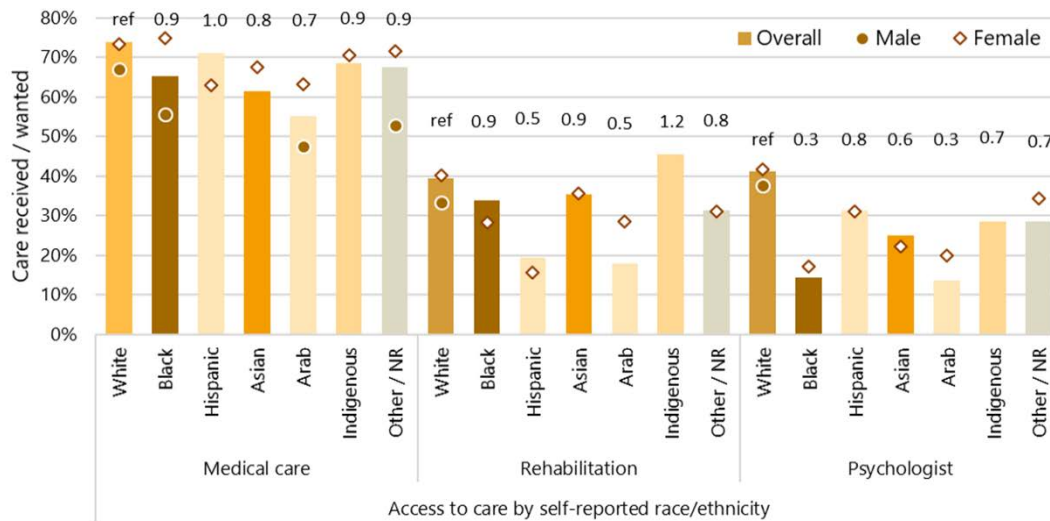
Participants who were hospitalized during the acute episode reported better access to medical care (84% versus 70% for outpatients), but similar access to rehabilitation or psychological services. The demand for care increased with the severity of acute symptoms, presumably due to its association with PCC severity.

With respect to average annual income, individuals in the highest income group ($\geq$ CAD 80,000) reported receiving rehabilitation and psychological follow-up services more often (1.5 and 1.7 times, respectively) than those in the lowest income group. No major differences were observed for access to medical care or across other categories, including material deprivation quintiles.

Several comparisons were made between sociodemographic characteristics and need for and access to medical care. The results presented here are exploratory and should be interpreted with caution ([Appendix 2 – Table 11](#)). Sex, age, and health region of residence did not appear to be associated with demand for and access to medical care. Access to care (received versus wanted) was also similar between those living in small towns or rural areas and residents of metropolitan areas.

Regarding self-reported race/ethnicity, the most pronounced differences were related to access to rehabilitation services (half as frequent among Hispanic or Arab respondents than among white individuals) and access to psychological follow-up (three times less frequent among Black or Arab individuals than among white individuals) ([Figure 12](#)). Women reported having access to medical services more often than men in the categories where comparison was possible (i.e. with more than 15 respondents).

Figure 12 Access to medical care (care received/care wanted) for post COVID-19 symptoms by self-reported race/ethnicity and sex



Note: The values above the bars represent the ratios of each category compared to the reference category (white race, reported by 83% of respondents).

Proportions stratified by sex are shown only when the total number of respondents who requested care in the given category exceeded 15.

5 DISCUSSION

5.1 PCC frequency and progression since the start of the pandemic

In June 2023, the risk of symptoms persisting for three months or more was 16% to 17% among HCWs affected by COVID-19, both among respondents to the telephone survey and respondents to the online survey. The cumulative risk of PCC increased progressively with the number of COVID-19 episodes. However, the prevalence of ongoing symptoms at the time of the survey (prevalent PCC cases) among respondents reached by telephone was roughly half that of electronic questionnaire respondents invited by email (7% vs 15%), which is likely more representative of reality, given the large difference in participation rates (69% vs 6% of those contacted). Based on the telephone survey, in which 20% of respondents reported never having had COVID-19, it can be estimated that approximately 6% of all HCWs in Quebec were experiencing ongoing PCC in summer 2023, representing roughly 24,000 HCWs.

The 16% to 17% risk of PCC among HCWs who had contracted COVID-19 and the 6% prevalence of ongoing PCC among all Quebec HCWs are similar to the respective estimates of 19% and 7% reported by the Canadian COVID-19 Antibody and Health Survey conducted among Canadian adults (10). Systematic reviews have reported PCC risks in COVID-19 cases ranging from 0% to 93%, due to disparities between the populations studied (community, hospitalized cases, outpatient cases), recruitment methods (often subject to selection bias), and how PCC is defined (6,7,19). A subgroup analysis of studies conducted among HCWs reported risks ranging from 21% to 70% (19). In non-hospitalized COVID-19 cases, the PCC risks reported in the literature vary between 10% and 30% (20–22), which is similar to that in our HCW cohort, which consisted primarily of non-hospitalized cases.

The highest risk of developing PCC was observed among HCWs who experienced their first COVID-19 infection early in the pandemic, when the ancestral strain of the virus was circulating (28%), with the risk being lower during the Delta (18%) and Omicron (10%–15%) periods—findings consistent with the literature (20–22). Nonetheless, most PCC cases in this study and elsewhere occurred following Omicron infection, given the large number of individuals infected with this variant. While previously published studies have focused only on the BA.1 and BA.2 subvariants (20,21,23), our study suggests that PCC risk remains similar across all Omicron subvariants, from BA.1 (12%) to XBB (15%).

The increase in cumulative PCC risk with the number of COVID-19 episodes in HCWs is similar to estimates reported in two other studies of confirmed or suspected cases, rising from 13% (one infection) to 23% (two infections) and then 37% (three infections) (10,24). These findings indicate that the risk persists during reinfections, although these data may somewhat overestimate the reality, as they are based on the electronic questionnaire respondents.

5.2 PCC symptoms and severity

Most prevalent PCC cases at the time of the electronic questionnaire reported experiencing fatigue (72%), and about half reported shortness of breath (53%), concentration/memory problems (50% and 48%), and brain fog (44%). These persistent symptoms are also the most frequently reported among PCC patients in a large number of studies (3,18,25–28).

Controls were asked about symptoms present in the two weeks prior to the questionnaire, whereas symptoms for prevalent PCC cases had to have persisted for at least 12 weeks. Despite this major difference in duration, PCC cases reported the listed symptoms 2 to 5 times more often than the controls, and severe symptoms 3 to 20 times more often. These findings are consistent with those reported in the literature. Several studies have compared the frequency of persistent symptoms in PCC cases with that of control groups. Alterations in taste or smell measured by psychophysical assessment one year after SARS-CoV-2 infection was observed three and four times more frequently, respectively, in COVID-19 cases than in non-COVID controls (29). Pronounced cognitive slowing in individuals with PCC was demonstrated in a study comparing these PCC cases with age-matched individuals who had had COVID-19 without persistent symptoms (30). Two large-scale studies based on administrative data on primary care consultations found an increase (between 1.5 and 6 times higher) in the number of consultations for several symptoms among COVID-19 patients compared with matched patients with no history of infection (31,32). In these studies, information was not available on symptom duration and its relationship to COVID-19, but the medical consultations occurred 12 weeks or more after SARS-CoV-2 infection. Another study using electronic health records and follow-up with patients with and without a history of SARS-CoV-2 infection reported a transient increase in mood and anxiety disorder diagnoses (33). The risk of a neurological diagnosis, including cognitive deficit, remained higher in patients who had experienced an episode of COVID-19 than in controls for the two years following the study. However, these three studies present all consultations or all diagnoses following an episode of COVID-19, whereas the participants in our study only reported persistent symptoms subjectively linked to COVID-19.

In PCC cases with a single COVID-19 infection, the average symptom duration was 15 months for PCC prevalent at the time of the questionnaire and seven months for resolved PCC, which is consistent with the durations reported in the Canadian survey by Kuang et al. (10). In our data, some patients appeared to have time-limited PCC, but over half of prevalent cases had symptoms lasting more than one year, and some patients (6%) experienced symptoms for more than three years, suggesting that a proportion of cases may have long-term symptoms. In the referenced Canadian survey, half of cases with ongoing persistent symptoms reported no improvement over time (10). Several studies have shown that in PCC cases with symptoms persisting beyond two years, the most common of these symptoms are fatigue, cognitive impairment, and pain (34). However, little longer-term follow-up data has been published for cases infected with the Omicron variant.

5.3 PCC risk factors

In our sample, PCC risk was higher in women; in HCWs aged 40 to 59 years compared with younger or older individuals; in individuals with chronic respiratory diseases, depressive disorder, and obesity; in certain racial/ethnic minorities; and in individuals experiencing material deprivation. These risk factors have also been described in the literature (23,35–37). The increased risk of PCC among certain racialized minorities and economically disadvantaged individuals has also been reported elsewhere (31,38), although other studies have not identified these associations (37). While biological and genetic factors are likely the main explanation for the increased risk of PCC in some groups, certain social factors may also play a role. For example, in women, it may be at least partly related to the work-family double burden (39), which poses a challenge for rest and recovery. Similarly, in middle-aged individuals, the increased PCC risk may be associated with difficulties balancing professional obligations and personal responsibilities. This could be both a source of stress and a barrier to self-care. These hypotheses cannot be confirmed with our data, but understanding the underlying mechanisms of the higher PCC risk in certain groups could help guide services and support in order to reduce the risk of PCC.

Among the data collected, the severity of the acute episode appears to be the most significant predictive factor of PCC. The increased risk among hospitalized cases, 21% compared to 13% in outpatient cases in our survey, is well documented (7,19,40). Some studies have observed an association with the number and duration of acute symptoms in cohorts that mainly used care beyond outpatient treatment (26,35,41). In our study, participants who experienced an acute episode including three or more severe acute symptoms as outpatients had an adjusted PCC risk 18 times higher than those with only mild acute symptoms. The importance of outpatient episode severity in PCC risk has unfortunately not been systematically described in the literature, nor has the importance of more recent variants.

Vaccination was not associated with protection against PCC in the multivariate analyses. Current evidence is contradictory regarding the protective effect of vaccination (42,43).

5.4 Medical care for PCC symptoms

Care pathways integrating primary care, rehabilitation, and mental health services appear necessary to meet the health needs of individuals with PCC (44,45). Among PCC cases who responded to the survey, the most frequently received type of healthcare was medical care (48%), to which many did not have access, as 67% wanted such care. Access to rehabilitation and psychological follow-up services was even more limited, as these services were wanted by one-third of patients but received by only 12% of cases. Studies conducted in Canada and abroad have also reported that fewer than 50% of cases consulted their doctor, and only 12% of cases among Canadian adults reported having received adequate care (10,45).

5.5 Study strengths and limitations

One of the strengths of this study is that it provides a comprehensive picture of the PCC situation in the Quebec HCW population. More than 22,000 HCWs invited by email responded to the long electronic questionnaire, which made it possible to examine certain PCC risk factors in depth, and will allow, in a future report, a thorough description of the associated functional impairments.

Despite the high absolute number of respondents, the low participation rate (5.7%) is one of the main limitations of this study. The email invitation indicated that completing the electronic questionnaire would take about 30 minutes, which likely discouraged a very large number of HCWs and led to an overrepresentation of HCWs experiencing PCC. It is also possible that very severe PCC cases were underrepresented if they did not participate due to their limited ability to respond to long questionnaires. The telephone validation survey made it possible to estimate this bias and obtain a PCC prevalence at the time of the survey that is representative of all HCWs. HCWs whose native language was neither French nor English are also underrepresented, which may limit generalizations to this group of HCWs.

Another limitation of this study is related to how PCC cases were identified, which was based on symptoms reported by participants and their subjective attribution of these symptoms to a COVID-19 episode. There is no sensitive and specific diagnostic test to confirm PCC. Medical conditions other than PCC that could explain the symptoms were not ruled out, as the participants were not assessed by a health professional. Our approach may overestimate the number of PCC cases, since many PCC symptoms are non-specific and may be wrongly attributed to COVID-19 while having a different etiology. However, this bias appears to be limited based on the comparison between the frequency of symptoms in cases and in controls, which is also a strength of this investigation. As there is no recognized approach for measuring PCC severity, we used a non-validated scale to categorize PCC severity.

Another limitation of self-reported data is the potential for recall bias, which may affect the accuracy of the information collected, including the reported time of COVID-19 onset and number of episodes, the duration of symptoms (especially if they were no longer present), and the attribution of persistent symptoms to the correct COVID-19 episode. This bias appears to be

minor based on the comparable distribution of reported episodes relative to the laboratory registry, as well as the attribution of PCC to the first episode among those who had experienced multiple episodes compared to the risk observed among those who had had a single episode.

The information collected in the questionnaire was not exhaustive. For example, we collected information on the presence and severity of 21 symptoms, while the literature describes over 200 (46). Certain risk factors, such as smoking status, were also not addressed (38,43). However, the symptoms most commonly described in the literature, as well as the main risk factors, were documented in our investigation.

HCWs were targeted because they were easy to contact and were considered a convenience sample representative of the PCC situation among all adults in Quebec. Nonetheless, some caution is required before extrapolating our findings to the general population or to Quebec's overall working population. HCWs were particularly affected by the pandemic due to their work, especially during the first waves, when the risk of PCC was higher due to infection with the ancestral SARS-CoV-2 strain and the absence of vaccines (12,38). In addition, the health workforce is predominantly composed of women (> 80%), and the workload of HCWs was particularly heavy during the pandemic. It is possible that PCC prevalence among HCWs is consequently higher than that of all adults in Quebec's general population. Therefore, any extrapolation to the general population must take into account the proportion of men, minority groups, and individuals with high material deprivation.

6 CONCLUSION

Our results have major public health implications. The number of adults living with PCC is already high when considering its prevalence of approximately 6% of HCWs, more than half of whom have had symptoms persisting over a year. This number will likely continue to increase with ongoing SARS-CoV-2 transmission and the risk of PCC from reinfections. PCC is likely one of the factors contributing to the current challenges faced by employers in Quebec amid labour shortages across several sectors, including health and social services.

The healthcare system will need to adapt to provide care to this “new” patient population that did not exist prior to the pandemic. The health services accessible to patients with PCC will need to expand, especially rehabilitation and psychological support services, as well as primary medical care. To facilitate access to services and navigation of the healthcare system, it will be important not only to train physicians to make accurate PCC diagnoses, but also to improve recognition of PCC and its associated symptoms among rehabilitation professionals and other health and social services professionals, as suggested by a study conducted in Alberta (45). Specific care pathways for interdisciplinary clinical care and post COVID-19 rehabilitation are being developed in Quebec and in other Canadian provinces (47,48), but will need to continue evolving to meet the current and future needs of patients with PCC. An in-depth understanding of the realities of patients and those who work in health and social services in Quebec will be essential to guide or adapt service delivery and symptom management, while taking into account the multidisciplinary nature of PCC management until the research leads to the development of curative treatments. Persistent PCC symptoms are associated with significant work absenteeism, which may require adjustments by insurers and the CNESST.

Currently there is no specific diagnostic test for PCC. The diagnosis is based on the persistence or emergence of symptoms following a SARS-CoV-2 infection in the absence of an alternative diagnosis (2). Confirmation of an acute SARS-CoV-2 infection remains central to establishing a PCC diagnosis. Rapid antigen detection tests for COVID-19 have imperfect sensitivity (false negatives), and access to them has become very limited since the summer of 2023. We can therefore anticipate an additional challenge in establishing the diagnosis for the many Quebecers who will develop PCC over the coming years without having had confirmation of their SARS-CoV-2 infection.

In conclusion, this new condition, which adds to the range of health problems that existed before the pandemic, poses major challenges for the health and social services system in terms of providing a diagnosis and appropriate and accessible rehabilitation services.

7 REFERENCES

1. Nalbandian A, Sehgal K, Gupta A, Madhavan MV, McGroder C, *et al.* Post-acute COVID-19 syndrome. *Nat Med.* 2021 ; 27 (4):601-15.
2. Organisation mondiale de la Santé. Une définition de cas clinique pour l'affection post-COVID-19 établie par un consensus Delphi [Internet]. OMS. 2021 [cité 1 nov 2021] p. 20. Disponible sur : https://www.who.int/fr/publications/i/item/WHO-2019-nCoV-Post_COVID-19_condition-Clinical_case_definition-2021.1
3. Cabrera Martimbianco AL, Pacheco RL, Bagattini ÂM, Riera R. Frequency, signs and symptoms, and criteria adopted for long COVID-19: A systematic review. *Int J Clin Pract.* 2021;75(10):e14357.
4. Du M, Ma Y, Deng J, Liu M, Liu J. Comparison of Long COVID-19 Caused by Different SARS-CoV-2 Strains : A Systematic Review and Meta-Analysis. *International Journal of Environmental Research and Public Health.* 2022;19(23) :16010.
5. Groff D, Sun A, Ssentongo AE, Ba DM, Parsons N, *et al.* Short-term and Long-term Rates of Postacute Sequelae of SARS-CoV-2 Infection : A Systematic Review. *JAMA Network Open.* 2021;4(10):e2128568.
6. Di Gennaro F, Belati A, Tulone O, Diella L, Fiore Bavaro D, *et al.* Incidence of long COVID-19 in people with previous SARS-Cov2 infection : a systematic review and meta-analysis of 120,970 patients. *Intern Emerg Med.* 2023;18(5):1573-81.
7. Chen C, Hauptert SR, Zimmermann L, Shi X, Fritsche LG, Mukherjee B. Global Prevalence of Post COVID-19 Condition or Long COVID autossass: A Meta-Analysis and Systematic Review. *J Infect Dis.* 2022;jiac136.
8. Perlis RH, Santillana M, Ognyanova K, Safarpour A, Lunz Trujillo K, *et al.* Prevalence and Correlates of Long COVID Symptoms Among US Adults. *JAMA Network Open.* 2022;5(10):e2238804.
9. Agence de la santé publique du Canada. COVID-19: Symptômes à long terme chez les adultes canadiens – Rapport Printemps 2023 – Canada.ca [Internet]. 2023 [cité 14 févr 2024]. Disponible sur : <https://sante-infobase.canada.ca/covid-19/syndrome-post-covid/rapport-printemps-2023.html>
10. Kuang S, Earl S, Clarke J, Zakaria D, Demers A, Aziz S. Insights on Canadian Society. 2023 [cité 29 janv 2024]. Experiences of Canadians with long-term symptoms following COVID-19. Disponible sur : <https://www150.statcan.gc.ca/n1/en/pub/75-006-x/2023001/article/00015-eng.pdf?st=Flv9-CF5>
11. De Serres G, Carazo S, Villeneuve J, Laliberté D, Martin R, *et al.* Enquête épidémiologique sur les travailleurs de la santé atteints par la COVID-19: rapport final, Institut national de santé publique du Québec. [Internet]. INSPQ. 2022. Disponible sur : [Enquête épidémiologique sur les travailleurs de la santé atteints par la COVID-19 : rapport final \(inspq.qc.ca\)](https://www.inspq.qc.ca/fr/etudes-et-recherche/etudes-et-recherche-en-cours/enquete-epidemiologique-sur-les-travailleurs-de-la-sante-atteints-par-la-covid-19-rapport-final)
12. Carazo S, Skowronski DM, Laforce R Jr, Talbot D, Falcone EL, *et al.* Physical, Psychological, and Cognitive Profile of Post-COVID Conditions in Healthcare Workers, Quebec, Canada. *Open Forum Infect Dis.* 2022;9 (8):ofac386.

13. Rapport annuel de gestion 2019-2020, Ministère de la Santé et des Services sociaux [Internet]. La Direction des communications du ministère de la Santé et des Services sociaux. [cité 14 févr 2024]. Disponible sur : <https://publications.msss.gouv.qc.ca/msss/document-002682/>
14. Smith N, Donaldson M, Wong G, Conte T, Lakzadeh P, *et al.* COVID-19 living evidence synthesis #11. 1 : Socioeconomic impact of post COVID-19 condition : Final report. Vancouver, Canada : Centre for qazClinical Epidemiology and Evaluation; 2023. Disponible sur : https://sporevidencealliance.ca/wp-content/uploads/2023/02/pcc-socioecon-impacts_les11.1_2023-01-31.pdf
15. Gamache P, Hamel D, Blaser C. (2019) Material and social deprivation index: A summary -INSPQ Website. https://www.inspq.qc.ca/sites/default/files/publications/2639_material_social_deprivation_index.pdf
16. Comité patronal de négociation du secteur de la santé et des services sociaux [Internet]. [cité 29 janv 2024]. Disponible sur : <https://cpnsss.gouv.qc.ca/>
17. Institut national de santé publique du Québec. Données sur les variants du SRAS-CoV-2 au Québec [Internet]. 2022 [cité 1 avr 2022]. Disponible sur : <https://www.inspq.qc.ca/covid-19/donnees/variants>
18. Lopez-Leon S, Wegman-Ostrosky T, Perelman C, Sepulveda R, Rebolledo PA, *et al.* More than 50 long-term effects of COVID-19 : a systematic review and meta-analysis. *Sci Rep.* 2021;11(1):16144.
19. Woodrow M, Carey C, Ziauddeen N, Thomas R, Akrami A, *et al.* Systematic Review of the Prevalence of Long COVID. *Open Forum Infect Dis.* 2023;10(7):ofad233.
20. Antonelli M, Pujol JC, Spector TD, Ourselin S, Steves CJ. Risk of long COVID associated with delta versus omicron variants of SARS-CoV-2. *Lancet.* 2022;399(10343):2263-4.
21. Ballouz T, Menges D, Kaufmann M, Amati R, Frei A, *et al.* Post COVID-19 condition after Wildtype, Delta, and Omicron SARS-CoV-2 infection and prior vaccination: Pooled analysis of two population-based cohorts. *PLoS One.* 2023;18(2):e0281429.
22. Canas LS, Molteni E, Deng J, Sudre CH, Murray B, *et al.* Profiling post-COVID-19 condition across different variants of SARS-CoV-2 : a prospective longitudinal study in unvaccinated wild-type, unvaccinated alpha-variant, and vaccinated delta-variant populations. *Lancet Digit Health.* 2023;5(7):e421-34.
23. Luo J, Zhang J, Tang HT, Wong HK, Lyu A, *et al.* Prevalence and risk factors of long COVID 6–12 months after infection with the Omicron variant among nonhospitalized patients in Hong Kong. *J Med Virol.* 2023;95(6):e28862.
24. Bowe B, Xie Y, Al-Aly Z. Acute and postacute sequelae associated with SARS-CoV-2 reinfection. *Nat Med.* 2022;28(11):2398-405.
25. Iqbal FM, Lam K, Sounderajah V, Clarke JM, Ashrafian H, Darzi A. Characteristics and predictors of acute and chronic post-COVID syndrome: A systematic review and meta-analysis. *EClinicalMedicine.* 2021;36:100899.

26. Domingo FR, Waddell LA, Cheung AM, Cooper CL, Belcourt VJ, et al. Prevalence of long-term effects in individuals diagnosed with COVID-19: an updated living systematic review medRxiv; 2021 juin [cité 14 févr 2024]. Disponible sur : <http://medrxiv.org/lookup/doi/10.1101/2021.06.03.21258317>
27. Enquête canadienne sur la santé et les anticorps contre la COVID-19 (ECSAC) — Cycle 2 [Internet]. [cité 17 oct 2023]. Disponible sur : <https://www.statcan.gc.ca/fr/enquete/menages/5339>
28. Fernández-de-las-Peñas C, Palacios-Ceña D, Gómez-Mayordomo V, Florencio LL, Cuadrado ML, et al. Prevalence of post-COVID-19 symptoms in hospitalized and non-hospitalized COVID-19 survivors: A systematic review and meta-analysis. *Eur J Intern Med*. 2021;92:55-70.
29. Boscolo-Rizzo P, Hummel T, Hopkins C, Dibattista M, Menini A, et al. High prevalence of long-term olfactory, gustatory, and chemesthesis dysfunction in post-COVID-19 patients: a matched case-control study with one-year follow-up using a comprehensive psychophysical evaluation. *Rhinology*. 2021;59(6):517-27.
30. Zhao S, Martin EM, Reuken PA, Scholcz A, Ganse-Dumrath A, et al. Long COVID is associated with severe cognitive slowing: a multicentre cross-sectional study. *eClinicalMedicine*. 2024;68:102434.
31. Subramanian A, Nirantharakumar K, Hughes S, Myles P, Williams T, et al. Symptoms and risk factors for long COVID in non-hospitalized adults. *Nat Med*. 2022;28(8):1706-14.
32. Mizrahi B, Sudry T, Flaks-Manov N, Yehezkelli Y, Kalkstein N, et al. Long covid outcomes at one year after mild SARS-CoV-2 infection: nationwide cohort study. *BMJ*. 2023;e072529.
33. Taquet M, Sillett R, Zhu L, Mendel J, Camplisson I, et al. Neurological and psychiatric risk trajectories after SARS-CoV-2 infection: an analysis of 2-year retrospective cohort studies including 1 284 437 patients. *Lancet Psychiatry*. 2022;9(10):815-27.
34. Fernandez-de-Las-Peñas C, Notarte KI, Macasaet R, Velasco JV, Catahay JA, et al. Persistence of post-COVID symptoms in the general population two years after SARS-CoV-2 infection: A systematic review and meta-analysis. *J Infect*. 2023;S0163-4453(23)00590-X.
35. Sudre CH, Murray B, Varsavsky T, Graham MS, Penfold RS, et al. Attributes and predictors of long COVID. *Nat Med*. 2021;27(4):626-31.
36. Woldegiorgis M, Cadby G, Ngeh S, Korda R, Armstrong P, et al. Long COVID in a highly vaccinated population infected during a SARS-CoV-2 Omicron wave – Australia, 2022 [Internet]. medRxiv; 2023 [cité 29 janv 2024]. p. 2023.08.06.23293706. Disponible sur : <https://www.medrxiv.org/content/10.1101/2023.08.06.23293706v1>
37. Thompson EJ, Williams DM, Walker AJ, Mitchell RE, Niedzwiedz CL, et al. Long COVID burden and risk factors in 10 UK longitudinal studies and electronic health records. *Nat Commun*. 2022;13 (1):3528.
38. Whitaker M, Elliott J, Chadeau-Hyam M, Riley S, Darzi A, et al. Persistent COVID-19 symptoms in a community study of 606,434 people in England. *Nat Commun*. 2022;13(1):1957.

39. Milan A, Keown L, Urquijo Covadonga R. Statistics Canada. Women in Canada: A Gender-based Statistical Report: Families, living arrangements and unpaid work. 2011. Disponible sur : <https://www150.statcan.gc.ca/n1/en/catalogue/89-503-X>
40. O'Mahoney LL, Routen A, Gillies C, Ekezie W, Welford A, *et al.* The prevalence and long-term health effects of Long Covid among hospitalised and non-hospitalised populations: a systematic review and meta-analysis. *eClinicalMedicine*. 2023;55:101762.
41. Bahmer T, Borzikowsky C, Lieb W, Horn A, Krist L, *et al.* Severity, predictors and clinical correlates of Post-COVID syndrome (PCS) in Germany: A prospective, multi-centre, population-based cohort study. *eClinicalMedicine*. 2022;51:101549.
42. Byambasuren O, Stehlik P, Clark J, Alcorn K, Glasziou P. Effect of covid-19 vaccination on long covid : systematic review. *bmjmed*. 2023;2(1):e000385.
43. Tsampasian V, Elghazaly H, Chattopadhyay R, Debski M, Naing TKP, *et al.* Risk Factors Associated With Post-COVID-19 Condition : A Systematic Review and Meta-analysis. *JAMA Intern Med*. 2023;183(6):566.
44. Katz GM, Bach K, Bobos P, Cheung A, Décary S, *et al.* Understanding How Post-COVID-19 Condition Affects Adults and Health Care Systems. *JAMA Health Forum*. 2023;4(7):e231933.
45. Horlick S, Krysa JA, Brehon K, Pohar Manhas K, Kovacs Burns K, *et al.* Exploring Rehabilitation Provider Experiences of Providing Health Services for People Living with Long COVID in Alberta. *Int J Environ Res Public Health*. 2023;20 (24):7176.
46. Davis HE, McCorkell L, Vogel JM, Topol EJ. Long COVID : major findings, mechanisms and recommendations. *Nat Rev Microbiol*. 2023;21(3):133-46.
47. Levin A, Malbeuf M, Hoens AM, Carlsten C, Ryerson CJ, *et al.* Creating a provincial post COVID-19 interdisciplinary clinical care network as a learning health system during the pandemic: Integrating clinical care and research. *Learn Health Syst*. 1 2022;7(1):e10316.
48. Manhas KP, O'Connell P, Krysa J, Henderson I, Ho C, Papathanassoglou E. Development of a Novel Care Rehabilitation Pathway for Post-COVID Conditions (Long COVID) in a Provincial Health System in Alberta, Canada. *Phys Ther*. 2022;102(9):pzac090.

APPENDIX 1 CONFLICTS OF INTEREST

Conflicts of interest

The authors and reviewers of this document declare the following potential conflicts of interest related to the research or the content of this publication:

Sara Carazo	Research grant from the Public Health Agency of Canada (PHAC) for a study on vaccine effectiveness against long COVID.
Simon Décary	Co-Scientific Director, Long COVID Web, pan-Canadian CIHR network. Scientific committee on post COVID-19 condition, World Health Organization. Knowledge Mobilization Committee and Health Care Services & Systems, Social Support group, McMaster CAN-PCC (Public Health Agency of Canada). Consultant for the Ministère de la Santé et des Services Sociaux du Québec.
Emilia Liana Falcone	Research grant from the COVID-19 Immunity Task Force (CITF). Collaboration with the company Bruker Corporation. Member of advisory committees or equivalent: Long COVID Advisory Board, Institut national d'excellence en santé et en services sociaux (INESSS), Subject Matter Expert, Chief Science Advisor Task Force on Post COVID-19 Condition. Subject Matter Expert, Post COVID-19 Condition Round Tables, CIHR and CDA; Steering Committee Member, Biobanque québécoise de la COVID-19.
Anne Bhéreur	Research grants for multiple long COVID studies from the Canadian Institutes of Health Research (CIHR). Member of expert and research committees: Network of specialized clinics for post-infectious syndromes related to long COVID and chronic Lyme disease. Expert committee on post COVID-19 syndrome, Institut national d'excellence en santé et en services sociaux (INESSS). Member of the Health Care Services & Systems, Social Support group of the Canadian Guidelines for Post COVID-19 Condition. Media appearances from 2021 to 2024 (television, radio, print) primarily aimed at raising awareness about long COVID and its challenges, and ways to reduce the risk of SARS-CoV-2 infection/reinfection. Member and patient partner of the Quebec COVID-Pandemic Network (rqcp.ca). Affected by long COVID since a SARS-CoV-2 infection in December 2020.
Alain Piché	Research grants for multiple long COVID studies from the CIHR and from Laurent Pharmaceuticals. Steering Committee Member, Biobanque québécoise de la COVID-19 and member of the diagnosis group of the Canadian Guidelines for Post COVID-19 Condition. Multiple radio and television interviews on long COVID from 2022 to 2024.

The other authors have duly completed their declarations of conflicts of interest and no real, apparent, or potential conflict of interest was found.

APPENDIX 2 ADDITIONAL TABLES

Table 7 Characteristics of all health workers invited by email, participants in the electronic questionnaire, and participants in the telephone questionnaire

Population	All HCWs (invited by email)		Electronic questionnaire participants		Telephone questionnaire participants	
Total N	397,222		22,496		3,930	
	N	%	N	%	N	%
Age (years)						
18–39	178,832	45.0	7,696	34.2	1,820	45.8
40–49	93,038	23.4	6,358	28.3	884	22.2
50–59	77,829	19.6	5,094	22.6	775	19.5
60+	47,523	12.0	3,348	14.9	499	12.5
Sex (Female)	309,300	77.9	18,151	80.7	3,113	78.3
Employment type						
Physician	18,450	4.6	1,178	5.2	177	4.4
Nursing and cardiorespiratory care	103,110	26.0	5,958	26.5	1,057	26.6
Paratechnical, ancillary services, or trades staff	110,885	27.9	3,728	16.6	1,062	26.7
Office staff, technician, or administrative professional	63,558	16.0	3,694	16.4	655	16.7
Health and social services technician or professional	75,763	19.1	5,903	26.2	752	18.9
Management	12,142	3.1	1,257	5.6	128	3.2
Pharmacist	5,574	1.4	237	1.1	69	1.7
Other/DK	7,740	1.9	541	2.4	68	1.7
Comorbidities^a						
At least one comorbidity	161,265	40.6	9,563	42.5	1,653	41.6
At least two comorbidities	60,213	15.2	3,672	16.3	591	14.9
Vaccination against COVID-19 at the time of questionnaire						
0 doses	1,130	0.3	172	0.8	2	0.1
1 dose	5,885	1.5	158	0.7	46	1.2
2 doses	109,203	27.5	3,179	14.1	1,044	26.2
3 or more doses	281,004	70.7	18,987	84.4	2,886	72.5
Health region						
Montréal	84,001	21.1	5,119	22.8	754	19.0
Montréal	67,099	16.9	4,004	17.8	650	16.3
Capitale-Nationale	41,217	10.4	2,745	12.2	422	10.6
Laurentides	29,825	7.5	1,626	7.2	312	7.8
Lanaudière	27,992	7.0	1,311	5.8	294	7.4
Mauricie and Centre-du-Québec	26,455	6.7	1,347	6.0	284	7.1
Estrie	25,304	6.4	1,580	7.0	281	7.1
Chaudières-Appalaches	20,255	5.1	1,101	4.9	206	5.2
Laval	19,103	4.8	950	4.2	163	4.1
Other (< 5%) ^b	55,971	14.1	2,713	12.1	612	15.4

^a Comorbidities: depressive disorder, alcohol abuse, drug abuse, hypertension, chronic lung disease, hypothyroidism, kidney disease, fluid and electrolyte disorders, peripheral vascular disorders, obesity, dementia, cerebrovascular disease, liver disease, psychosis, pulmonary vascular disorders, rheumatoid arthritis, coagulopathy, weight loss, paralysis, ulcer disease, AIDS/HIV, anaemia, cardiovascular disease, diabetes, neurological disorders, immune system problems, cancer.

^b Other health regions: Bas-Saint-Laurent, Saguenay–Lac-Saint-Jean, Outaouais, Laval, and others.

Abbreviations: DK: don't know; HCW: healthcare worker

Note: Values in blue indicate statistically significant bivariate associations ($p < 0.05$): electronic questionnaire participants vs all HCWs, and telephone questionnaire participants vs random sample of non-respondents

Table 8 Risk of PCC and of prevalent severe PCC according to race/ethnicity and material and social deprivation indices, stratified by sex

	Population			Risk of PCC			Risk of severe pPCC		
	Total	Female	Male	Total	Female	Male	Total	Female	Male
	N	N	N	Row %	Row %	Row %	Row %	Row %	Row %
	16,661	13,694	2,967	16.8	17.3	14.2	4.7	4.8	4.3
Race/ethnicity									
White	14,435	11,977	2,368	16.0	16.5	13.4	4.5	4.6	4.1
Arab	283	177	106	21.6	19.8	24.5	9.2	6.2	14.2
Asian	425	348	77	14.8	16.4	7.8	2.8	3.4	0.0
Hispanic	337	241	96	23.1	25.7	16.7	6.5	7.5	4.2
Black	695	517	178	22.6	25.0	15.7	4.9	5.6	2.8
Other/DK	490	361	129	23.3	24.7	19.4	5.3	6.1	3.1
Average annual income^a									
< CAD 60,000	2,928	2,243	685	23.9	25.5	18.7	9.8	10.4	7.9
CAD 60,000 – < 70,000	4,164	3,739	425	17.0	17.0	16.2	3.3	3.2	4.0
CAD 70,000 – < 80,000	6,505	5,488	1,017	14.6	15.1	11.9	3.9	4.1	2.8
≥ CAD 80,000	892	584	308	11.0	11.3	10.4	2.2	2.2	2.3
Material deprivation index^b									
Q1 (very advantaged)	4,089	3,300	789	14.1	14.5	12.4	3.4	3.4	3.5
Q2	3,826	3,191	635	16.8	17.4	13.7	4.3	4.3	4.1
Q3	3,288	2,732	556	17.3	18.0	13.8	4.7	4.8	4.0
Q4	2,768	2,287	481	17.6	18.1	15.0	5.6	5.9	4.4
Q5 (very deprived)	2,088	1,696	392	19.6	20.2	17.1	6.3	6.3	6.4
Social deprivation index^b									
Q1 (very advantaged)	3,317	2,817	500	15.3	16.2	10.8	4.3	4.7	2.4
Q2	3,221	2,713	508	17.4	17.7	15.4	4.5	4.3	5.5
Q3	3,285	2,736	549	16.6	17.3	12.9	4.8	4.8	4.6
Q4	3,211	2,603	608	17.4	18.0	15.0	5.1	5.1	4.9
Q5 (very deprived)	3,025	2,337	688	16.8	17.2	15.6	4.5	4.6	3.9

^a Among PCC cases with a job title excluding the following categories: other health professionals and other health technicians.

^b Among PCC cases with information on the material and social deprivation indices, excluding 836 respondents with missing or unlinked index data.

Abbreviations: PCC: post COVID-19 condition; pPCC: prevalent post COVID-19 condition; CAD: Canadian dollars; DK: don't know; Q1–Q5: quintile

Table 9 Multivariate analysis of risk factors associated with the likelihood of developing post COVID-19 condition, stratified by period of SARS-CoV-2 variant circulation

	Pre-variants of concern period	Alpha, Gamma, or Delta period	Omicron period
	Adjusted OR ^a (95% CI)	Adjusted OR ^a (95% CI)	Adjusted OR ^a (95% CI)
PCC cases (n)	647	214	1,484
COVID controls (n)	1,678	1,215	10,972
Age (years)			
18–39	1 [reference]	1 [reference]	1 [reference]
40–49	1.9 (1.4–2.4)	1.6 (1.1–2.4)	1.6 (1.4–1.9)
50–59	1.9 (1.4–2.5)	2.3 (1.4–3.6)	1.8 (1.5–2.1)
≥ 60	2.4 (1.6–3.5)	1.0 (0.5–2.2)	1.3 (1.1–1.7)
Sex			
Female	1 [reference]	1 [reference]	1 [reference]
Male	0.7 (0.4–1.2)	0.9 (0.4–1.8)	0.9 (0.7–1.2)
Language			
French	1 [reference]	1 [reference]	1 [reference]
English	1.0 (0.7–1.5)	1.2 (0.6–2.2)	1.1 (0.9–1.3)
Place of birth			
Born in Canada	1 [reference]	1 [reference]	1 [reference]
Born outside Canada	1 (0.7–1.5)	1.1 (0.6–1.9)	1.0 (0.8–1.3)
Race/ethnicity			
White	1 [reference]	1 [reference]	1 [reference]
Arab	1.5 (0.7–2.8)	2.9 (1.2–7.4)	1.3 (0.8–2.0)
Asian	0.8 (0.4–1.6)	0.8 (0.2–2.8)	1.2 (0.8–1.8)
Hispanic	1.4 (0.8–2.4)	1.6 (0.6–4.5)	1.4 (0.9–2.1)
Black	1.1 (0.7–1.7)	1.3 (0.7–2.8)	1.5 (1.0–2.0)
Other/DK	1.4 (0.8–2.2)	2.2 (1.1–4.4)	1.9 (1.4–2.5)
Comorbidities			
Chronic respiratory disease (yes vs no)	1.8 (1.3–2.5)	1.4 (0.8–2.5)	1.5 (1.2–1.8)
Cardiovascular disease (yes vs no)	1.1 (0.7–1.7)	2.6 (1.4–5.0)	1.2 (0.9–1.6)
Obesity (yes vs no)	1.6 (1.1–2.3)	0.7 (0.3–1.4)	1.2 (0.9–1.5)
Diabetes (yes vs no)	1.3 (0.8–2.2)	2.1 (1.0–4.4)	0.9 (0.7–1.3)
Hypertension (yes vs no)	1.2 (0.8–1.8)	0.9 (0.4–1.7)	1.1 (0.8–1.3)
Depressive disorder (yes vs no)	1.3 (1.0–1.7)	1.7 (1.1–2.6)	1.3 (1.1–1.6)
≥ 2 comorbidities ^b (vs < 2)	1.0 (0.7–1.5)	0.6 (0.4–1.1)	1.1 (0.9–1.3)
Material deprivation index (quintiles)			
Q1 (very advantaged)	1 [reference]	1 [reference]	1 [reference]
Q2–Q3–Q4	1.1 (0.8–1.4)	1.8 (1.2–2.8)	1.2 (1.1–1.4)
Q5 (very deprived)	1.1 (0.8–1.6)	1.7 (1.0–3.0)	1.5 (1.2–1.8)
Social deprivation index (quintiles)			
Q1 (very advantaged)	1 [reference]	1 [reference]	1 [reference]
Q2–Q3–Q4	1.1 (0.8–1.4)	1.0 (0.7–1.5)	1.3 (1.1–1.5)
Q5 (very deprived)	1.2 (0.9–1.6)	1.0 (0.6–1.7)	1.2 (1.0–1.5)

Table 9 Multivariate analysis of risk factors associated with the likelihood of developing post COVID-19 condition, stratified by period of SARS-CoV-2 variant circulation (continued)

	Pre-variants of concern period	Alpha, Gamma, or Delta period	Omicron period
	Adjusted OR^a (95% CI)	Adjusted OR^a (95% CI)	Adjusted OR^a (95% CI)
PCC cases (n)	647	214	1,484
COVID controls (n)	1,678	1,215	10,972
Vaccination status^c			
Unvaccinated or 1 dose	NA	1 [reference]	1 [reference]
≥ 2 doses, last dose ≥ 6 mo prior	NA	1.4 (0.6–2.8)	1.5 (0.8–2.7)
≥ 2 doses, last dose < 6 mo prior	NA	1.1 (0.7–1.6)	1.0 (0.5–1.9)
Variants			
Omicron BA.1	NA	NA	1 [reference]
Omicron BA.2	NA	NA	0.9 (0.8–1.0)
Omicron BA.4/BA.5	NA	NA	0.9 (0.7–1.0)
Omicron BQ1	NA	NA	1.0 (0.8–1.2)
Omicron XBB	NA	NA	1.2 (0.8–1.8)

^a Odds ratio adjusted for the final model variables and health regions.

^b Comorbidities: depressive disorder, alcohol abuse, drug abuse, hypertension, chronic lung disease, hypothyroidism, kidney disease, fluid and electrolyte disorders, peripheral vascular disorders, obesity, dementia, cerebrovascular disease, neurological disorders, liver disease, psychosis, pulmonary vascular disorders, rheumatoid arthritis, coagulopathy, weight loss, paralysis, ulcer disease, AIDS/HIV, anaemia, cardiovascular disease, diabetes, immune system problems, cancer.

^c Vaccination status at the onset of the acute episode of COVID-19 infection.

Abbreviations: PCC: post COVID-19 condition; CI: confidence interval; NA: not applicable; DK: don't know; OR: odds ratio.

Table 10 Multivariate analysis of risk factors associated with the likelihood of developing post COVID-19 condition, stratified by acute episode treatment type (hospitalized or outpatient)

	COVID cases hospitalized during acute episode	Outpatient COVID cases with one acute episode
	Adjusted OR ^a (95% CI)	Adjusted OR ^a (95% CI)
PCC cases (n)	94	1,411
COVID controls (n)	354	9,780
Age (years)		
18–39	1 [reference]	1 [reference]
40–49	2.0 (1.1–3.5)	1.6 (1.4–1.9)
50–59	3.1 (1.7–5.6)	1.8 (1.5–2.0)
≥ 60	2.8 (1.2–6.3)	1.4 (1.2–1.7)
Sex		
Female	1 [reference]	1 [reference]
Male	2.4 (0.7–7.8)	0.8 (0.6–1.1)
Language		
French	1 [reference]	1 [reference]
English	0.8 (0.2–2.4)	1.1 (0.9–1.3)
Place of birth		
Born in Canada	1 [reference]	1 [reference]
Born outside Canada	1.0 (0.4–2.2)	1.0 (0.8–1.2)
Race/ethnicity		
White	1 [reference]	1 [reference]
Arab	1.8 (0.5–6.8)	1.5 (1.0–2.1)
Asian	1.1 (0.2–4.7)	1.1 (0.8–1.5)
Hispanic	3.8 (0.9–16.1)	1.4 (1.0–1.9)
Black	2.4 (0.9–6.9)	1.2 (1.0–1.6)
Other/DK	3.1 (1.2–8.4)	1.7 (1.3–2.2)
Comorbidities		
Chronic respiratory disease (yes vs no)	1.7 (0.9–3.1)	1.5 (1.3–1.8)
Cardiovascular disease (yes vs no)	1.3 (0.5–3.1)	1.3 (1.0–1.6)
Obesity (yes vs no)	0.8 (0.3–1.7)	1.2 (1.0–1.5)
Diabetes (yes vs no)	1.2 (0.5–2.9)	1.1 (0.9–1.4)
Hypertension (yes vs no)	0.9 (0.5–1.9)	1.1 (0.9–1.3)
Depressive disorder (yes vs no)	1.0 (0.6–1.8)	1.4 (1.2–1.6)
≥ 2 comorbidities ^b (vs < 2)	1.3 (0.7–2.5)	1.0 (0.9–1.2)
Variants		
Pre-variants of concern	5.7 (1.6–20.2)	3.0 (2.2–4.1)
Alpha, Gamma, Delta	2.6 (0.9–7.6)	1.4 (1.1–1.7)
Omicron	1 [reference]	1 [reference]
Material deprivation index (quintiles)		
Q1 (very advantaged)	1 [reference]	1 [reference]
Q2–Q3–Q4	1.6 (0.9–2.7)	1.2 (1.1–1.4)
Q5 (very deprived)	1.7 (0.8–3.5)	1.4 (1.2–1.6)

Table 10 Multivariate analysis of risk factors associated with the likelihood of developing post COVID-19 condition, stratified by acute episode treatment type (hospitalized or outpatient) (continued)

	COVID cases hospitalized during acute episode	Outpatient COVID cases with one acute episode
	Adjusted OR^a (95% CI)	Adjusted OR^a (95% CI)
PCC cases (n)	94	1,411
COVID controls (n)	354	9,780
Social deprivation index (quintiles)		
Q1 (very advantaged)	1 [reference]	1 [reference]
Q2–Q3–Q4	1.1 (0.7–1.9)	1.2 (1.0–1.3)
Q5 (very deprived)	1.1 (0.6–2.3)	1.2 (1.0–1.4)
Vaccination status^c		
Unvaccinated or 1 dose	1 [reference]	1 [reference]
≥ 2 doses, last dose ≥ 6 mo prior	1.8 (0.5–6.3)	1.4 (1.0–1.9)
≥ 2 doses, last dose < 6 mo prior	1.3 (0.4–4.3)	1.0 (0.7–1.3)

^a Odds ratio adjusted for the final model variables and health regions.

^b Comorbidities: depressive disorder, alcohol abuse, drug abuse, hypertension, chronic lung disease, hypothyroidism, kidney disease, fluid and electrolyte disorders, peripheral vascular disorders, obesity, dementia, cerebrovascular disease, neurological disorders, liver disease, psychosis, pulmonary vascular disorders, rheumatoid arthritis, coagulopathy, weight loss, paralysis, ulcer disease, AIDS/HIV, anaemia, cardiovascular disease, diabetes, immune system problems, cancer.

^c Vaccination status at the onset of the acute episode of COVID-19 infection.

Abbreviations: PCC: post COVID-19 condition; CI: confidence interval; NA: not applicable; DK: don't know; OR: odds ratio

Table 11 Medical care requested and received according to sociodemographic characteristics of post COVID-19 condition cases

<i>Sociodemographic characteristics</i>	Total	Medical care				Rehabilitation/occupational therapy services				Psychological follow-up			
		Request ed/Tota l	Receive d/Total	Receive d/Requ ested	Benefite d/Recei ved	Request ed/Tota l	Receive d/Total	Receive d/Requ ested	Benefite d/Recei ved	Request ed/Tota l	Receive d/Total	Receive d/Requ ested	Benefite d/Recei ved
	N	%	%	%	%	%	%	%	%	%	%	%	%
Sex	2,718												
Female	2,305	67.5%	49.8%	73.8%	73.0%	41.3%	15.7%	38.1%	82.4%	32.1%	12.4%	38.5%	82.5%
Male	413	63.7%	40.4%	63.5%	70.1%	37.8%	12.6%	33.3%	75.0%	30.5%	9.4%	31.0%	79.5%
Age	2,718												
18–39 years	809	62.8%	44.3%	70.5%	72.1%	37.7%	12.4%	32.8%	82.0%	34.1%	13.0%	38.0%	84.8%
40–49 years	926	69.9%	51.7%	74.0%	72.2%	43.3%	15.6%	35.9%	79.9%	32.5%	11.4%	35.2%	86.8%
50–59 years	683	69.7%	49.5%	71.0%	71.6%	43.3%	17.4%	40.2%	83.2%	31.5%	12.3%	39.1%	76.2%
≥ 60 years	300	62.3%	46.7%	74.9%	77.9%	35.7%	17.3%	48.6%	80.8%	24.7%	9.7%	39.2%	72.4%
Race/ethnicity	2,718												
White	2,243	66.0%	48.8%	73.9%	72.3%	39.3%	15.5%	39.4%	83.0%	30.9%	12.7%	41.1%	83.5%
Black	149	67.8%	44.3%	65.3%	65.2%	45.6%	15.4%	33.8%	52.2%	32.9%	4.7%	14.3%	57.1%
Hispanic	74	83.8%	59.5%	71.0%	81.8%	48.6%	9.5%	19.4%	100%	43.2%	13.5%	31.3%	90.0%
Asian	62	62.9%	38.7%	61.5%	79.2%	54.8%	19.4%	35.3%	91.7%	32.3%	8.1%	25.0%	80.0%
Arab	55	72.7%	40.0%	55.0%	68.2%	50.9%	9.1%	17.9%	60.0%	40.0%	5.5%	13.6%	0.0%
Indigenous	26	73.1%	50.0%	68.4%	61.5%	42.3%	19.2%	45.5%	60.0%	26.9%	7.7%	28.6%	0.0%
Other/DK/NR	109	70.6%	47.7%	67.5%	82.7%	46.8%	14.7%	31.4%	87.5%	38.5%	11.0%	28.6%	91.7%
Health region	2,718												
Montréal	600	67.8%	47.7%	70.3%	72.0%	42.7%	14.8%	34.8%	78.7%	35.0%	12.5%	35.7%	86.7%
Montréal	537	67.4%	50.3%	74.6%	74.1%	43.4%	17.5%	40.3%	83.0%	35.6%	14.3%	40.3%	77.9%
Capitale-Nationale	295	68.5%	47.5%	69.3%	65.7%	39.3%	15.3%	38.8%	86.7%	31.9%	11.5%	36.2%	88.2%
Estrie	195	63.6%	49.2%	77.4%	69.8%	36.9%	14.9%	40.3%	75.9%	28.2%	9.2%	32.7%	88.9%
Laurentides	193	65.3%	46.6%	71.4%	72.2%	41.5%	14.5%	35.0%	82.1%	27.5%	14.5%	52.8%	85.7%
Rest of Quebec	898	66.5%	48.2%	72.5%	75.1%	39.3%	14.5%	36.8%	81.5%	29.3%	10.2%	35.0%	77.2%

Table 11 Medical care requested and received according to sociodemographic characteristics of PCC cases (continued)

<i>Sociodemographic characteristics</i>	Total	Medical care				Rehabilitation/occupational therapy services				Psychological follow-up			
		Request ed/Tota l	Receive d/Total	Receive d/Requ ested	Benefite d/Recei ved	Request ed/Tota l	Receive d/Total	Receive d/Requ ested	Benefite d/Recei ved	Request ed/Tota l	Receive d/Total	Receive d/Requ ested	Benefite d/Recei ved
Census area	2,718												
Montréal Metropolitan Area	1,388	66.6%	48.4%	72.6%	72.9%	43.2%	15.5%	35.9%	80.5%	35.5%	12.8%	36.1%	83.1%
Other metropolitan areas (> 100,000 inhab.)	687	70.2%	50.1%	71.4%	68.6%	41.6%	16.4%	39.5%	83.2%	29.5%	11.9%	40.4%	80.5%
Cities (10, 000 to 100,000 inhab.)	244	63.5%	45.5%	71.6%	77.5%	37.7%	14.3%	38.0%	71.4%	28.3%	11.1%	39.1%	74.1%
Small towns/rural areas (< 10,000 inhab.)	399	64.2%	47.1%	73.4%	76.1%	33.1%	13.0%	39.4%	88.5%	25.3%	9.3%	36.6%	86.5%
Employment type	2,718												
Physician	95	51.6%	36.8%	71.4%	85.7%	36.8%	18.9%	51.4%	88.9%	27.4%	15.8%	57.7%	93.3%
Nurse/Licensed practical nurse	793	67.6%	49.9%	73.9%	72.2%	38.7%	13.5%	34.9%	81.3%	30.4%	9.7%	32.0%	79.2%
Patient attendant/Nurse aide	316	69.9%	48.4%	69.2%	70.6%	44.9%	15.5%	34.5%	67.3%	38.0%	12.0%	31.7%	78.9%
Psychosocial professional	287	67.6%	51.6%	76.3%	75.0%	42.5%	17.8%	41.8%	82.4%	31.4%	15.3%	48.9%	84.1%
Housekeeping staff	107	68.2%	52.3%	76.7%	71.4%	44.9%	19.6%	43.8%	71.4%	36.4%	14.0%	38.5%	80.0%
Administrator/Manager/Executive	506	67.0%	48.4%	72.3%	70.6%	41.5%	13.4%	32.4%	82.4%	29.1%	10.1%	34.7%	84.3%
Other	614	66.1%	45.9%	69.5%	73.4%	39.9%	16.4%	41.2%	88.1%	33.1%	13.7%	41.4%	82.1%
Average annual income^a	2,382												
< CAD 60,000	673	72.4%	51.6%	71.3%	72.0%	45.2%	15.3%	33.9%	75.7%	38.0%	12.8%	33.6%	79.1%
CAD 60,000 – < 70,000	692	63.4%	46.4%	73.1%	71.0%	36.3%	13.7%	37.8%	80.0%	28.5%	9.2%	32.5%	81.3%
CAD 70,000 – < 80,000	922	66.8%	49.9%	74.7%	72.4%	41.9%	15.9%	38.1%	84.4%	31.3%	12.5%	39.8%	83.5%
CAD 80,000+	95	51.6%	36.8%	71.4%	85.7%	36.8%	18.9%	51.4%	88.9%	27.4%	15.8%	57.7%	93.3%

Table 11 Medical care requested and received according to sociodemographic characteristics of PCC cases (continued)

<i>Sociodemographic characteristics</i>	Total	Medical care				Rehabilitation/occupational therapy services				Psychological follow-up			
		Demand/Total	Received/Total	Received/Demand	Benefited/Received	Demand/Total	Received/Total	Received/Demand	Benefited/Received	Demand/Total	Received/Total	Received/Demand	Benefited/Received
Material deprivation index^b	2,609												
Q1 (very advantaged)	563	62.5%	44.0%	70.5%	73.4%	37.8%	15.6%	41.3%	83.0%	31.1%	12.8%	41.1%	81.9%
Q2	628	68.0%	49.8%	73.3%	70.9%	39.5%	15.9%	40.3%	81.0%	31.4%	13.2%	42.1%	81.9%
Q3	553	66.7%	49.4%	74.0%	71.1%	42.9%	14.3%	33.3%	86.1%	34.5%	10.1%	29.3%	87.5%
Q4	469	69.7%	51.4%	73.7%	72.6%	42.0%	15.8%	37.6%	79.7%	30.5%	12.2%	39.9%	75.4%
Q5 (very deprived)	396	68.7%	47.2%	68.8%	74.3%	42.9%	15.7%	36.5%	74.2%	30.6%	10.1%	33.1%	77.5%
Social deprivation index	2,609												
Q1 (very advantaged)	494	67.8%	50.6%	74.6%	68.8%	46.0%	15.0%	32.6%	82.4%	33.6%	11.7%	34.9%	79.3%
Q2	545	68.8%	51.9%	75.5%	80.9%	40.9%	16.3%	39.9%	88.8%	29.2%	10.6%	36.5%	82.8%
Q3	535	64.7%	44.7%	69.1%	69.0%	37.4%	15.5%	41.5%	75.9%	28.8%	10.7%	37.0%	86.0%
Q4	542	65.9%	46.7%	70.9%	74.3%	40.2%	15.7%	39.0%	77.6%	33.2%	12.2%	36.7%	80.3%
Q5 (very deprived)	493	67.7%	48.1%	71.0%	66.7%	40.0%	14.6%	36.5%	80.6%	34.1%	14.0%	41.1%	78.3%

^a Among PCC cases with a job title excluding the following categories: other health professionals and other health technicians.

^b Among PCC cases with information on material and social deprivation indices.

Abbreviations: PCC: post COVID-19 condition; inhab.: inhabitants; DK: don't know; NR: no response; Q1–Q5: quintiles

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