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Post COVID-19 Condition in Healthcare Workers in Quebec: Functional impact

Phase 1: May–July 2023



VIGIE AND SURVEILLANCE

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EPIDEMIOLOGICAL INVESTIGATION REPORT

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interest. The situations that pose a risk of conflict of
interest and the measures taken are presented in
[Appendix 1](#).

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FOREWORD

The Institut national de santé publique du Québec (INSPQ) is Quebec’s public health expertise and reference centre. Its mission is to support the Ministère de la Santé et des Services sociaux, Quebec’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 functional impact of post COVID-19 condition in health workers.

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 part two 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
CHSLD	residential and long-term care centre [<i>centre d'hébergement et de soins de longue durée</i>]
COPSOQ	Copenhagen Psychosocial Questionnaire
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
PR	prevalence ratio
PSR	psychosocial risk
QICDSS	Quebec Integrated Chronic Disease Surveillance System
RADT	COVID-19 rapid antigen detection test
RPA	private seniors' residence [<i>résidence privée pour aînés</i>]
SARS-CoV-2	severe acute respiratory syndrome coronavirus 2
WAI	Work Ability Index
WHO	World Health Organization
WRFQ	Work Role Functioning Questionnaire

HIGHLIGHTS

An epidemiological investigation was conducted during the summer of 2023 among healthcare workers (HCWs) in Quebec to estimate the frequency of post COVID-19 condition (PCC), its functional impacts, and its progression over a two-year follow-up period. This second report presents the results on the functional impact of PCC from the first phase of the investigation.

- At the time of the investigation, around 6% (24,000) of all HCWs in Quebec were experiencing symptoms of PCC, with mild PCC (24%), moderate PCC (43%), severe PCC (18%), and very severe PCC (15%) according to self-reported symptoms.
- Over 50% of PCC cases reported worse physical performance than before the pandemic. A serious limitation to physical activity (shortness of breath on level ground) was reported by 22% of PCC cases, compared to 3% to 6% of HCWs without PCC.
- Cognitive difficulties in daily activities were reported three times more often by PCC cases than by HCWs without PCC.
- Two-thirds of PCC cases reported psychological distress, compared to one-third of HCWs without PCC. PCC-related distress increased with the severity of the PCC.
- The majority of PCC cases were still in paid employment at the time of the investigation, but 12% had reduced their working hours and 6% had changed to a less demanding job.
- Absences of 25 or more workdays for health-related reasons in the last year were reported by 26% of PCC cases, compared with 10% of HCWs without PCC. Risk of absenteeism exceeding 100 days was associated with the number of PCC symptoms, the presence of fatigue or moderate or severe cognitive symptoms, and history of depressive disorder, chronic lung disease, and diabetes.
- Among HCWs who had been in paid employment over the four prior weeks, PCC cases experienced difficulties meeting work demands an average of 27% of the time, compared to 18% for HCWs without PCC. The risk of experiencing functional difficulties at work was associated with the number of PCC symptoms, the presence of fatigue or cognitive symptoms, female sex, and age below 55 years.
- In summary, all functional impact indicators worsened as the severity of PCC increased. Physical performance and the capacity to meet the physical demands of work were the most strongly affected indicators.
- The work-related psychosocial risk factors most likely to influence work functioning and job retention among HCWs with PCC were: quantitative demands, work-life conflicts, role conflicts, work quality, and recognition.

SUMMARY

Context and objectives

Post COVID-19 condition (PCC), or long COVID, is a chronic post-infectious condition that persists for a minimum of three months and may present as a continuous, intermittent, or progressive illness. It occurs following SARS-CoV-2 infection, affects one or more organ systems, and is characterized by persistent symptoms such as severe fatigue, shortness of breath, post-exertional malaise, pain, and cognitive problems. PCC has a significant impact on work functioning and on personal and social life. Its impacts are expected to be of major significance for healthcare workers (HCWs) in Quebec, given the presence of work-related psychosocial risks in this sector of activity and the challenges the sector faces.

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 a legal mandate to conduct an epidemiological investigation of HCWs in Quebec to assess the frequency of PCC, its functional impacts, and its progression over a two-year follow-up period.

The first phase of the investigation was conducted in the summer of 2023. An initial [report](#), published in October 2024, presented the findings relating to PCC frequency, its risk factors, and related healthcare. The present report describes the findings relating to the functional impact of PCC to address the following objectives:

1. Describe the impact of PCC on the overall functioning of HCWs
2. Assess the impact of PCC on HCWs' professional activities
3. Determine the role of work-related psychosocial risks in the association between PCC and work functioning

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 target population consisted of HCWs who were working or had worked during the pandemic in the health and social services network. This included HCWs in public or private healthcare settings, who were either listed on the payroll of MSSS healthcare facilities or registered with one of six professional orders, totalling approximately 400,000 individuals. The HCWs were invited to complete an electronic questionnaire. In addition to sociodemographic, employment, and clinical data, the following impact measures were collected: difficulty with exertion (assessed using the modified Medical Research Council dyspnea scale), cognitive impairments in daily activities, psychological distress (assessed using the Kessler scale), work participation, absenteeism, work modifications due to PCC, work ability (assessed using five questions from the Work Ability Index), work functioning (measured with the Work Role

Functioning Questionnaire), and work-related psychosocial risks (measured using 22 items from the Copenhagen Psychosocial Questionnaire).

PCC cases were defined as HCWs who had had at least one episode of COVID-19 and reported symptoms lasting 12 weeks or more following a COVID-19 episode. The reported severity of persistent symptoms was used to classify PCC into four categories: mild, moderate, severe, and very severe.

Exertional capacity, cognitive impairments in daily life, absenteeism, work ability, and work functioning among PCC cases were compared with those of COVID controls (individuals who had had COVID-19 without any persistent symptoms) and non-COVID controls (individuals reporting never having had COVID-19).

Results

Of the 397,222 HCWs invited to participate, 21,518 completed the electronic questionnaire and were included in the analysis of PCC frequency presented in the first report. For the analyses on functional impact, students, PCC cases without prevalent symptoms at the time of the survey, and respondents who did not complete any section on functional impact were excluded, leaving 19,346 HCWs. Among them, 2,112 had PCC symptoms, of whom 24%, 43%, and 33% were classified as having mild, moderate, and severe/very severe PCC, respectively.

PCC cases reported physical performance before the pandemic similar to that of controls. At the time of the survey, two-thirds of PCC cases reported a decline in their performance, compared with less than one-third of controls. A serious limitation to physical activity (shortness of breath on level ground) was reported by 22% of PCC cases (between 7% and 57%, depending on severity), compared to 3% to 6% of controls.

Cognitive difficulties in daily activities were reported three times more frequently by PCC cases than controls. Among PCC cases, 35% reported often or very often experiencing concentration or attention problems, a proportion that increased to 70% among very severe PCC cases.

One-third of controls reported experiencing psychological distress, compared to two-thirds of PCC cases, 24% of whom attributed this distress to PCC. PCC-related distress increased with the severity of the PCC: from 11% among mild cases to 44% among the very severe cases.

The majority of PCC cases (88%) were still in paid employment at the time of the survey, but it was not possible to determine from the information collected whether the HCWs were present at work, on leave, or receiving disability benefits. Overall, 8% of PCC cases had stopped working, 12% had reduced their working hours, and 6% had changed to a less demanding job. Work participation decreased as severity increased. Among very severe PCC cases, over 50% had stopped working or changed their job due to their illness, and 37% reported health-related absences of 100 or more workdays over the past year.

The vast majority of PCC cases and controls considered their work ability to be very good or excellent before the pandemic. However, at the time of the survey, these proportions had dropped, most notably among cases (49%), but also among COVID controls (82%) and non-COVID controls (74%). PCC cases reported a similar decline in their ability to meet both the mental and physical demands of their work.

Among HCWs who had been in paid employment over the four prior weeks, PCC cases experienced difficulties meeting work demands an average of 27% of the time, compared to 18% for HCWs without PCC. This difficulty increased with PCC severity: from twice as high as in controls for mild PCC cases to 22 times higher for very severe cases.

In summary, all functional impact indicators worsened as the severity of PCC increased. Physical performance and the capacity to meet the physical demands of work were the most strongly affected indicators.

In the multivariate analyses of PCC cases who were in paid employment, the number of symptoms, the presence of moderate or severe fatigue or cognitive symptoms, a history of depressive disorder, chronic lung disease, diabetes, female sex, and age below 55 years were factors associated with a risk of over 100 days of absenteeism and/or a risk of experiencing work functioning difficulties more than 10% of the time.

Among all HCWs, the work-related psychosocial risks most strongly negatively correlated with work functioning were: quantitative and emotional demands, work-life conflict, and role conflicts. Conversely, the ability to perform one's tasks with satisfactory quality and recognition for one's work showed a positive correlation. The factors most likely to influence work functioning among PCC cases were: quantitative demands, work-life conflicts, and recognition.

Discussion and conclusion

PCC has a significant impact on the overall functioning of affected individuals, as well as on their work participation and ability. Across all studied dimensions, the effect of PCC increases with symptom severity, and cases with moderate and severe symptoms are responsible for the burden of disease in terms of functional impact. Among individuals with PCC who are returning to work, a considerable number need to modify their tasks or adjust their work schedules to accommodate persistent impairments. Factors such as physical workplace accommodations, support policies, vocational rehabilitation programs, and appropriate insurance frameworks play a critical role in facilitating a successful return to work.

1 INTRODUCTION

1.1 Context

In 2021, the World Health Organization (WHO) defined post COVID-19 condition (PCC, also known as long COVID) as a constellation of clinical symptoms that persist more than three months after a probable or confirmed SARS-CoV-2 infection (1). According to the 2024 definition by the National Academies of Sciences, Engineering, and Medicine (NASEM), long COVID is an infection-associated chronic condition that occurs after SARS-CoV-2 infection and is present for at least three months as a continuous, relapsing and remitting, or progressive disease state that affects one or more organ systems (2). Individuals affected by PCC present varied persistent symptoms that primarily include severe fatigue, dyspnea (difficulty breathing), post-exertional malaise, muscle and joint pain, neurological disorders, and cognitive problems (“brain fog”) (3,4). In Quebec, the risk of PCC among healthcare workers (HCWs) was approximately 15% among individuals who had had COVID-19, according to the results of the most recent epidemiological investigation conducted in the summer of 2023 (5).

A recent systematic review showed the significant impact of PCC on return to work and work ability, but primarily included studies on patients hospitalized during an acute episode of PCC (6). The Canadian COVID-19 Antibody and Health Survey, conducted in 2023, reported that 22% of Canadians with persistent post-COVID-19 symptoms had missed work due to their symptoms, but the report did not specify the symptoms’ severity or characteristics (7).

The functional impacts of PCC may be of major significance to affected individuals, particularly HCWs, considering the significant presence of work-related psychosocial risks (PSRs) in this sector and the challenges facing the health and social services field (e.g. staff shortages).

On December 20, 2022, Dr. Luc Boileau, 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. An initial report, publicly released in October 2024, discusses PCC frequency, its risk factors, and related healthcare (5). The present report describes the main findings related to the functional impact of PCC in professional and personal spheres.

2 OBJECTIVES

2.1 General objective

The general objective of this report is to assess the functional impact of PCC based on data collected in the first phase of the investigation on HCWs between May and August 2023.

2.2 Specific objectives

1. Describe the impact of PCC on the overall functioning of HCWs;
2. Assess the impact of PCC on HCWs' professional activities;
3. Determine the role of work-related psychosocial risks in the association between PCC and work functioning.

3 METHODOLOGY

The methodology and findings of the first phase of the investigation regarding PCC frequency, risk factors, and related healthcare are detailed in the first report (5). In this section, we will present the methodological aspects related to the analyses of the functional impact of PCC.

3.1 Survey design

This first phase of the investigation used a cross-sectional survey design. The data from this phase will serve as a starting point for the planned prospective evaluation at the second and third measurement points (one year apart) with participants in the first questionnaire.

3.2 Study population

3.2.1 Population

The investigation targeted nearly 400,000 HCWs in Quebec who were working or had worked during the pandemic in the health and social services network. The inclusion criteria required that participants be 18 years of age or older, be able to communicate in French or English, reside in Quebec, and be or have been listed—from the beginning of 2020—on the payroll of MSSS healthcare facilities or registered with one of six professional orders representing physicians, nurses, licensed practical nurses, respiratory therapists, pharmacists, and midwives. Other professions were included only if the personnel performed their duties at a public institution. To be included in the analysis, the HCWs had to have completed the electronic questionnaire (see next section). Individuals who identified as students or interns were excluded from the analysis on the functional impact of PCC.

3.2.2 Definition of PCC cases and controls

The HCWs were classified into three groups:

1. **PCC cases:** HCWs who reported having had at least one COVID-19 episode and symptoms lasting at least 12 weeks (≥ 84 days) following a COVID-19 episode. Only PCC cases who still had symptoms at the time of the survey were included in the analyses reported here;
2. **Non-COVID controls:** HCWs who reported never having had COVID-19;
3. **COVID controls:** HCWs who reported having had at least one COVID-19 episode but symptoms lasting less than 12 weeks following each episode.

3.3 Data collection and study procedure

3.3.1 Data sources

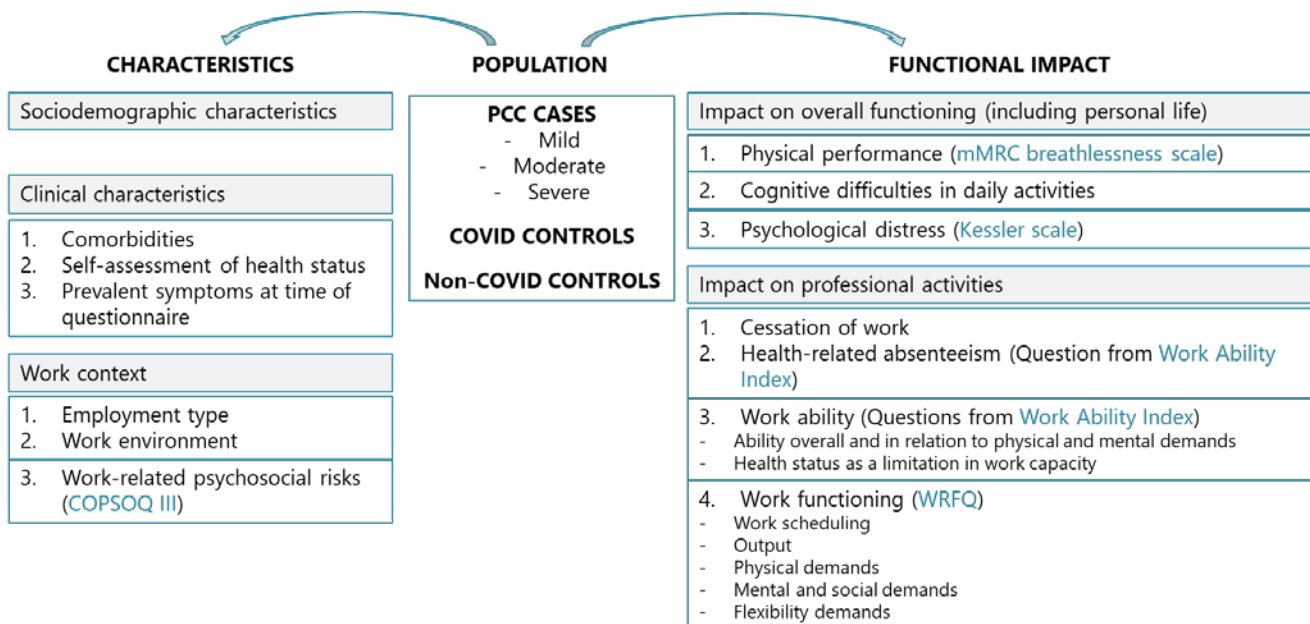
The principal data source was a self-administered electronic questionnaire on the secure platform REDCap. It collected clinical data for each COVID-19 episode, on PCC (if present), and on physical performance, cognitive functioning in daily activities, work ability, work functioning, psychological distress, and employment characteristics for all participants (cases and controls).

These data were matched with those in the Quebec Integrated Chronic Disease Surveillance System (QICDSS), which provided sociodemographic characteristics and information on comorbidities.

3.3.2 Information collected

Figure 1 summarizes all of the information collected.

Figure 1 Information collected for cases and controls



Abbreviations: COPSOQ III: third version of the Copenhagen Psychosocial Questionnaire; mMRC: modified British Medical Research Council; PCC: post COVID-19 condition; WRFQ: Work Role Functioning Questionnaire

The following variables were analyzed:

1. **Sociodemographic data** like age, sex, health region (HR) of residence, place of birth (in or outside Canada), race/ethnicity, material deprivation index, and social deprivation index.
2. **Employment data** such as current work status, job type, and work environment. Job types were grouped into three categories according to the nature of their tasks:
 - Category 1: Nursing and licensed practical nursing staff, physicians, psychosocial professionals, and other types of health professionals;
 - Category 2: Patient attendants, nurse aides, housekeeping staff, and other health technicians;
 - Category 3: Administrative staff and managers.
3. **PCC severity**: As there is currently no recognized definition, severity was classified into four categories based on the severity of symptoms following a SARS-CoV-2 infection as reported in the electronic questionnaire:
 - Mild PCC: presence of mild symptoms only;
 - Moderate PCC: presence of at least one moderate symptom but no severe symptoms;
 - Severe PCC: presence of one or two severe symptoms;
 - Very severe PCC: presence of at least three severe symptoms.
4. **Perception of general health status**, before the pandemic and at the time of the survey.
5. **Difficulty with exertion** before the pandemic and at the time of the survey: assessed using the modified Medical Research Council dyspnea scale (“mMRC breathlessness scale”) (8). This scale measures the degree of activity at which a person experiences breathlessness. Higher scores correspond to greater severity (values from 1 to 5).
6. **Cognitive impairments in daily activities** were measured using four questions assessing attention span, organization, memory problems, and loss of necessary items. These questions have already been used with a cohort of HCWs and have shown a correlation with PCC and with psychological distress (9).
7. **Psychological distress** was assessed with the six-item Kessler scale (K6), which aims to identify depressive and anxiety symptoms experienced over the prior four weeks (10). The 6 questions are scored on a scale from 0 to 4 points, for a maximum of 24 points. Psychological distress is considered high at a score of 7 points or more and very high at over 13 points. An additional question verified the respondent’s perceived link between the distress and their current main job, persistent COVID-19 symptoms, and/or personal life.
8. **Work participation**: Defined as being in paid employment at the time of the questionnaire and for the four weeks prior (two questions).

9. **Absenteeism and work modifications:** Health-related absenteeism over the last year was measured among all participants using a question from the Work Ability Index (WAI) (11). Cessation of work or modifications to one’s work schedule or job type due to PCC were documented for PCC cases through the questionnaire.
10. **Work ability** before the pandemic and at the time of the survey was assessed using five questions taken from the WAI. The various items of this instrument have been considered valid and reliable in the occupational health context for more than 20 years (11–13), and have already been used to assess the impact of PCC (14). As the questions on mental resources were not included in the questionnaire, the overall WAI score was not calculated. A score was constructed to measure work ability using the following items: overall work ability (0 to 10 points), work ability in relation to physical demands (1 to 5), and work ability in relation to mental demands (1 to 5).
11. **Work functioning** was measured using the Work Role Functioning Questionnaire (WRFQ) among individuals who had been in paid employment during the four prior weeks. The WRFQ makes it possible to assess the impact of health problems on work performance by quantifying the percentage of time during which the HCW experiences difficulties meeting work demands (15). This questionnaire includes 27 questions with 5 response options ranging from “difficult all the time” (0 points = 100%) to “difficult none of the time” (4 points = 0%), as well as a response option for situations in which the question does not apply to the respondent’s work. Five dimensions of work functioning over the prior four weeks are assessed: (1) work scheduling demands, (2) output demands, (3) physical demands, (4) mental and social demands, and (5) flexibility demands (Appendix – [Table 15](#)). A French-language cross-cultural adaptation was developed in 2004 for 22 of the 27 items (16). The five remaining items underwent double back-translation to ensure the linguistic accuracy of the adaptation (17).
12. **Work-related psychosocial risks** are factors that relate to work organization, employment conditions, management practices, and social relations, and that increase the likelihood of adverse health effects for exposed individuals (18). They are measured using 22 items from the third version of the Copenhagen Psychosocial Questionnaire (COPSOQ III) (19), on 5-choice response scales (indicating frequency or intensity of exposure), and refer to the following 4 domains (details in [Table 16](#) in the appendix):
- Demands at Work: (1) Quantitative Demands, (2) Work Pace, (3) Emotional Demands;
 - Work Organization and Job Contents: (4) Influence at Work, (5) Quality of Work;
 - Interpersonal Relations and Leadership: (6) Recognition, (7) Role Conflicts, (8) Social Support from Colleagues, (9) Social Support from Supervisor;
 - Work–Individual Interface: (10) Job Insecurity, (11) Job Satisfaction (salary), (12) Work-Life Conflict.

At present, there is no established threshold for COPSOQ III indicators, which are treated as continuous variables. For an exploratory analysis, we also categorized them into the following levels: high (≥ 75 points), moderate (26–74 points), and low (≤ 25 points). Depending on the indicator, these levels reflect an unfavourable situation (e.g. high quantitative demands) or a favourable situation (e.g. high level of influence at work, high level of recognition at work).

3.4 Statistical analysis

3.4.1 Functional impacts of PCC

Exertional capacity, cognitive impairments in daily life, absenteeism, work ability, and work functioning among PCC cases were compared with those of COVID controls and non-COVID controls using univariate descriptive analyses. For the multivariate regression analyses, the functional work impact outcomes examined were: a) long-term absenteeism, defined as 100 workdays or more of health-related absence; and b) presenteeism or suboptimal work functioning, measured with the WRFQ and defined as difficulty meeting work demands 10% or more of the time at work (WRFQ < 90%). This cutoff is based on the literature (20,21), and we also used as a complement the score WRFQ < 75%, which is close to the mean WRFQ score measured in our population. The association between PCC and these outcomes was assessed by comparing PCC cases and COVID controls. Prognostic clinical, sociodemographic, and employment factors for long-term absence and suboptimal work functioning were assessed by exclusively including individuals with PCC. Relative risks were estimated using odds ratios (ORs) and their 95% confidence intervals (CIs). Compliance with the assumptions of linearity, independence, multicollinearity, and overdispersion were verified for each regression model. These analyses were stratified according to the three predefined job categories.

The association between work-related PSRs and work functioning was examined using descriptive analyses and multivariate regression models of PCC cases according to illness severity.

3.5 Ethics

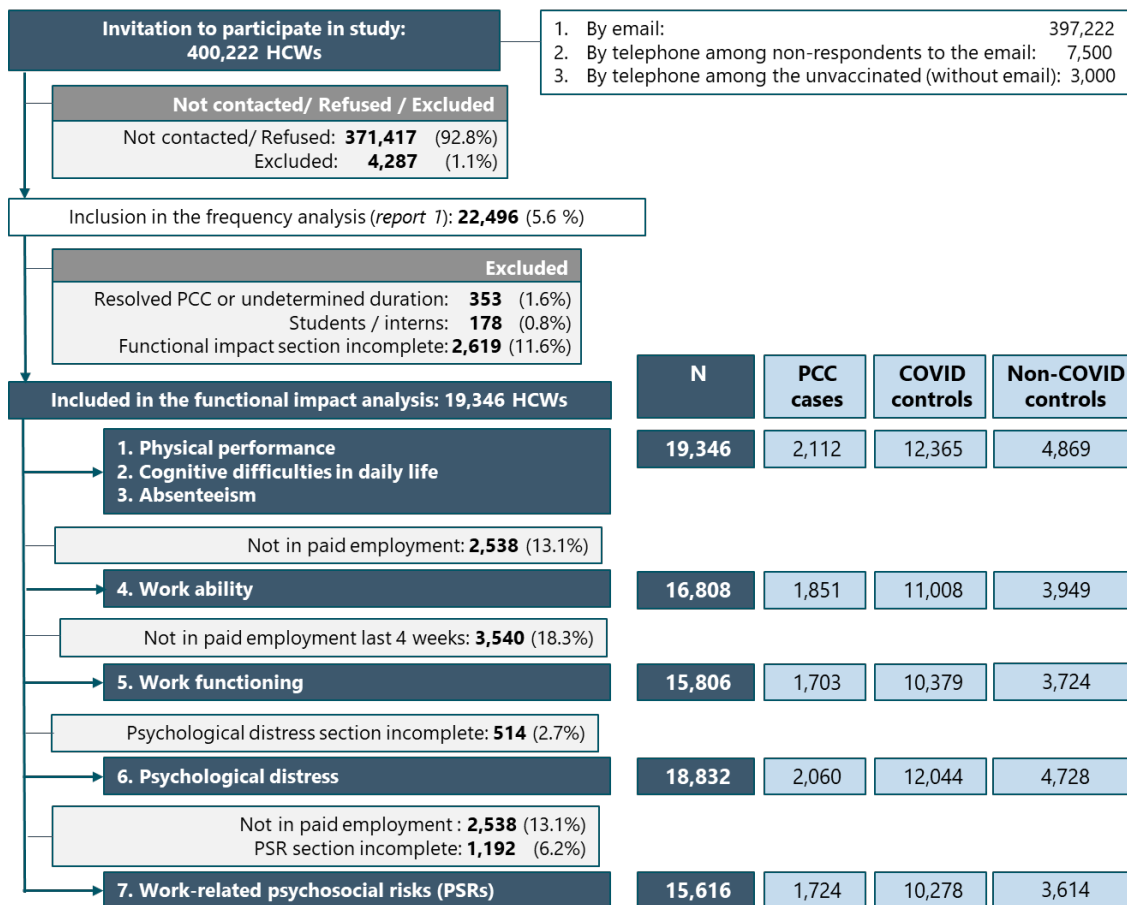
This epidemiological study was conducted by the INSPQ in collaboration with the CHU de Québec–Université Laval Research Center as part of an epidemiological investigation mandate from Quebec's National Director of Public Health under Quebec's Public Health Act. The project was approved by the research ethics committee of the CHU de Québec–Université Laval and an electronic consent form was signed by all participants.

4 RESULTS

4.1 Population

The population that was invited to participate in the electronic survey and participated is described in the first report (5). In summary, 397,222 HCWs received an email invitation to participate in the study. In addition, 7,500 HCWs who did not respond to the email and 3,000 unvaccinated HCWs for whom an email address was not available were invited by telephone. Among them, 371,417 (92.8%) did not respond, could not be contacted (invalid email address or phone number), or refused to participate, and 4,787 (1.1%) were excluded, leaving 21,518 (5.4%) HCWs included in the analysis of PCC frequency presented in the first report. Additional exclusions for the analyses of the functional impacts of PCC included students (178; 0.8%), participants whose PCC had resolved by the time of the survey or had an undetermined duration (353; 1.6%), and those who did not complete any section on functional impact (2,619; 11.6%).

Figure 2 Participation diagram



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

According to the sections of the questionnaire that were completed and whether the participant was in paid employment at the time of the survey (a necessary condition for the questions from the WAI and from the WRFQ and COPSOQ III questionnaires), between 15,616 HCWs (including 1,724 PCC cases) and 19,346 HCWs (including 2,112 PCC cases) were included in the analyses (Figure 2).

4.2 Sociodemographic and employment characteristics

Among respondents with prevalent PCC at the time of the survey, 85% were female, compared with 81% of COVID controls and 76% of non-COVID controls (Table 1). The average age of PCC cases (46.4 years) was similar to that of the COVID controls (44.7 years) and of non-COVID controls (49.6 years). With respect to employment type, category 1 (representing mainly nursing staff) accounted for 57% of PCC cases, 62% of COVID controls, and 53% of non-COVID controls. Job category 2 (representing mainly patient attendants) accounted for 25% of PCC cases, 18% of COVID controls, and 24% of non-COVID controls. Category 3, administrative staff and managers, accounted for 18% of PCC cases, 20% of COVID controls, and 24% of non-COVID controls. More than 40% of PCC cases and controls worked in hospitals, followed by in clinics and residential and long-term care centres (CHSLDs).

Half of PCC cases, 40% of COVID controls, and 45% of non-COVID controls had at least one comorbidity according to QICDSS administrative data, based on diagnoses recorded up to March 31, 2021. A history of depressive disorder was the most frequent comorbidity for all groups.

Table 1 Sociodemographic and employment characteristics of participants

	Total PCC cases		Mild PCC cases		Moderate PCC cases		Severe or very severe PCC cases		COVID controls		Non-COVID controls	
	N	%	N	%	N	%	N	%	N	%	N	%
<i>Number of participants</i>	2,112		508		902		702		12,365		4,869	
Age (years)												
Mean (SD)	46.4 (11.0)		45.4 (10.6)		46.7 (11.1)		46.7 (11.2)		44.7 (12.1)		49.6 (12.9)	
18–44	971	46.0	263	51.8	401	44.5	307	43.7	6,566	53.1	1,735	35.6
45–54	623	29.5	137	27.0	267	29.6	219	31.2	2,955	23.9	1,212	24.9
≥ 55	518	24.5	108	17.4	234	23.1	176	21.5	2,844	17.9	1,922	32.0
Sex (Female)	1,792	84.8	430	84.6	779	86.4	583	83.0	10,058	81.3	3,692	75.8
Born in Canada	1,792	84.8	437	86.0	765	84.8	590	84.0	10,701	86.5	3,857	79.2
Race/ethnicity												
White	1,791	84.8	445	87.6	752	83.4	594	84.6	10,853	87.8	3,892	79.9
Black	81	3.8	18	3.5	38	4.2	25	3.6	425	3.4	420	8.6
Asian	38	1.8	11	2.2	20	2.2	7	1.0	318	2.6	144	3.0
Arab	38	1.8	5	1.0	13	1.4	20	2.8	180	1.5	132	2.7
Hispanic	57	2.7	14	2.8	24	2.7	19	2.7	223	1.8	66	1.4
Other/DK/NR	107	5.1	15	3.0	55	6.1	37	5.3	366	3.0	215	4.4

Table 1 Sociodemographic and employment characteristics of participants (continued)

	Total PCC cases		Mild PCC cases		Moderate PCC cases		Severe or very severe PCC cases		COVID controls		Non-COVID controls	
	N	%	N	%	N	%	N	%	N	%	N	%
<i>Number of participants</i>	2,112		508		902		702		12,365		4,869	
HR												
Montréal	451	21.4	109	21.5	208	23.1	134	19.1	2,637	21.3	1,260	25.9
Montérégie	419	19.8	101	19.9	179	19.8	139	19.8	2,181	17.6	867	17.8
Capitale-Nationale	228	10.8	48	9.4	110	12.2	70	10.0	1,625	13.1	523	10.7
Laurentides	148	7.0	40	7.9	59	6.5	49	7.0	907	7.3	350	7.2
Estrie	160	7.6	41	8.1	65	7.2	54	7.7	877	7.1	354	7.3
Other	706	33.4	169	33.3	281	31.2	256	36.5	4,138	33.5	1,515	31.1
Employment type												
Nursing staff	463	21.9	123	24.2	236	26.2	104	14.8	2,597	21.0	903	18.5
Licensed practical Nursing staff	141	6.7	31	6.1	45	5.0	65	9.3	504	4.1	199	4.1
Physician	76	3.6	23	4.5	35	3.9	18	2.6	722	5.8	267	5.5
Psychosocial pros.	213	10.1	62	12.2	91	10.1	60	8.5	1,259	10.2	336	6.9
Other health pros.	313	14.8	96	18.9	132	14.6	85	12.1	2,541	20.5	866	17.8
PA/Nurse aide	302	14.3	42	8.3	102	11.3	158	22.5	1,045	8.5	556	11.4
Housekeeping	57	2.7	10	2.0	22	2.4	25	3.6	256	2.1	168	3.5
Other health technicians	164	7.8	36	7.1	77	8.5	51	7.3	981	7.9	422	8.7
Admin/Managers	383	18.1	85	16.7	162	18.0	136	19.4	2,460	19.9	1,152	23.7
Comorbidities^a												
None	1,042	49.3	289	56.9	446	49.4	307	43.7	7,367	59.6	2,703	55.5
At least two	486	23.0	86	16.9	197	21.8	203	28.9	1,965	15.9	942	19.3
Most frequent comorbidities												
Depressive disorder	403	19.1	71	14.0	186	20.6	146	20.8	1,561	12.6	581	11.9
Chronic lung disease	252	11.9	42	8.3	101	11.2	109	15.5	947	7.7	396	8.1
Cardiovascular disease	114	5.4	22	4.3	42	4.7	50	7.1	489	4.0	233	4.8
Obesity	159	7.5	24	4.7	65	7.2	70	10.0	596	4.8	248	5.1

^a 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.

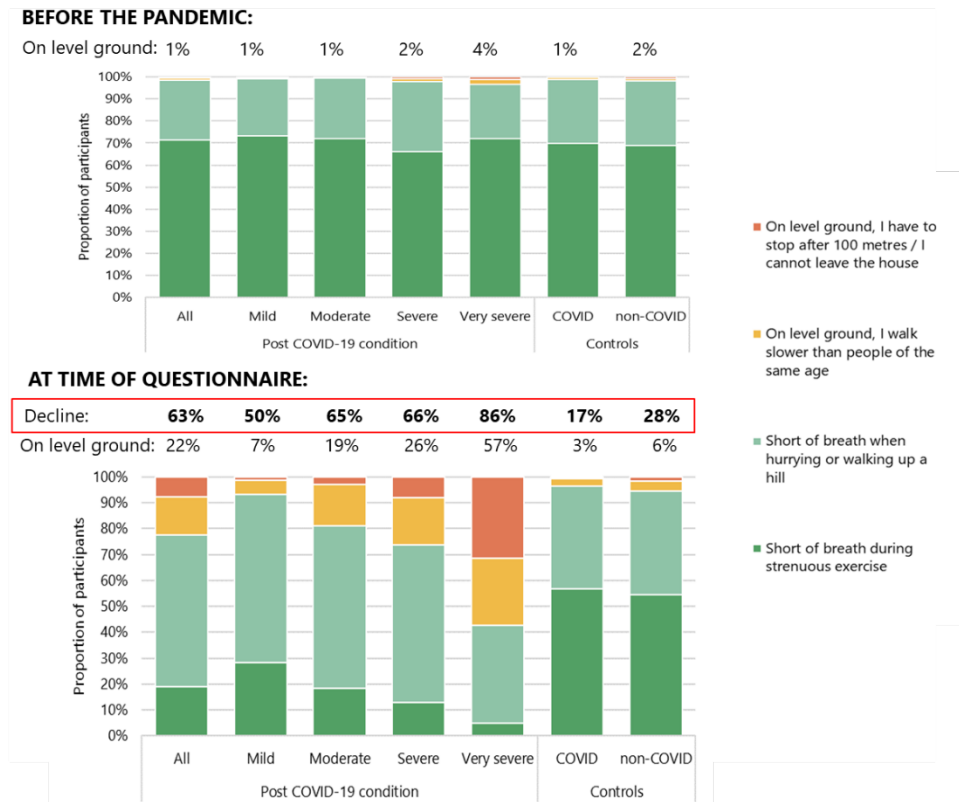
Abbreviations: Admin/Managers: administrative staff and managers; DK: don't know; HR: health region; NA: not applicable; NR: no response; PA: patient attendant; PCC: post COVID-19 condition; pros.: professionals; SD: standard deviation

4.3 Impact of PCC on overall functioning

4.3.1 Physical performance

Both PCC cases and controls reported having similar physical performance to before the pandemic, with only 1% to 2% experiencing moderate to severe limitation (mMRC score ≥ 3 out of 5, breathless on level ground). However, 4% of very severe PCC cases reported being breathless on level ground before the pandemic (Figure 3). Deterioration in physical performance was two to three times more frequent among cases than controls, and moderate to severe exercise limitation was reported by four to seven times more cases (22%) than controls (3% and 6%). Poor physical performance increased with PCC severity; however, even among mild PCC cases, 50% reported worse physical performance than before the pandemic.

Figure 3 Physical performance measured by the mMRC breathlessness scale before the pandemic and at the time of the questionnaire

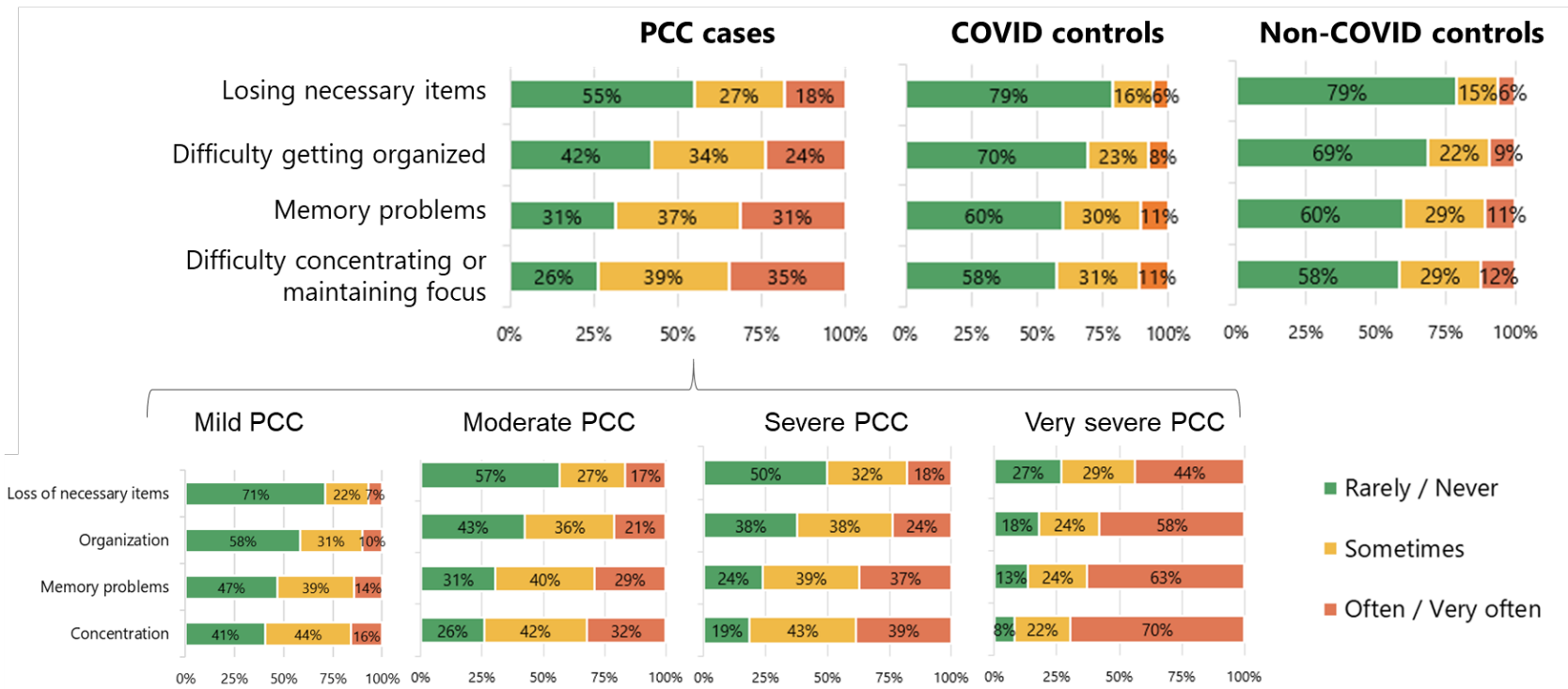


Note: mMRC breathlessness scale question: How would you describe your physical performance before the pandemic and currently? Percentages in the first line (on level ground) describe the proportion of participants who reported being breathless on level ground (score $\geq 3/5$).

4.3.2 Cognitive difficulties in daily activities

Questions aimed at assessing cognitive impairments in daily activities show that the proportion of HCWs who reported having problems often or very often was about three times higher among cases than controls, and this proportion increased with PCC severity ([Figure 4](#)). Among very severe PCC cases, 70% reported often/very often having concentration or attention problems, and 44% often/very often lost necessary items.

Figure 4 Frequency of cognitive impairments in daily activities



Abbreviations: PCC: post COVID-19 condition

Note: Questions on cognitive impairments: During the past four weeks, in your daily and leisure activities, how often have you experienced difficulty concentrating or maintaining focus? Difficulty getting organized? Memory problems? Losing necessary items?

4.3.3 Psychological distress

Among controls (COVID and non-COVID), approximately 38% had high or very high psychological distress (K6 score ≥ 7) at the time of the survey (Table 2). Among PCC cases, 64% reported high or very high distress; 24% of them attributed it partially or fully to post-COVID symptoms, and 40% linked their distress to other reasons (current main employment and/or personal life). The proportion of PCC cases who reported distress not related to PCC (40%) was similar to those of COVID controls (37%) and non-COVID controls (39%). The proportion of cases with very high distress (K6 score ≥ 13) increased with PCC severity, reaching 56% among very severe PCC cases. Women with PCC reported high distress slightly more often than men (65% vs 60%), but the percentages of men and women who attributed their distress partially or fully to post-COVID symptoms were similar ($\sim 24\%$).

Table 2 Proportion with psychological distress measured by the Kessler scale

	Proportion with psychological distress					% attributed to PCC (% fully attributed to PCC) ^a	PR ^b	PD ^b
	High or very high (score ≥ 7)		High (score 7–12)	Very high (score ≥ 13)				
	N	N	%	%	%	% (%)		
Overall								
PCC cases	2,112	1,352	64.0	38.0	26.0	23.7 (13.1)	1.7	27.3%
Mild PCC	502	231	46.0	35.5	10.6	11.0 (1.2)	1.3	9.3%
Moderate PCC	873	538	61.6	40.1	21.5	20.0 (8.1)	1.7	24.9%
Severe PCC	375	286	76.3	40.8	35.5	34.9 (21.9)	2.1	39.5%
Very severe PCC	307	275	89.6	33.2	56.4	44.3 (37.5)	2.4	52.9%
COVID controls	12,044	4,423	36.7	27.6	9.1	NA	Ref	Ref
Non-COVID controls	4,728	1,854	39.2	26.6	12.6	NA	1.1	2.5%
Female								
PCC cases	1,794	1,162	64.8	38.6	26.2	23.6 (13.0)	1.7	26.1%
Mild PCC	424	199	46.9	36.1	10.8	10.8 (1.2)	1.2	8.2%
Moderate PCC	757	471	62.2	40.2	22.1	19.3 (7.9)	1.6	23.5%
Severe PCC	307	238	77.5	42.0	35.5	36.2 (22.1)	2.0	38.8%
Very severe PCC	259	234	90.3	34.0	56.4	45.2 (38.6)	2.3	51.6%
COVID controls	9,796	3,792	38.7	29.1	9.6	NA	Ref	Ref
Non-COVID controls	3,588	1,498	41.8	28.3	13.5	NA	1.1	3.0%
Male								
PCC cases	318	190	59.7	34.9	24.8	24.5 (13.2)	2.1	31.7%
Mild PCC	78	32	41.0	32.1	9.0	11.5 (1.3)	1.4	13.0%
Moderate PCC	116	67	57.8	39.7	18.1	25.0 (9.5)	2.1	29.7%
Severe PCC	68	48	70.6	35.3	35.3	29.4 (20.6)	2.5	42.5%
Very severe PCC	48	41	85.4	28.2	56.3	39.6 (31.3)	3.0	57.3%
COVID controls	2,248	631	28.1	21.4	6.7	NA	Ref	Ref
Non-COVID controls	1,140	356	31.2	21.5	9.7	NA	1.1	3.2%

^a Proportion of PCC cases with high or very high psychological distress partially or fully attributed to PCC and proportion of PCC cases with high or very high psychological distress fully attributed to PCC.

^b Values in blue indicate statistically significant univariate associations ($p < 0.05$).

Abbreviations: NA: not applicable; PCC: post COVID-19 condition; PD: prevalence difference; PR: prevalence ratio

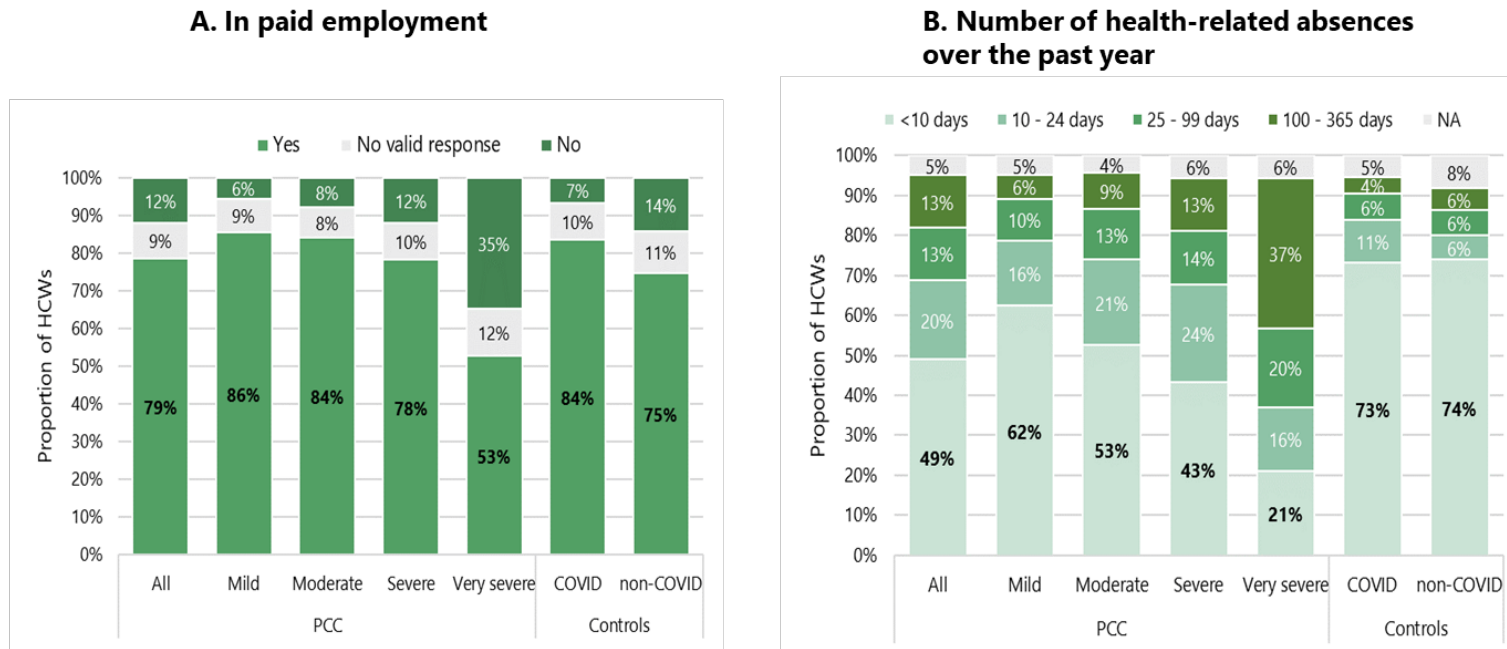
4.4 Impact of PCC on functioning in professional activities

4.4.1 Work participation: cessation, absenteeism, or change

Overall, 12% of PCC cases reported not being in paid employment at the time of the survey compared with 7% and 14% of COVID controls and non-COVID controls ([Figure 5a](#)). The higher proportion of unemployed non-COVID controls may be associated with age (32% aged 55 or older versus 18% of COVID controls and 21% of PCC cases). Information on retirement status and disability benefits was not collected. Even though the majority of PCC cases were still in paid employment, 26% reported absences of 25 workdays or more over the past year due to health problems, compared with 10% and 12% of controls ([Figure 5b](#)). Among PCC cases, 8% reported having stopped working due to the illness, 12% had reduced their number of working hours, and 6% had changed to a less demanding job ([Figure 6](#)).

Severe PCC cases, representing 14% of all cases, were disproportionately affected, with more than 50% having stopped or modified their work because of their illness: 33% reported having stopped working, 7% had changed to a less demanding job, 15% had reduced their number of working hours, and 37% had been absent 100 workdays or more over the past year ([Figure 5](#) and [Figure 6](#)).

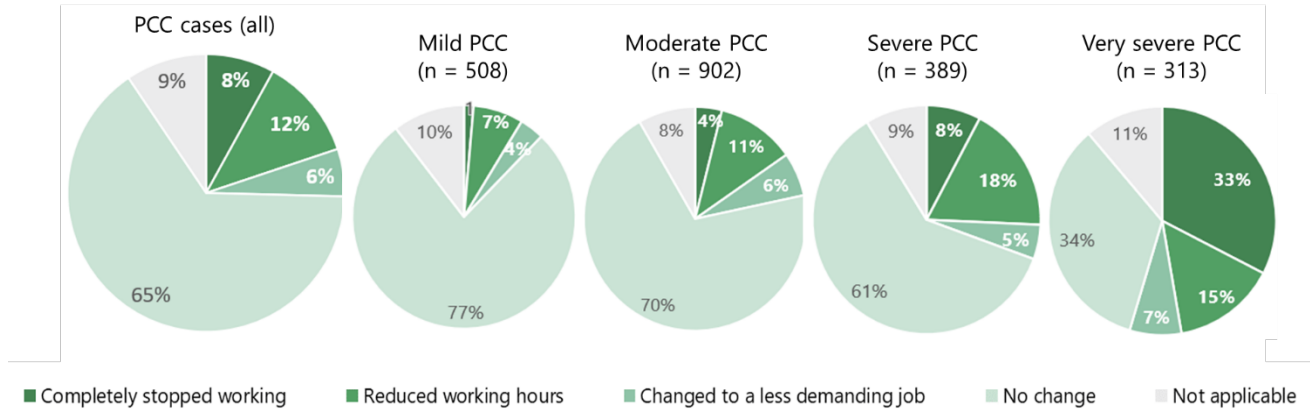
Figure 5 Proportion of respondents working at the time of the survey and health-related absenteeism



Abbreviations: NA: not applicable; PCC: post COVID-19 condition

Note: No valid response = individuals with inconsistent answers to the questions “in paid employment” and “in paid employment over the last four weeks,” or who responded “not applicable” to one of the questions.

Figure 6 Stopping work or changing job due to PCC



Abbreviations: PCC: post COVID-19 condition

Note: Question asked to PCC cases: Have you stopped working, reduced your working hours, or changed jobs (voluntarily or by employer decision) because of persistent symptoms related to COVID-19?

4.4.2 Work ability

While more than 92% of PCC cases and controls reported their overall work ability as very good or excellent before the pandemic, these proportions had dropped by the time of the survey to 49% among PCC cases, 82% among COVID controls, and 74% among non-COVID controls (Table 3). Among cases, the decline was greater when the PCC was more severe. While among controls there was greater decline with respect to mental rather than physical work demands, among cases it was equally pronounced for both types of demands. Overall, the work ability score of PCC cases was 20% lower than that of COVID controls (prevalence ratio = 0.8), and the prevalence ratio of the score further decreased with increasing PCC severity (0.9; 0.8; 0.8; and 0.6).

Table 3 Work ability self-assessment

	PCC cases					Controls	
	All	Mild	Moderate	Severe	Very severe	COVID controls	Non-COVID controls
N	1,851	459	823	340	229	11,008	3,949
	%	%	%	%	%	%	%
Before the pandemic							
Overall ability							
Very good/Excellent	96.3	96.7	96.2	95.6	96.5	94.9	92.5
Fairly good	3.4	3.3	3.4	4.1	2.6	4.6	6.7
Somewhat poor/Poor	0.3	0.0	0.4	0.3	0.9	0.5	0.9
Physical demands							
Very good/Excellent	93.7	95.4	93.6	93.5	91.3	93.5	90.8
Fairly good	5.7	4.4	6.0	6.2	7.0	5.9	8.1
Somewhat poor/Poor	0.5	0.2	0.5	0.3	1.7	0.6	1.1
Mental demands							
Very good/Excellent	95.0	97.2	94.7	92.9	94.8	93.8	91.6
Fairly good	4.4	2.6	4.6	6.2	4.8	5.4	7.2
Somewhat poor/Poor	0.6	0.2	0.7	0.9	0.4	0.8	1.2
Mean score (2–20) (SD)	18.3 (2.1)	18.3 (2.1)	18.3 (2.2)	18.3 (2.3)	18.3 (2.5)	18.1 (2.3)	17.7 (2.4)
Score PR	1.0	1.0	1.0	1.0	1.0	Ref	1.0
At the time of the survey							
Overall ability							
Very good/Excellent	49.2	71.9	51.2	36.5	15.3	82.2	73.7
Fairly good	34.4	24.2	37.3	41.8	33.2	14.5	20.0
Somewhat poor/Poor	16.5	3.9	11.5	21.8	51.5	3.4	6.3
At the time of the survey							
Physical demands							
Very good/Excellent	46.1	68.6	48.2	34.7	10.5	82.4	74.7
Fairly good	33.4	26.6	36.9	38.5	27.1	14.2	19.2
Somewhat poor/Poor	20.4	4.8	14.8	26.8	62.4	3.5	6.1
Mental demands							
Very good/Excellent	46.3	63.8	48.2	37.6	17.0	77.0	69.7
Fairly good	34.6	30.1	37.2	40.0	26.6	17.5	21.5
Somewhat poor/Poor	19.1	6.1	14.6	22.4	56.3	5.5	8.8
Mean score (2–20) (SD)	13.6 (3.7)	15.5 (2.9)	13.9 (3.2)	12.7 (3.3)	9.6 (3.7)	16.8 (3.2)	15.9 (3.4)
Score PR	0.8	0.9	0.8	0.8	0.6	Ref	0.9

Abbreviations: PCC: post COVID-19 condition; PR: prevalence ratio; SD: standard deviation

Note: Mean score integrating the following items: overall work ability (0 to 10 points), work ability in relation to physical demands (1 to 5), and work ability in relation to mental demands (1 to 5).

4.4.3 Work functioning

Work functioning was measured using the WRFQ among HCWs who had been in paid employment during the prior four weeks. The WRFQ score is interpreted as the percentage of work time during which the individual does not experience difficulty meeting job demands (Appendix – [Table 15](#)). The mean WRFQ score was 72.5 among PCC cases, 77.1 among non-COVID controls, and 82.0 among COVID controls ([Table 4](#)). The score for PCC cases with mild symptoms (79.1) was similar to that of controls, but was lower for severe cases (who were still in paid employment) (69.9) and declined further for very severe PCC cases (57.0).

Among PCC cases, all work dimensions were affected, but this was particularly pronounced for work scheduling and physical demands (the latter dimension applicable to only 50% of participants) ([Table 4](#)).

Table 4 Work functioning in the dimensions measured by the Work Role Functioning Questionnaire

	Overall WRFQ score	Dimensions				
		Work scheduling	Output demands	Physical demands	Mental/social demands	Flexibility demands
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Cronbach's alpha	0.98	0.89	0.94	0.94	0.96	0.95
Total valid N ^a	16,094	14,568	15,665	8,016	15,859	14,577
PCC CASES	72.5 (22.3)	69.3 (25.9)	72.6 (24.4)	70.4 (27.4)	72.8 (23.8)	73.8 (25.5)
Mild PCC	79.1 (21.7)	77.6 (23.9)	78.7 (23.2)	80.1 (25.6)	78.6 (22.9)	79.7 (23.4)
Moderate PCC	72.9 (21.5)	68.8 (25.5)	72.8 (23.6)	71.5 (26.0)	73.3 (22.6)	74.3 (25.2)
Severe PCC	69.9 (20.5)	66.4 (24.9)	70.2 (23.3)	64.9 (26.1)	71.0 (22.7)	71.8 (24.8)
Very severe PCC	57.0 (21.7)	51.5 (24.6)	57.9 (25.6)	51.1 (25.8)	57.5 (25.7)	58.3 (27.0)
COVID controls	82.0 (22.5)	81.1 (24.2)	81.5 (23.7)	82.7 (26.8)	82.1 (23.2)	82.1 (24.2)
Non-COVID controls	77.1 (25.1)	77.0 (26.6)	76.5 (26.4)	76.8 (28.3)	77.3 (26.5)	76.8 (27.1)

^a Valid N for each score or subscore excluding those with > 20% of items missing responses or marked as not applicable.
Abbreviations: PCC: post COVID-19 condition; SD: standard deviation; WRFQ: Work Role Functioning Questionnaire

The distribution of the WRFQ score, and particularly the proportion of HCWs without difficulties in their functioning (optimal functioning 90%–100% of the time at work), provides complementary information to the mean score for assessing work functioning ([Table 5](#)). Overall, the proportion of PCC cases with optimal functioning was half that of COVID controls (23% vs 47%) and decreased with PCC severity, dropping to 14% for severe cases and 4% for very severe cases. Male sex and older age were associated with a higher proportion of HCWs with optimal functioning 90% or more of the time at work, among both cases and controls. HCWs in job category 1 (mainly nursing staff) reported lower scores than the other job categories, but the severe and very severe cases in category 3 (managers, administration) had the lowest proportion of optimal functioning (11% and 0%, respectively) ([Table 5](#)).

Table 5 Distribution of overall WRFQ score

	PCC cases					Controls	
	All	Mild	Moderate	Severe	Very severe	COVID controls	Non-COVID controls
N	1,703	443	770	310	180	10,379	3,724
Overall WRFQ score							
Mean	72.5	79.1	72.9	57.0	69.9	82.0	77.1
Score categories:	%	%	%	%	%	%	%
0% – < 50%	16.2	9.0	15.1	16.5	38.3	8.9	13.8
50% – < 75%	26.5	16.5	27.4	32.3	37.2	11.6	15.2
75% – < 90%	44.3	48.9	44.7	44.0	23.5	42.0	44.5
90%–100%	22.7	34.3	22.3	14.2	3.9	47.1	37.4
Overall score of 90%–100%							
Sex	%	%	%	%	%	%	%
Female	20.7	32.6	20.5	13.9	3.3	45.2	35.1
Male	29.1	43.1	33.6	15.3	6.7	55.5	44.6
Age group	%	%	%	%	%	%	%
18–44 years	19.0	31.6	17.9	11.5	3.2	42.8	31.0
45–54 years	22.4	37.5	22.3	13.4	2.0	47.3	33.5
55 years or older	28.5	37.0	30.9	21.5	8.6	60.2	48.6
Job categories	%	%	%	%	%	%	%
1. Nurses, physicians, psychosocial professionals, other health professionals	21.1	34.9	18.5	12.8	2.4	45.2	33.7
2. Patient attendants, housekeeping staff, other health technicians	22.3	33.3	24.8	18.7	7.9	49.1	43.6
3. Managers, supervisors, administrative staff	24.1	32.9	31.9	11.1	0.0	51.2	40.1

Abbreviations: PCC: post COVID-19 condition; SD: standard deviation; WRFQ: Work Role Functioning Questionnaire

4.4.4 Job cessation, absenteeism, and presenteeism among PCC cases

Among PCC cases who stopped working due to their persistent symptoms (n = 174, 9%), 76% had severe symptoms, 46% reported 100 or more workdays of absence in the past year, and 18% responded “not applicable” to this question (Table 6). Among PCC cases, 13% (n = 246) had reduced their working hours, while 6% (n = 114) had changed to a less demanding job. The frequency of these two types of work adjustments increased with PCC symptom severity (Table 6). Most cases who had changed their work reported fewer than 100 workdays of absence (85%–88% depending on PCC severity), but experienced suboptimal work functioning (65%–83% with WRFQ < 90%).

Among PCC cases who had not made any changes to their work due to PCC (n = 1,336, 71%), over 90% reported fewer than 100 workdays of absence, even among severe and very severe cases. However, most cases reported difficulties in work functioning, the proportion increasing with PCC severity from 58% for mild cases to 75% for severe or very severe cases.

Table 6 Health-related absenteeism and work functioning difficulties according to work changes due to PCC

1. Work changes due to PCC ^c			2. Workdays absent for health reasons						3. Difficulties in work functioning (WRFQ)							
			< 100 days		≥ 100 days		NA ^a		WRFQ 90–100%		WRFQ < 90%		NA ^b			
			N	Col %	Row N	Row %	Row N	Row %	Row N	Row %	Row N	Row %	Row N	Row %		
PCC (overall)			1,870													
No change	1,336	71%	1,258	94%	78	6%	-	-	314	24%	892	67%	130	10%		
Reduced working hours	246	13%	208	85%	38	15%	-	-	18	7%	213	87%	15	6%		
Changed job	114	6%	98	86%	16	14%	-	-	16	14%	87	76%	11	10%		
Stopped working	174	9%	36	21%	112	64%	26	15%	1	1%	27	16%	146	84%		
Mild PCC			444													
No change	385	87%	370	96%	15	4%	-	-	132	34%	222	58%	31	8%		
Reduced working hours	35	8%	32	91%	3	9%	-	-	4	11%	28	80%	3	9%		
Changed job	17	4%	15	88%	2	12%	-	-	4	24%	11	65%	2	12%		
Stopped working	7	2%	1	14%	4	57%	2	29%	0	0%	2	29%	5	43%		
Moderate PCC			807													
No change	615	76%	580	94%	35	6%	-	-	140	23%	419	68%	56	9%		
Reduced working hours	101	13%	88	87%	13	13%	-	-	12	12%	84	83%	5	5%		
Changed job	56	7%	48	86%	8	14%	-	-	9	16%	42	75%	5	9%		
Stopped working	35	4%	11	31%	15	43%	9	26%	0	0%	11	31%	24	69%		
Severe or very severe PCC			619													
No change	336	54%	308	92%	28	8%	-	-	42	13%	251	75%	43	13%		
Reduced working hours	110	18%	88	80%	22	20%	-	-	2	2%	101	92%	7	6%		
Changed job	41	7%	35	85%	6	15%	-	-	3	7%	34	83%	4	10%		
Stopped working	132	21%	24	18%	93	70%	15	11%	1	1%	14	11%	117	89%		

^a The participants responded “not applicable” to the question on health-related absenteeism.

^b Not applicable as the WRFQ questions were not asked to individuals who reported not being in paid employment over the four prior weeks.

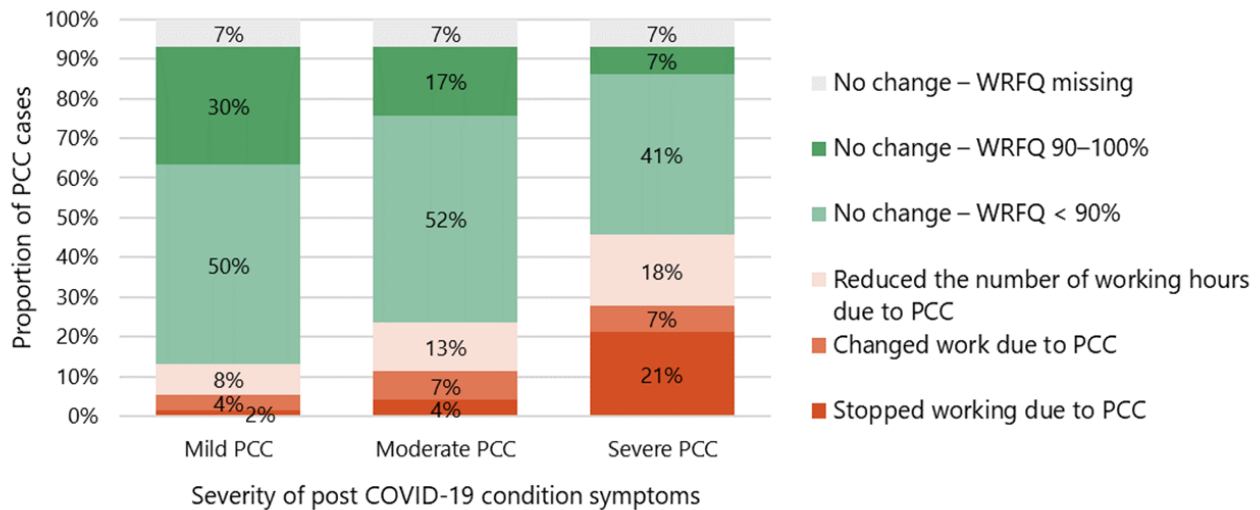
^c The questionnaire did not allow for determining whether the job change occurred before the previous year or during the previous year, for which the days of absence were being assessed.

Abbreviations: NA: not applicable; No change: neither stopped working nor modified job; PCC: post COVID-19 condition; WRFQ: Work Role Functioning Questionnaire

More mild and moderate PCC cases had changed their work among nurses and other health professionals in their category than among patient attendants and other health technicians, or among managers (Appendix – [Table 18](#)). The latter also reported fewer health-related absences of 100 days or more, compared with other types of HCWs.

In summary, 9% of PCC cases (rising from 2% to 21% with severity) had completely stopped working because of their symptoms, 6% (rising from 4% to 7% with severity) had changed jobs to a less demanding position, 13% (rising from 8% to 18% with severity) had reduced their working hours, 48% had no change in their work but had suboptimal functioning (WRFQ < 90%), although the reduced functioning may not be related to PCC, and 17% (30% to 7%, proportion decreasing with severity) had no change and maintained optimal functioning (WRFQ = 90%–100%) (Figure 7).

Figure 7 Functional work impact (stopping work or changing job and functional difficulties by PCC severity)



Abbreviations: No change: neither stopped working nor modified job; PCC: post COVID-19 condition; WRFQ: Work Role Functioning Questionnaire

4.4.5 Multivariate analysis of the association between PCC, absenteeism, and work functioning

Cases of moderate, severe, and very severe PCC had increased risks of health-related absenteeism of 100 or more workdays compared with COVID controls in the multivariate analysis adjusting for age, sex, language, being born in Canada, race/ethnicity, the presence and number of certain comorbidities, job category, social and material deprivation indices, and health region ([Table 7](#)). This risk increased with PCC severity.

In the multivariate analysis adjusting for the same variables, PCC cases had increased risks of difficulties in work functioning more than 25% of the time (mean score < 75%) or more than 10% of the time (mean score < 90%) compared with COVID controls (Table 8). These risks increased with PCC severity, overall and within the different job categories. The prevalence ratios of suboptimal functioning among severe and very severe PCC cases were highest for category 3 HCWs (managers and others), followed by category 1 (nurses and others) and category 2 (patient attendants and others), but with overlapping confidence intervals.

Table 7 **Multivariate analysis of the association between PCC severity and health-related absenteeism of 100 workdays or more per year**

Exposure	N	Health-related absenteeism ≥ 100 days/year	
		Crude OR (95% CI)	Adjusted OR ^a (95% CI)
Mild PCC cases	484	1.5 (1.0–2.2)	1.5 (1.0–2.1)
Moderate PCC cases	863	2.3 (1.8–2.9)	2.0 (1.5–2.5)
Severe PCC cases	367	3.6 (2.6–4.8)	3.1 (2.2–4.2)
Very severe PCC cases	295	14.2 (11.0–18.2)	12.2 (9.4–15.9)
COVID controls	11,685	1 [ref]	1 [ref]

^a Odds ratio adjusted for age, sex, language, being born in Canada, race/ethnicity, the presence of certain comorbidities (depressive disorder, hypertension, chronic lung disease, obesity, cardiovascular disease, diabetes, cancer), the number of comorbidities (by category from 0 to 5 or more), job category, social and material deprivation indices, health regions.

Abbreviations: CI: confidence interval; OR: odds ratio; PCC: post COVID-19 condition; ref: reference

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

Table 8 Multivariate analysis of the association between PCC severity and work functioning

		Risk of having functional difficulties ≥ 25% of the time (WRFQ score < 75%)		Risk of having functional difficulties ≥ 10% of the time (WRFQ score < 90%)	
Exposure	N	Crude OR (95% CI)	Adjusted OR^a (95% CI)	Crude OR (95% CI)	Adjusted OR^a (95% CI)
All (n = 12,082)					
Mild PCC cases	443	1.3 (1.1–1.7)	1.3 (1.1–1.7)	1.7 (1.4–2.1)	1.7 (1.4–2.1)
Moderate PCC cases	770	2.9 (2.5–3.3)	3.0 (2.6–3.5)	3.1 (2.6–3.7)	3.1 (2.6–3.8)
Severe PCC cases	310	3.6 (2.9–4.6)	3.9 (3.1–4.9)	5.4 (3.9–7.4)	5.7 (4.1–7.9)
Very severe PCC cases	180	11.9 (8.5–16.8)	13.0 (9.1–18.5)	22.0 (10.3–46.9)	22.5 (10.5–48.3)
COVID controls	10,379	1 [ref]	1 [ref]	1 [ref]	1 [ref]
Stratification by job category					
	N	Crude OR (95% CI)	Adjusted OR^b (95% CI)	Crude OR (95% CI)	Adjusted OR^b (95% CI)
1. Nurses, physicians, psychosocial professionals, other health professionals (n = 9,489)					
Mild PCC cases	295	1.4 (1.0–1.8)	1.4 (1.0–1.8)	1.5 (1.2–2.0)	1.6 (1.2–2.0)
Moderate PCC cases	465	3.3 (2.8–4.0)	3.6 (3.0–4.4)	3.6 (2.9–4.6)	3.7 (2.9–4.7)
Severe PCC cases	156	3.9 (2.8–5.4)	4.4 (3.1–6.1)	5.6 (3.5–8.9)	6.0 (3.7–9.6)
Very severe PCC cases	83	13.5 (8.0–22.9)	14.8 (8.6–25.4)	33.4 (8.2–136.1)	33.0 (8.1–134.9)
COVID controls	6,484	1 [ref]	1 [ref]	1 [ref]	1 [ref]
2. Patient attendants, housekeeping staff, other health technicians (n = 3,043)					
Mild PCC cases	75	1.2 (0.7–2.0)	1.2 (0.7–2.1)	1.9 (1.2–3.2)	2.0 (1.2–3.3)
Moderate PCC cases	161	1.9 (1.4–2.7)	2.1 (1.4–3.0)	2.9 (2.0–4.3)	3.1 (2.1–4.5)
Severe PCC cases	91	3.0 (1.9–4.5)	2.7 (1.7–4.3)	4.2 (2.5–7.2)	4.1 (2.4–7.2)
Very severe PCC cases	63	7.4 (4.3–12.7)	8.4 (4.8–14.8)	11.3 (4.5–28.2)	11.8 (4.6–30.0)
COVID controls	1,853	1 [ref]	1 [ref]	1 [ref]	[ref]
3. Managers, supervisors, administrative staff (n = 3,274)					
Mild PCC cases	73	1.4 (0.8–2.4)	1.4 (0.8–2.5)	2.1 (1.3–3.5)	2.0 (1.2–3.3)
Moderate PCC cases	144	2.6 (1.8–3.8)	2.6 (1.8–3.9)	2.2 (1.5–3.2)	2.3 (1.6–3.3)
Severe PCC cases	63	4.1 (2.5–6.9)	4.6 (2.7–7.9)	13.4 (6.2–29.1)	14.3 (6.5–31.4)
Very severe PCC cases	34	22.5 (9.3–54.8)	26.5 (10.4–67.2)	NA ^c	NA ^c
COVID controls	2,042	1 [ref]	1 [ref]	1 [ref]	1 [ref]

^a Odds ratio adjusted for age, sex, language, being born in Canada, race/ethnicity, the presence of certain comorbidities (depressive disorder, hypertension, chronic lung disease, obesity, cardiovascular disease, diabetes, cancer), the number of comorbidities (by category from 0 to 5 or more), job category, social and material deprivation indices, health regions.

^b Odds ratio adjusted for the same variables except the job category.

^c Severe and very severe PCC cases were grouped together for job category 3, as all very severe cases (n = 34) had a score < 90%.

Abbreviations: CI: confidence interval; OR: odds ratio; PCC: post COVID-19 condition; ref: reference; WRFQ: Work Role Functioning Questionnaire

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

4.4.6 Prognostic factors for absenteeism and difficulties in work functioning among PCC cases

The prognostic factors for long-term health-related absenteeism (≥ 100 workdays/year) and suboptimal work functioning (WRFQ $< 90\%$) were examined among PCC cases who were in paid employment at the time of the survey.

In a multivariate polytomous analysis in which PCC symptoms were categorized according to their severity and number (Model 1), they were strongly associated with absenteeism and suboptimal work functioning. Compared with mild PCC cases, moderate and severe cases with 6 or more symptoms had a 3-times higher risk of absenteeism ([Table 9](#)) and a risk of suboptimal functioning 6 times (moderate cases) and 11 times (severe cases) higher ([Table 10](#)). For the analysis of symptoms that considered only the presence and severity of fatigue and cognitive symptoms (Model 2), severe fatigue and severe cognitive symptoms independently increased the risk of absenteeism by 1.9 times ([Table 9](#), Model 2), while the risk of suboptimal work functioning was more strongly associated with severe cognitive symptoms (OR = 4.4) than with severe fatigue (OR = 28) ([Table 10](#), Model 2).

Female sex and age below 55 years were not associated with absenteeism, but were significantly associated with the risk of difficulties in work functioning ([Table 9](#) and [Table 10](#)). Certain comorbidities, such as a history of depressive disorder, chronic respiratory disease, and diabetes, were associated with absenteeism, but not with difficulties in work functioning ([Table 9](#) and [Table 10](#)). There was no association between level of material deprivation and absenteeism or difficulties in work functioning. HCWs in category 3 (managers, supervisors, administrative staff) had a lower risk of absenteeism than those in the two other job categories, but a similar risk of difficulties in work functioning.

Table 9 Multivariate analysis to assess the prognostic factors for absenteeism among PCC cases

Characteristics of PCC cases	N	% abs	Risk of absenteeism ≥ 100 days/year		
			Crude OR (95% CI)	Model 1 Adjusted OR ^a (95% CI)	Model 2 Adjusted OR ^a (95% CI)
Severity and number of symptoms					
Mild only (≥ 1 symptom)	440	4.1	1 [ref]	1 [ref]	
Moderate (1–5 reported symptoms)	415	3.9	0.9 (0.5–1.9)	0.9 (0.5–1.8)	
Moderate (≥ 6 reported symptoms)	353	10.8	2.8 (1.6–5.0)	2.9 (1.6–5.3)	
Severe (1–5 reported symptoms)	117	7.7	2.0 (0.9–4.5)	1.9 (0.8–4.4)	
Severe (≥ 6 reported symptoms)	368	11.4	2.9 (1.7–5.2)	2.9 (1.6–5.2)	
Fatigue					
No or mild fatigue	925	4.5	1 [ref]		1 [ref]
Moderate or severe	768	10.5	2.4 (1.7–3.6)		1.9 (1.3–3.0)
Cognitive symptoms					
Absent or mild	1,193	5.3	1 [ref]		1 [ref]
Moderate or severe	500	12.0	2.4 (1.7–3.5)		1.9 (1.3–2.9)
Sex					
Female	1,430	7.4	1 [ref]	1 [ref]	1 [ref]
Male	263	6.5	0.9 (0.5–1.5)	0.9 (0.6–1.5)	0.8 (0.5–1.5)
Age					
18–44 years	826	7.7	1.3 (0.8–2.2)	1.7 (0.9–3.0)	1.6 (0.9–2.8)
45–54 years	512	7.4	1.3 (0.7–2.2)	1.5 (0.8–2.7)	1.4 (0.8–2.5)
55 years or older	355	5.9	1 [ref]	1 [ref]	1 [ref]
Material deprivation index^b					
Very advantaged	351	4.6	1 [ref]	1 [ref]	1 [ref]
Advantaged to deprived	1,021	8.6	1.9 (1.1–3.4)	1.9 (1.1–3.4)	1.8 (1.1–3.3)
Very deprived	246	5.3	1.2 (0.6–2.5)	1.0 (0.4–2.3)	1.0 (0.4–2.3)
Comorbidities (ref = absent)					
History of depressive disorder	318	11.3	1.9 (1.3–2.9)	2.3 (1.3–4.3)	2.3 (1.2–4.2)
Chronic lung disease	191	11.0	1.7 (1.0–2.8)	1.9 (1.0–3.7)	2.1 (1.1–4.0)
Obesity	129	5.4	0.7 (0.3–1.6)	0.6 (0.3–1.6)	0.6 (0.3–1.6)
Cardiovascular disease	79	6.3	0.9 (0.3–2.2)	1.2 (0.4–3.5)	1.2 (0.4–3.4)
Diabetes	72	12.5	1.9 (0.9–3.9)	2.4 (1.0–5.9)	2.6 (1.1–6.3)
Job category^c					
Category 1	985	7.2	0.7 (0.5–1.1)	0.9 (0.6–1.5)	0.9 (0.5–1.4)
Category 2	391	10.0	1 [ref]	1 [ref]	1 [ref]
Category 3	317	4.1	0.4 (0.2–0.8)	0.5 (0.2–1.0)	0.5 (0.2–0.9)
Work environment					
Hospital	726	6.6	1.1 (0.6–2.1)	1.0 (0.6–1.9)	1.0 (0.6–1.9)
CHSLD/RPA	292	11.3	2.0 (1.1–3.7)	1.8 (1.0–3.5)	1.9 (1.0–3.5)
Clinics, rehabilitation centres	372	6.5	1.1 (0.6–2.1)	1.0 (0.5–2.0)	1.0 (0.5–2.0)
Other	303	5.9	1 [ref]	1 [ref]	1 [ref]

^a Model adjusted for the variables presented in the table and the following variables: place of birth, preferred language, ethnicity, HR, city size, social deprivation index, and number of comorbidities.

^b A category was added for the 75 individuals missing information for the deprivation indices.

^c Category 1: Nurses, physicians, psychosocial professionals, other health professionals; Category 2: Patient attendants, housekeeping staff, other health technicians; Category 3: Managers, supervisors, administrative staff.

Abbreviations: abs: absenteeism; CHSLD: residential and long-term care centre; CI: confidence interval; OR: odds ratio; PCC: post COVID-19 condition; ref: reference; RPA: private seniors' residence

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

Table 10 Multivariate analysis to assess the prognostic factors associated with work functioning among PCC cases

Characteristics of PCC cases	N	% WRFQ <90%	Risk of suboptimal work functioning (WRFQ < 90%)		
			Crude OR (95% CI)	Model 1 Adjusted OR ^a (95% CI)	Model 2 Adjusted OR ^a (95% CI)
Severity and number of symptoms					
Mild only (≥ 1 symptom)	442	65.8	1 [ref]	1 [ref]	
Moderate (1–5 reported symptoms)	415	66.8	1.0 (0.8–1.4)	1.1 (0.8–1.5)	
Moderate (≥ 6 reported symptoms)	353	90.2	4.8 (3.2–7.1)	5.7 (3.7–8.6)	
Severe (1–5 reported symptoms)	117	74.8	1.5 (1.0–2.4)	1.9 (1.1–3.0)	
Severe (≥ 6 reported symptoms)	368	94.3	8.7 (5.4–14.1)	10.9 (6.5–17.9)	
Fatigue					
No or mild fatigue	930	69.1	1 [ref]		1 [ref]
Moderate or severe	772	88.7	3.5 (2.7–4.6)		2.8 (2.1–3.8)
Cognitive symptoms					
Absent or mild	1,198	71.3	1 [ref]		1 [ref]
Moderate or severe	504	94.0	6.4 (4.3–9.4)		4.4 (2.9–6.7)
Sex					
Female	1,434	79.4	1 [ref]	1 [ref]	1 [ref]
Male	268	70.9	0.6 (0.5–0.8)	0.7 (0.5–0.9)	0.6 (0.5–0.9)
Age					
18–44 years	827	81.1	1.7 (1.3–2.3)	2.0 (1.5–2.9)	1.8 (1.3–2.5)
45–54 years	513	77.6	1.4 (1.0–1.9)	1.6 (1.1–2.2)	1.4 (1.0–2.0)
55 years or older	362	71.5	1 [ref]	1 [ref]	1 [ref]
Material deprivation index^b					
Very advantaged	353	76.2	1 [ref]	1 [ref]	1 [ref]
Advantaged to deprived	1,026	78.4	1.9 (1.1–3.4)	1.2 (0.9–1.6)	1.2 (0.8–1.6)
Very deprived	248	80.6	1.2 (0.6–2.5)	1.5 (1.0–2.4)	1.6 (1.0–2.5)
Comorbidities (ref = absent)					
History of depressive disorder	319	81.8	1.3 (1.0–1.8)	1.2 (0.8–1.8)	1.2 (0.8–1.8)
Chronic lung disease	193	77.2	1.0 (0.7–1.4)	0.8 (0.5–1.3)	0.9 (0.5–1.4)
Obesity	131	80.2	1.2 (0.7–1.8)	0.9 (0.5–1.6)	1.0 (0.6–1.8)
Cardiovascular disease	79	81.0	1.2 (0.7–2.2)	1.1 (0.6–2.2)	1.1 (0.5–2.3)
Diabetes	73	79.5	1.1 (0.6–2.0)	0.9 (0.5–1.9)	0.9 (0.5–1.9)
Job category^c					
Category 1	998	79.0	1.1 (0.8–1.4)	1.2 (0.8–1.6)	1.1 (0.8–1.5)
Category 2	390	77.7	1 [ref]	1 [ref]	1 [ref]
Category 3	314	75.5	0.9 (0.6–1.3)	0.9 (0.6–1.4)	0.9 (0.6–1.3)
Work environment					
Hospital	730	76.0	0.7 (0.5–1.0)	0.6 (0.4–0.9)	0.7 (0.5–1.0)
CHSLD/RPA	291	76.6	0.8 (0.5–1.1)	0.7 (0.5–1.1)	0.7 (0.5–1.2)
Clinics, rehabilitation centres	371	80.6	1.0 (0.7–1.4)	1.0 (0.7–1.5)	1.0 (0.7–1.6)
Other	310	81.0	1 [ref]	1 [ref]	1 [ref]

^a Model adjusted for the variables presented in the table and the following variables: place of birth, preferred language, ethnicity, HR, city size, social deprivation index, and number of comorbidities.

^b A category was added for the 75 individuals missing information for the deprivation indices.

^c Category 1: Nurses, physicians, psychosocial professionals, other health professionals; Category 2: Patient attendants, housekeeping staff, other health technicians; Category 3: Managers, supervisors, administrative staff.

Abbreviations: abs: absenteeism; CHSLD: residential and long-term care centre; CI: confidence interval; OR: odds ratio; PCC: post COVID-19 condition; ref: reference; RPA: private seniors' residence

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

4.5 Summary of functional impact indicators

4.5.1 Summary of the functional impact indicators of PCC according to illness severity

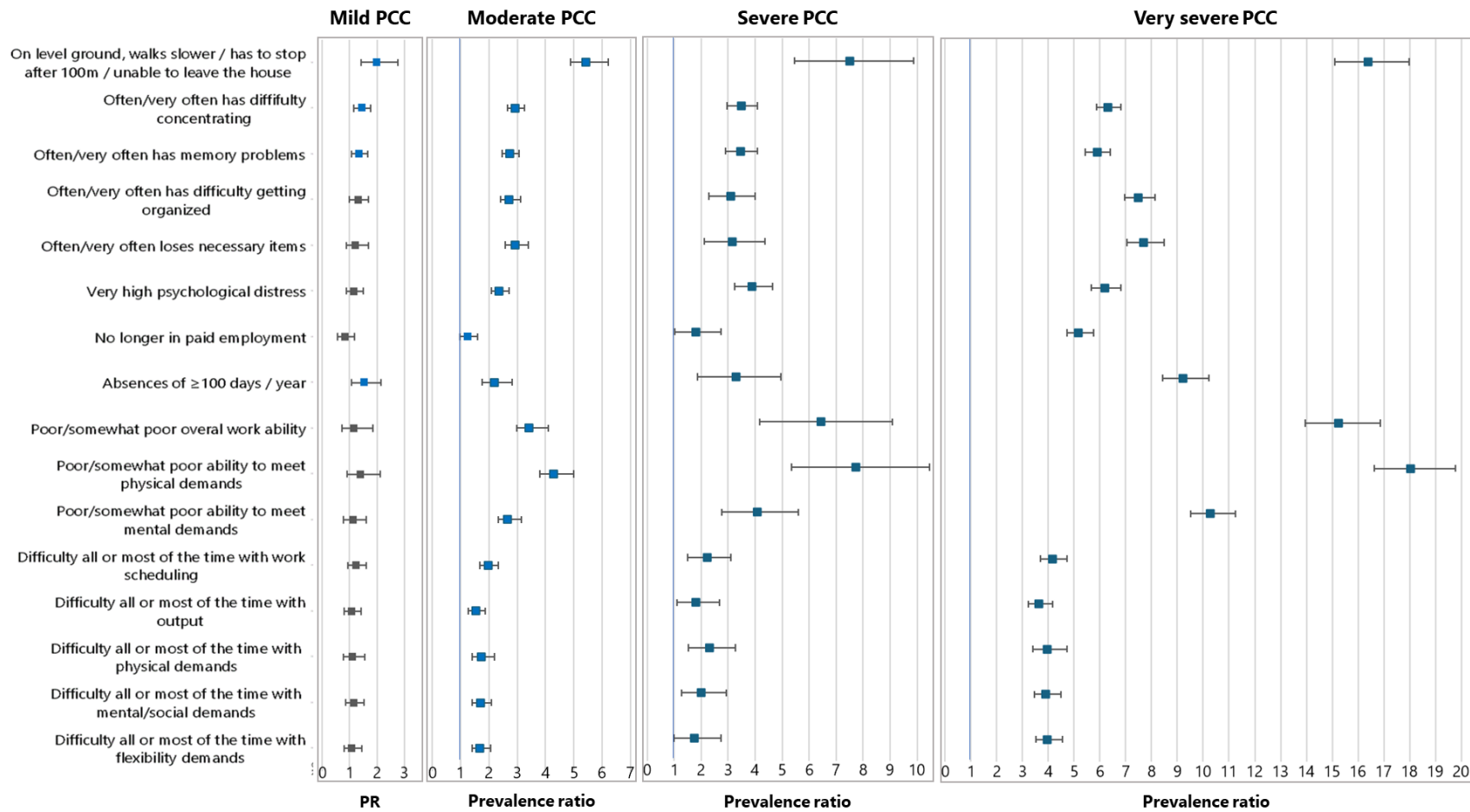
All of the functional impact indicators, such as physical performance and cognitive difficulties, as well as work participation, ability, and functioning, declined as the degree of PCC severity increased (Table 11). Cases with mild PCC had a prevalence of severe functional impairment similar to that of the controls, with prevalence ratios between 0.8 and 1.8, while among HCWs with very severe PCC, functional impairment was very significant at all levels, with prevalence ratios between 5.2 and 39.1 (Figure 8). Physical performance and ability to meet the physical demands of work were the most severely affected indicators, while being in paid employment was the least affected compared with the controls.

Table 11 Prevalence of functional impact indicators according to PCC severity

	All	Mild	Moderate	Severe	Very severe	COVID controls
Indicators	%	%	%	%	%	%
Physical performance (mMRC)						
On level ground, walks slower or has to stop after 100 m/unable to leave the house (mMRC ≥ 3)	22.5	6.9	19.0	26.2	57.2	3.5
Cognitive difficulties						
Often/very often has difficulty concentrating or maintaining focus	34.6	15.7	32.4	38.6	69.6	11.0
Often/Very often has memory problems	31.5	14.2	29.3	37.0	62.9	10.7
Often/very often has difficulty getting organized	23.9	10.0	21.0	23.9	57.8	7.7
Often/very often loses necessary items	18.3	6.9	16.6	18.0	43.8	5.7
Work participation and absenteeism						
No longer in paid employment	12.0	5.5	7.8	12.1	34.8	6.7
Stopped working due to PCC	8.0	1.4	3.9	7.7	32.6	NA
Among those working, absences of ≥ 100 days/year	13.0	6.1	9.0	13.1	37.4	4.1
Work ability (questions from the WAI)						
Poor/somewhat poor overall work ability	20.1	4.8	14.8	26.8	62.4	3.5
Poor/somewhat poor ability to meet the physical demands of work	18.8	6.1	14.6	22.4	56.3	5.5
Poor/somewhat poor ability to meet the mental demands of work	16.1	3.9	11.5	21.8	51.5	3.4
Work functioning (WRFQ)						
Difficulty with work scheduling ≥ 50% of the time	21.1	12.7	20.2	22.9	42.9	10.3
Difficulty with output ≥ 50% of the time	16.3	10.3	14.9	17.6	35.3	9.7
Difficulty with physical demands ≥ 50% of the time	22.6	12.7	20.1	26.8	45.9	11.6
Difficulty with mental/social demands ≥ 50% of the time	16.3	10.1	15.0	17.9	34.5	8.8
Difficulty with flexibility demands ≥ 50% of the time	16.3	9.9	15.5	16.3	36.6	9.2

Abbreviations: mMRC: modified British Medical Research Council; PCC: post COVID-19 condition; WAI: Work Ability Index; WRFQ: Work Role Functioning Questionnaire

Figure 8 Crude prevalence ratio of functional impact indicators according to PCC severity, compared with COVID controls



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

Note: Blue squares indicate statistically significant bivariate associations ($p < 0.05$).

4.6 Role of work-related psychosocial risks in the association between PCC and functional impact on professional activities

4.6.1 Psychosocial risks among cases and controls and correlation with work functioning

PCC cases reported slightly more adverse psychosocial dimensions (lower or higher scores, depending on the dimension) compared with both control types for each work-related PSR ([Table 12](#)). For both cases and controls, the PSRs most negatively correlated with work functioning (according to the WRFQ) were quantitative and emotional demands, work-life conflict, and role conflicts. A positive correlation with work functioning was observed for work quality (an indicator referring to the ability to perform tasks to a satisfactory quality) and for recognition. These correlations were stronger among PCC cases than among controls, except for emotional demands.

Table 12 Internal consistency and mean score of work-related PSR indicators (COPSOQ III) and correlation with work functioning (WRFQ)

N	Cronbach's alpha	PCC cases		COVID controls		Non-COVID controls	
		1,772	1,603	10,278	9,498	3,614	3,301
Domains and dimensions of the COPSOQ III (number of items)		Mean score (SD)	Correlation with WRFQ (r)	Mean score (SD)	Correlation with WRFQ (r)	Mean score (SD)	Correlation with WRFQ (r)
Demands at Work							
Quantitative Demands (2)	0.83	33.6 (24.9)	-0.38	27.8 (23.8)	-0.28	28.0 (24.3)	-0.30
Work Pace (2)	0.68	65.0 (22.2)	-0.14	62.4 (22.7)	-0.10	60.4 (23.3)	-0.15
Emotional Demands (2)	0.57	50.8 (26.7)	-0.22	46.8 (26.3)	-0.21	44.6 (27.0)	-0.25
Work-Individual Interface							
Job Insecurity (2)	0.69	28.0 (28.6)	-0.29	18.7 (23.3)	-0.18	23.4 (26.2)	-0.18
Job Satisfaction (with salary) (1)	-	49.3 (29.3)	0.16	56.0 (28.8)	0.15	52.8 (30.4)	0.17
Work-Life Conflict (2)	0.89	51.3 (30.3)	-0.34	41.4 (30.1)	-0.27	41.0 (30.9)	-0.29
Work Organization							
Influence at Work (2)	0.54	42.1 (24.8)	0.06	45.3 (25.0)	0.05	45.3 (26.2)	0.10
Quality of Work (1)	-	68.8 (22.5)	0.27	73.1 (21.8)	0.19	72.6 (22.7)	0.20
Interpersonal Relations and Leadership							
Recognition (2)	0.70	66.9 (25.0)	0.25	72.6 (22.4)	0.21	69.7 (24.4)	0.21
Role Conflicts (2)	0.74	42.5 (25.5)	-0.29	37.6 (24.3)	-0.20	38.2 (25.1)	-0.24
Social Support from Colleagues (2)	0.51	48.8 (22.6)	-0.02	52.7 (22.8)	-0.04	50.7 (23.7)	-0.03
Social Support from Supervisor (2)	0.81	52.3 (29.3)	0.10	56.2 (28.5)	0.06	55.6 (29.7)	0.09

Abbreviations: COPSOQ III: third version of the Copenhagen Psychosocial Questionnaire; PCC: post COVID-19 condition; PSR: work-related psychosocial risk; r: correlation coefficient; SD: standard deviation; WRFQ: Work Role Functioning Questionnaire

Note 1: Values in blue indicate statistically significant differences ($p < 0.05$) between PCC cases and controls.

Note 2: The intensity of the cell shading increases with the magnitude of the correlations (absolute values of < 0.15 ; 0.15–0.24; 0.25–0.40).

4.6.2 Psychosocial risks and level of functional impact on professional activities by PCC severity

The univariate relationships between work-related PSRs and the level of functional impact were assessed for each level of PCC severity. The four categories of functional work impact described in [Figure 7](#) were used: (0) no change in work nor functional difficulties (WRFQ = 90%–100%), (1) no change in work but functional difficulties (WRFQ < 90%), (2) change of work or reduction in working hours, and (3) cessation of work. The results of these descriptive analyses should be interpreted with caution, given the cross-sectional design, the multiple comparisons performed, and the lack of adjustment for other variables.

Table 13 Work-related psychosocial risks (COPSOQ III) according to level of functional impact on work among moderate, severe, and very severe PCC cases

	Moderate PCC cases			Severe or very severe PCC cases			
	Functional impact on work (% with each favourable PSR)			Functional impact on work (% with each favourable PSR)			
	0	1	2	0	1	2	3
N	128	391	147	39	218	136	48
Work-related PSRs (favourable)							
1. Demands at Work							
Quantitative Demands (low)	79.7	44.0	43.5	87.2	41.7	33.8	45.8
Work Pace (low)	9.4	7.2	5.4	17.9	4.6	5.9	2.1
Emotional Demands (low)	35.2	21.7	27.9	43.6	19.7	25.7	18.8
2. Work Organization							
Influence at Work (high)	21.9	10.2	15.6	25.6	13.3	15.4	14.6
Quality of Work (high)	89.1	63.7	61.2	87.2	59.2	51.5	58.3
3. Interpersonal Relations							
Recognition (high)	75.8	48.6	57.8	71.8	48.6	44.1	54.2
Role Conflicts (low)	53.1	29.2	34.7	64.1	30.3	27.2	37.5
Social Support from Colleagues (high)	26.6	21.2	12.2	23.1	17.9	15.4	25.0
Social Support from Supervisor (high)	43.0	28.4	34.0	46.2	33.9	30.9	33.3
4. Work–Individual Interface							
Job Insecurity (low)	78.9	65.7	56.5	64.1	53.2	37.5	29.2
Satisfaction with Salary (high)	55.5	38.9	38.8	41.0	28.9	29.4	37.5
Work-Life Conflict (low)	57.0	23.5	24.5	51.3	19.7	12.5	37.5

Abbreviations: PSR: psychosocial risk; WRFQ, Work Role Functioning Questionnaire

Note: Scale for functional impact on work:

- (0) no functional difficulties (WRFQ = 90%–100%) and no change in work
- (1) functional difficulties (WRFQ < 90%) but no change in work
- (2) reduced working hours or having changed to a less demanding job
- (3) stopped work due to post COVID-19 condition

Among moderate, severe, and very severe PCC cases, several favourable work-related psychosocial dimensions, specifically lower levels of quantitative demands, work pace, role conflicts, and work-life conflict, were reported more frequently by individuals for whom PCC had no functional impact on their work (category 0), compared with those reporting such an impact (categories 1, 2, 3) ([Table 13](#)). There were few or no differences between HCWs with functional difficulties (category 1), work adaptations (category 2), and work cessation (category 3) in terms of the proportion reporting favourable work-related psychosocial dimensions.

4.6.3 Role of psychosocial risks in the association between PCC and functional impact on professional activities

Among moderate, severe, and very severe PCC cases who were in paid employment, the PSRs most strongly associated with increased work difficulties (WRFQ < 90%) were quantitative demands, work-life conflict, and role conflicts ([Table 14](#)). Conversely, quality of work and recognition were associated with reduced functional impact as measured by the WRFQ. Satisfaction with salary, influence at work, and social support from colleagues were the PSRs least strongly associated with work functioning.

Table 14 Multivariate analysis of the association between psychosocial risks and work functioning among moderate, severe, and very severe PCC cases

		Association between PSRs and WRFQ < 90%	
		Moderate PCC cases	Severe and very severe PCC cases
		OR ^a (95% CI)	OR ^a (95% CI)
1. DEMANDS AT WORK			
Quantitative Demands	Continuous score	1.04 (1.03–1.05)	1.06 (1.04–1.09)
	Low vs high	0.09 (0.02–0.31)	0.06 (0.00–0.53)
Work Pace	Continuous score	1.01 (1.00–1.02)	1.01 (1.00–1.03)
	Low vs high	0.51 (0.24–1.10)	0.21 (0.06–0.69)
Emotional Demands	Continuous score	1.01 (1.00–1.02)	1.02 (1.01–1.04)
	Low vs high	0.39 (0.22–0.71)	0.18 (0.06–0.54)
2. WORK–INDIVIDUAL INTERFACE			
Job Insecurity	Continuous score	1.02 (1.01–1.03)	1.01 (1.00–1.03)
	Low vs high	0.15 (0.05–0.47)	0.23 (0.06–0.86)
Satisfaction with Salary	Continuous score	0.98 (0.98–0.99)	0.99 (0.97–1.00)
	High vs low	0.51 (0.32–0.81)	0.60 (0.26–1.33)
Work-Life Conflict	Continuous score	1.03 (1.02–1.04)	1.03 (1.02–1.04)
	Low vs high	0.09 (0.04–0.17)	0.08 (0.03–0.25)
3. WORK ORGANIZATION AND JOB CONTENTS			
Influence at Work	Continuous score	0.98 (0.98–0.99)	0.99 (0.98–1.00)
	High vs low	0.41 (0.22–0.76)	0.64 (0.24–1.65)
Quality of Work	Continuous score	0.96 (0.95–0.97)	0.94 (0.91–0.96)
	High vs low	0.41 (0.17–0.94)	0.14 (0.03–0.68)
4. INTERPERSONAL RELATIONS AND LEADERSHIP			
Recognition	Continuous score	0.96 (0.95–0.97)	0.96 (0.94–0.98)
	High vs low	0.09 (0.02–0.31)	NE
Role Conflicts	Continuous score	1.02 (1.02–1.03)	1.03 (1.02–1.05)
	Low vs high	0.12 (0.05–0.30)	0.17 (0.06–0.51)
Social Support from Colleagues	Continuous score	0.99 (0.98–1.00)	0.99 (0.98–1.01)
	High vs low	0.81 (0.46–1.45)	0.77 (0.28–2.12)
Social Support from Supervisor	Continuous score	0.98 (0.97–0.99)	0.98 (0.97–0.99)
	High vs low	0.38 (0.23–0.65)	0.34 (0.13–0.86)

^a Model including all psychosocial risks and adjusted for age, sex, employment type, work environment, health region, social deprivation index, and number of comorbidities.

Abbreviations: CI: confidence interval; OR: odds ratio; PCC: post COVID-19 condition; WRFQ: Work Role Functioning Questionnaire

Note 1: Values in blue indicate statistically significant multivariate associations ($p < 0.05$).

Note 2: Individuals with a moderate score for each PSR are not included in the table.

5 DISCUSSION

5.1 Impact of the COVID-19 pandemic beyond PCC

The significant impact of PCC on affected individuals' overall functioning, work participation and ability, and quality of life observed in our participants has also been noted in other studies (22–24). However, among HCWs, this assessment must take into account impairments that could be related to their work in the pandemic. The COVID-19 pandemic strongly impacted health workers, causing them higher levels of fatigue, stress, cognitive disorders, and burnout than the general population, even among workers not infected with SARS-CoV-2 (25). In Quebec, high work-related psychological distress was present in over 40% of HCWs during the second and third waves, regardless of whether or not they were infected with SARS-CoV-2 (26). Although the most serious consequences of COVID-19 for HCWs, in terms of both risk of infection and the overcapacity of healthcare facilities, occurred in the first three years of the pandemic, by summer 2023 about 15% of HCWs without PCC (COVID and non-COVID controls) reported that their overall work ability, ability to meet physical demands, and ability to meet mental demands were worse than before the pandemic, and about 40% had high psychological distress.

5.2 Impact of PCC on overall functioning

The impact on overall functioning was assessed using two measures: physical performance and cognitive impairments in daily activities. Moderate to severe limitation in physical activity was reported by 22% of PCC cases overall, and by 57% of those with three or more severe symptoms, compared with 3% of COVID controls and 6% of non-COVID controls. Studies that followed patients hospitalized for COVID-19 over one and two years reported decreased exercise capacity, measured by the six-minute walk test, compared with the general population, as well as a high proportion (50%) who had not returned to pre-hospitalization physical activity levels (22,27).

The impact on physical performance three to four months post-infection was also demonstrated in patients not hospitalized during their acute COVID-19 episode (28). Among patients from dedicated PCC clinics, 36% and 40% reported moderate to severe exercise limitation, with a drastic reduction in the frequency of moderate or intense physical activity compared with their activity before COVID-19 infection (29,30). As these patients were followed at a PCC clinic, they likely had moderate or severe symptoms.

Among our participants, one-third of moderate and severe PCC cases reported cognitive impairments with a significant impact on their daily activities. These impairments were about three times more frequent than in controls, following the trend observed at the beginning of the pandemic (2021) among HCWs in Quebec (9). These cognitive symptoms were also frequently observed in other patients with PCC (1,31), and were associated with limitations in daily functioning (32).

Psychological distress is not a measure of functional impact, but is a consequence of PCC that may contribute to the degree of disability associated with the illness. HCWs with PCC reported high or very high psychological distress twice as often as HCWs without PCC, contrary to observations from the HCW survey conducted in 2021 (9). The excess distress, compared to HCWs without PCC, was attributed to PCC by affected HCWs and increased with the severity of their symptoms. It is not possible to distinguish whether this excess distress is directly caused by PCC or if it is a secondary psychological reaction to the persistence of symptoms and accompanying functional disabilities.

5.3 Impact of PCC on functioning in professional activities

Persistent PCC symptoms have a considerable impact on individuals' physical, cognitive, and psychological capacity to participate in work, resulting in increased absenteeism and presenteeism (6). Presenteeism is defined as the phenomenon of people continuing to work despite ill health that should prompt rest, which likely accounts for suboptimal functioning and productivity losses (33). Several studies have shown the impact of PCC on patients' ability to return to work (31, 34, 39–41), or their need for workplace adaptations, such as reduced hours or changes in tasks (35,37). The proportion of patients with PCC returning to work varies between 50% and 80% depending on the type of cohort (e.g. HCWs, patients at post-COVID clinics, support groups), the time since SARS-CoV-2 infection, and PCC severity (31, 34, 39, 41). About 80% of PCC cases in our survey reported continuing to be in paid employment, a proportion that decreased to 53% among cases with multiple severe symptoms. Among PCC cases returning to work, several adaptations were reported. These may include using the strategy of taking absences from work, possibly to manage symptoms (use of more than 24 days of absence per year in 26% of PCC cases). They may also include modifications to tasks, schedules, workstations, or the job itself (in about 20% of PCC cases).

In addition to the return to work, several studies have assessed work ability, mainly measured with the Work Ability Index questionnaire. Work ability was reduced in PCC cases compared with their best lifetime capacity, pre-pandemic capacity, or a control group (38–40). However, work ability remained unchanged or only decreased slightly in over half of PCC cases in a study of HCWs and in a study of patients at a PCC clinic (39,41). In our investigation, the work ability of PCC cases was reduced compared with their (self-reported) situation before the pandemic (16.5% vs 0.3% with low work ability), as well as compared with the control group (16.5% vs 3.4% with low work ability). About 50% of all PCC cases reported their work ability as good or excellent, ranging from 72% for mild cases, to 37% and 15% for severe and very severe cases.

The association between PCC severity and work ability was measured indirectly in two studies, which showed that the (self-reported) level of decline in health status and the number of symptoms were inversely associated with work ability (40,42). Our study showed that the risk of absenteeism and difficulty in work functioning, compared with the control group, increases with the severity of PCC symptoms. The risk was low for mild cases, but 12 and 13 times higher for very severe cases, in all job categories. Several studies have reported the presence of cognitive impairments and severe fatigue as the main symptom predictors of limitations in work participation, capacity, or functioning (43–47). Time since infection and depressive symptoms were also associated with work functioning (9, 48, 51). In our study, cognitive symptoms (brain fog, concentration and memory problems) and fatigue were both associated with a twofold higher risk of long-term absenteeism. Difficulties in

work functioning were more strongly associated with cognitive symptoms (OR = 4.4) than with fatigue (OR = 2.8).

In summary, our results confirm observations reported in the literature and add stratification by PCC severity as an essential element in understanding the functional impact of this illness. This is a significant contribution to the current knowledge. In all studied dimensions, the effect of PCC on professional activities increases with symptom severity. Mild PCC cases, which represent 25% of all cases, have work participation and ability fairly comparable to HCWs without PCC. The largest part of the disease burden in terms of functional impairments is due to cases with severe symptoms, which represent one-third of PCC cases.

5.4 Role of work-related psychosocial risks

According to data from the Quebec Population Health Survey, 2014–2015 and 2020–2021 editions, the healthcare and social assistance sector has been one of the fields most affected by work-related PSRs in Quebec, even before the pandemic (49,50). The harmful nature of work-related PSRs, for both physical and mental health, is supported by scientific literature internationally, as described by recent systematic reviews (51–53). These reviews show that exposure to work-related PSRs increases the risk of psychological distress, anxiety and depressive symptoms, burnout, vascular diseases, musculoskeletal disorders, and other adverse health outcomes in employed individuals.

HCWs with PCC who participated in our study reported a less favourable psychosocial work environment than controls for each psychosocial dimension assessed. It is possible that people in poorer health have a more negative perception of their working conditions and psychosocial work environment, or that the associations between PSRs and the functional impact of PCC are bidirectional. In multivariate analyses, several unfavourable psychosocial dimensions (or work-related PSRs) were associated with an increased risk of difficulties in work functioning, in both moderate and severe PCC cases. Among these dimensions are quantitative demands, role conflicts, and work-life conflict. Conversely, some psychosocial dimensions considered favourable were associated with a decrease in the functional impact of PCC. These favourable dimensions are the ability to perform tasks with satisfactory quality and recognition at work. All of these findings, based on cross-sectional self-reported data, suggest an association between PSRs and PCC symptoms, which may influence the functional impacts of PCC.

In this study, we treated the PSR indicators as continuous variables, as recommended, without commenting on score differences deemed clinically important between PCC cases and controls. Two German studies of healthcare staff considered five-point differences in COPSOQ III indicators to be clinically important, according to the Cohen's effect sizes (54,55). We could also consider that several differences between groups in our study are clinically important, such as the difference between PCC cases and COVID controls in scores for quantitative demands and work-life conflict.

We also used PSR indicators as categorical variables in the multivariate analyses for exploratory purposes. We have thus estimated that the probability of reporting suboptimal work functioning was reduced by about 90% for moderate and severe PCC cases reporting a low rather than high level of quantitative demands and work-life conflict. Further studies will be needed to specify and validate the thresholds beyond which an adverse effect is expected for COPSOQ III indicators.

Considering our results and the demonstrated associations between exposure to work-related PSRs and the health status of workers, it is plausible that work-related PSRs contribute to PCC and its associated functional impacts through various mechanisms. Some work-related PSRs, such as high quantitative demands, may make work more burdensome for workers affected by PCC, thus complicating their continued employment. Moreover, psychological distress associated with work (particularly work-related PSRs) could add to the PCC-related psychological distress and contribute to disability and difficulty in work functioning. The next phases of this study, with a longitudinal design, may allow a better understanding of the mechanisms linking, among other things, work-related PSRs to functional impacts associated with PCC.

5.5 Study strengths and limitations

Strengths of this study include the large number of participants, the comparison of PCC cases with controls, and the use of multiple validated questionnaires to assess functional impairments and work-related PSRs.

The low participation rate likely led to an overrepresentation of HCWs with PCC. Its impact was assessed in the estimation of the condition's frequency (5). Differential participation of PCC cases according to their severity could influence the interpretation of our results, as well as underestimate functional disability in more severe cases (if, for example, they were too affected to participate in the questionnaire). However, thanks to the large number of participants, the overall description of functional impact by severity category and the analyses compared to controls are not affected by the participation rate.

Two types of control groups were formed based on their report of prior SARS-CoV-2 infection. Some non-COVID controls could have had an undocumented or unsuspected infection, given the context of decreased use of diagnostic tests.

However, this potential bias does not impact the conclusions, as the COVID controls were used as the main comparison group in the analyses.

On the other hand, even though the association between PCC and absenteeism or work incapacity was assessed adjusting for the main potential confounding factors, the absence of residual confounding by other factors, such as certain work-related PSRs, cannot be guaranteed.

The most significant limitation of this study is that it is based on a self-administered questionnaire without external objective validation of the PCC diagnosis, the functional impairments, or the work-related PSRs. To assess the impact of a phenomenon that has occurred over a number of years, the cross-sectional design of this study is not ideal and could be associated with recall bias, particularly for questions concerning functioning before the pandemic. This issue will be addressed in the follow-up of phases 2 and 3. The effect of clinical management and received care on symptom progression and functional impact could not be assessed using a cross-sectional design.

There are currently no biological tests to confirm a PCC diagnosis. The diagnosis relies on a broad clinical definition, which includes a large number of symptoms not specific to PCC, and there are no internationally accepted criteria defining PCC severity. While the specificity of this clinical definition increases with the number and severity of symptoms, the proportion of HCWs whose self-reported persistent symptoms are not related to COVID-19 is likely higher among mild PCC cases than among those with more severe PCC (5).

Objective validation of functional impairments through physical or mental capacity tests conducted by external examiners, although desirable, is difficult to implement in such a large sample of HCWs. The same applies to objective assessment of exposure to work-related PSRs. The use of large validated questionnaires remains a relevant alternative for large-scale population studies.

5.6 Implications for public health

Nearly three-quarters of HCWs with PCC had a moderate or severe impairment associated with significant prolonged physical and cognitive functional impairments. This has implications for disability, rehabilitation services, and return to work support.

This study provides a robust empirical basis demonstrating that HCWs with PCC who have significant functional impairments have a real disability. The results presented could also provide an estimate of functional impairments, which is likely generalizable to all adult workers affected by PCC, potentially having implications for the entire working population of Quebec.

Even though the majority of participating PCC cases were still working, it appears relevant to consider offering rehabilitation services to reduce their functional impairments and prevent deterioration that would lead to cessation of employment and additional healthcare and social services costs.

Employers play an important role in this regard. Job retention among people with functional impairments, and the return to work for those who have had to interrupt their employment, will partly depend on employer support and a supportive, adaptable work environment. Insurance companies will also be essential stakeholders in recognizing a definition of partial work disability that considers different levels of severity as well as the fluctuating nature of PCC.

Finally, the results of this study suggest that managing PSRs in health and social services settings could help prevent work incapacity among staff affected by PCC. Since the assent of the Act to modernize the occupational health and safety regime in October 2021, identifying and managing PSRs in workplaces is a legal obligation of Quebec employers (56). They must now identify, correct, and control these risks, just like other occupational hazards. Assessing work-related PSRs and implementing interventions to reduce them is also one of the objectives of the MSSS's "Plan d'action national visant la prévention des risques en milieu de travail et la promotion de la santé globale 2019–2023", which is the ministry's action plan to prevent workplace risks and promote overall health (57).

6 CONCLUSION

PCC causes physical, cognitive, and psychological impairments that have a significant functional impact and are more disabling when the PCC is severe. Although the majority of PCC cases are still working, these impairments affect their well-being and limit their productivity. Among people with PCC who are returning to work, a considerable number need to modify their tasks or work schedules to accommodate persistent impairments. Factors such as physical workplace accommodations, support policies, vocational rehabilitation programs, and appropriate insurance frameworks play a critical role in facilitating a successful return to work.

The next phases of this investigation will further explore the progression of PCC's functional impact through one- and two-year follow-ups.

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APPENDIX 1 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, Canadian Institutes of Health Research (CIHR) Pan-Canadian 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 and 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.
Alain Piché	Research grants for multiple long COVID studies from the Canadian Institutes of Health Research (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. Participation in multiple radio and television interviews on long COVID from 2022 to 2024.
Clermont Dionne	Research grant from the Canadian Institutes of Health Research (CIHR) for a study on the psychosocial work environment from 2024 to 2027.

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 15 Scoring method for the Work Role Functioning Questionnaire v2.0

Dimensions	Items	Item scores	Dimension scores
1. Work scheduling	<p>1.1. <i>Get going easily at the beginning of the workday</i></p> <p>1.2. <i>Start on your job as soon as you arrived at work</i></p> <p>1.3. <i>Do your work without stopping to take extra breaks or rests</i></p> <p>1.4. <i>Stick to a routine or schedule</i></p>	<p>0 – Difficult all of the time = 0%</p> <p>1 – Difficult most of the time = 25%</p> <p>2 – Difficult half of the time = 50%</p> <p>3 – Difficult some of the time = 75%</p> <p>4 – Difficult none of the time = 100%</p> <p>NA – Does not apply to my job</p>	<p>a. Calculate only if < 20% of the items are not applicable</p> <p>b. Add up the score for all items and divide by the number of valid items (score = 0%–100%)</p>
2. Output demands	<p>2.1 <i>Work fast enough</i></p> <p>2.2 <i>Finish work on time</i></p> <p>2.3 <i>Do your work without making mistakes</i></p> <p>2.4 <i>Satisfy the people who judge your work</i></p> <p>2.5 <i>Feel a sense of accomplishment in your work</i></p> <p>2.6 <i>Feel you have done what you are capable of doing</i></p>	<p>0 = 0%</p> <p>1 = 25%</p> <p>2 = 50%</p> <p>3 = 75%</p> <p>4 = 100%</p> <p>NA</p>	<p>a. Calculate if < 20% of items NA</p> <p>b. Add up the score for all items and divide by the number of valid items (score = 0%–100%)</p>
3. Physical demands	<p>3.1 <i>Lift, carry, or move objects at work weighing more than 10 pounds</i></p> <p>3.2 <i>Sit, stand, or stay in one position for longer than 15 minutes while working</i></p> <p>3.3 <i>Repeat the same motions over and over again while working</i></p> <p>3.4 <i>Bend, twist, or reach while working</i></p> <p>3.5 <i>Use hand-held tools or equipment</i></p>	<p>0 = 100%</p> <p>1 = 75%</p> <p>2 = 50%</p> <p>3 = 25%</p> <p>4 = 0%</p> <p>NA</p>	<p>a. Calculate if < 20% of items NA</p> <p>b. Add up the score for all items and divide by the number of valid items (score = 0%–100%)</p>
4. Mental and social demands	<p>4.1 <i>Keep your mind on your work</i></p> <p>4.2 <i>Do work carefully</i></p> <p>4.3 <i>Concentrate on your work</i></p> <p>4.4 <i>Work without losing your train of thought</i></p> <p>4.5 <i>Easily read or use your eyes while working</i></p> <p>4.6 <i>Speak with people in person, in meetings, or on the phone</i></p> <p>4.7 <i>Control your temper around people when working</i></p>	<p>0 = 100%</p> <p>1 = 75%</p> <p>2 = 50%</p> <p>3 = 25%</p> <p>4 = 0%</p> <p>NA</p>	<p>a. Calculate if < 20% of items NA</p> <p>b. Add up the score for all items and divide by the number of valid items (score = 0%–100%)</p>

Scoring method for the Work Role Functioning Questionnaire v2.0

Dimensions	Items	Item scores	Dimension scores
5. Flexibility demands	5.1 <i>Set priorities in my work</i> 5.2 <i>Handle changes in my work</i> 5.3 <i>Process incoming information, for example emails, in time</i> 5.4 <i>Perform multiple tasks at the same time</i> 5.5 <i>Be proactive, show initiative in my work</i>	0 = 100% 1 = 75% 2 = 50% 3 = 25% 4 = 0% NA	a. Calculate if < 20% of items NA b. Add up the score for all items and divide by the number of valid items (score = 0%–100%)
Total work role functioning score			Mean score for valid items (score = 0%–100%)

Abbreviations: NA: not applicable

Table 16 Items and construction of the work-related psychosocial risk indicators measured by the COPSOQ III questionnaire

PSR indicator	Items	Response scale (points)	Construction of the indicator
Domain: Demands at Work			
1. Quantitative Demands	1.1 <i>How often do you not have time to complete all your work tasks?</i> 1.2 <i>Do you get behind with your work?</i>	Always = 100 Often = 75 Sometimes = 50 Seldom = 25 Never or hardly ever = 0	Mean score for the two items (score = 0–100 points)
2. Work Pace	2.1 <i>Do you have to work very fast?</i>	Always = 100 Often = 75 Sometimes = 50 Seldom = 25 Never or hardly ever = 0	Mean score for the two items (score = 0–100 points)
	2.2 <i>Do you work at a high pace throughout the day?</i>	To a very large extent = 100 To a large extent = 75 Somewhat = 50 To a small extent = 25 To a very small extent = 0	
3. Emotional Demands	3.1 <i>Do you have to deal with other people's personal problems as part of your work?</i>	Always = 100 Often = 75 Sometimes = 50 Seldom = 25 Never or hardly ever = 0	Mean score for the two items (score = 0–100 points)
	3.2 <i>Is your work emotionally demanding?</i>	To a very large extent = 100 To a large extent = 75 Somewhat = 50 To a small extent = 25 To a very small extent = 0	
Domain: Work Organization			
4. Influence at Work	4.1 <i>Do you have a large degree of influence on the decisions concerning your work?</i> 4.2 <i>Can you influence the amount of work assigned to you?</i>	Always = 100 Often = 75 Sometimes = 50 Seldom = 25 Never or hardly ever = 0	Mean score for the two items (score = 0–100 points)
5. Quality of Work	5.1 <i>To what extent do you find it possible to perform your work tasks at a satisfactory quality?</i>	To a very large extent = 100 To a large extent = 75 Somewhat = 50 To a small extent = 25 To a very small extent = 0	Not applicable

Table 16 Items and construction of the work-related psychosocial risk indicators measured by the COPSOQ III questionnaire (continued)

PSR indicator	Items	Response scale (points)	Construction of the indicator
Domain: Interpersonal Relations and Leadership			
6. Recognition	6.1 <i>Is your work recognized and appreciated by the management?</i> 6.2 <i>Are you treated fairly at your workplace?</i>	To a very large extent = 100 To a large extent = 75 Somewhat = 50 To a small extent = 25 To a very small extent = 0	Mean score for the two items (score = 0–100 points)
7. Role Conflicts	7.1 <i>Are contradictory demands placed on you at work?</i> 7.2 <i>Do you sometimes have to do things which ought to have been done in a different way?</i>	To a very large extent = 100 To a large extent = 75 Somewhat = 50 To a small extent = 25 To a very small extent = 0	Mean score for the two items (score = 0–100 points)
8. Social Support from Colleagues	8.1 <i>How often do you get help and support from your colleagues, if needed?</i> 8.2 <i>How often are your colleagues willing to listen to your problems at work, if needed?</i>	Always = 100 Often = 75 Sometimes = 50 Seldom = 25 Never or hardly ever = 0	Mean score for the two items (score = 0–100 points)
9. Social Support from Supervisor	9.1 <i>How often is your immediate superior willing to listen to your problems at work, if needed?</i> 9.2 <i>How often do you get help and support from your immediate superior, if needed?</i>	Always = 100 Often = 75 Sometimes = 50 Seldom = 25 Never or hardly ever = 0	Mean score for the items (score = 0–100 points)
Domain: Work–Individual Interface			
10. Job Insecurity	10.1 <i>Are you worried about becoming unemployed?</i> 10.2 <i>Are you worried about it being difficult for you to find another job if you became unemployed?</i>	To a very large extent = 100 To a large extent = 75 Somewhat = 50 To a small extent = 25 To a very small extent = 0	Mean score for the items (score = 0–100 points)
11. Job Satisfaction (salary)	11.1 <i>Regarding your work in general, how pleased are you with your salary?</i>	Very satisfied = 100 Satisfied = 75 Neither/Nor = 50 Unsatisfied = 25 Very unsatisfied = 0	Not applicable
12. Work-Life Conflict	12.1 <i>Do you feel that your work drains so much of your energy that it has a negative effect on your private life?</i> 12.2 <i>Do you feel that your work takes so much of your time that it has a negative effect on your private life?</i>	To a very large extent = 100 To a large extent = 75 Somewhat = 50 To a small extent = 25 To a very small extent = 0	Mean score for the items (score = 0–100 points)

Table 17 Health-related absenteeism and work functioning difficulties according to work changes due to PCC

Work changes due to PCC	Nurses, physicians, psychosocial professionals, other health professionals			Patient attendants, housekeeping staff, other health technicians			Managers, supervisors, administrative staff		
	N (%)	≥ 100 d absent	WRFQ < 90%	N (%)	≥ 100 d absent	WRFQ < 90%	N (%)	≥ 100 d absent	WRFQ < 90%
	Row %		Row %	Row %		Row %	Row %		Row %
Mild PCC	293	6.5	64.3	78	3.9	67.1	73	2.7	67.2
No change	245 (83.6)	4.9	61.2	73 (93.6)	2.7	65.2	67 (91.8)	1.5	65.6
Reduced working hours	29 (9.9)	10.3	88.5	2 (2.6)	0.0	100.0	4 (5.5)	0.0	75.0
Changed job	14 (4.8)	7.1	66.7	2 (2.6)	50.0	100.0	1 (1.4)	0.0	100.0
Stopped working	5 (1.7)	75.0	100.0	1 (1.3)	NE	NE	1 (1.4)	100.0	100.0
Moderate PCC	489	9.3	81.2	165	11.6	75.0	153	4.7	68.6
No change	361 (73.8)	5.3	78.7	132 (80.0)	9.8	71.8	122 (79.7)	2.5	67.5
Reduced working hours	71 (14.5)	12.7	91.0	20 (12.1)	15.0	84.2	10 (6.5)	10.0	70.0
Changed job	35 (7.2)	17.1	81.8	7 (4.2)	14.3	100.0	14 (9.2)	7.1	76.9
Stopped working	22 (4.5)	61.1	100.0	6 (3.6)	40.0	100.0	7 (4.6)	66.7	NE
Severe PCC	297	24.7	91.0	206	27.8	85.0	116	19.3	91.9
No change	162 (54.5)	9.9	86.7	97 (47.1)	7.2	80.5	77 (66.4)	6.5	89.7
Reduced working hours	59 (19.9)	16.9	100.0	41 (19.9)	26.8	94.4	10 (8.6)	10.0	100.0
Changed job	20 (6.7)	15.0	94.1	16 (7.8)	18.8	86.7	5 (4.3)	0.0	100.0
Stopped working	56 (18.9)	84.3	100.0	52 (25.2)	77.3	85.7	24 (20.7)	72.7	100.0

Abbreviations: d: days; NE: not estimable; No change: neither stopped working nor modified job; PCC: post COVID-19 condition; WRFQ: Work Role Functioning Questionnaire

Table 18 Work functioning in the dimensions measured by the Work Role Functioning Questionnaire, stratified by job category

	Overall WRFQ score	Dimensions				
		Work scheduling	Output demands	Physical demands	Mental/social demands	Flexibility demands
Category 1: Nursing and licensed practical nursing staff, physicians, psychosocial professionals, and other health professionals						
Total valid N ^a	9,489	8,679	9,290	4,746	9,416	8,847
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
PCC CASES						
Mild PCC	78.4 (22.4)	76.9 (24.1)	77.8 (23.6)	79.5 (27.7)	77.8 (23.5)	78.1 (24.8)
Moderate PCC	72.1 (20.1)	67.9 (24.0)	71.8 (22.1)	72.2 (25.4)	72.9 (21.1)	73.0 (23.8)
Severe PCC	69.6 (19.1)	65.1 (25.5)	69.5 (21.1)	65.3 (27.2)	70.9 (20.7)	71.1 (23.8)
Very severe PCC	54.2 (22.0)	49.2 (24.7)	55.5 (25.5)	48.8 (23.7)	54.3 (25.4)	55.9 (27.1)
COVID controls	81.7 (22.1)	80.5 (24.2)	81.1 (23.2)	82.8 (27.0)	81.8 (22.8)	81.3 (24.0)
Non-COVID controls	76.7 (24.1)	76.4 (26.0)	76.0 (25.3)	77.3 (27.8)	77.1 (25.2)	75.4 (26.3)
Category 2: Patient attendants, nurse aides, housekeeping staff, and other health technicians						
Total valid N ^a	3,043	2,635	2,896	2,005	2,926	2,327
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
PCC CASES						
Mild PCC	78.9 (23.2)	77.1 (25.4)	78.8 (24.5)	80.3 (20.3)	79.8 (24.6)	82.4 (22.2)
Moderate PCC	74.3 (22.0)	70.0 (26.9)	75.1 (24.2)	72.8 (25.8)	75.0 (23.9)	77.5 (26.5)
Severe PCC	70.0 (23.0)	66.3 (26.5)	71.3 (26.8)	65.6 (25.9)	71.0 (26.2)	74.7 (25.6)
Very severe PCC	60.8 (21.9)	55.7 (25.0)	59.8 (26.1)	56.2 (27.5)	62.2 (26.8)	61.2 (28.2)
COVID controls	81.0 (24.7)	80.8 (25.6)	80.7 (26.3)	80.0 (27.4)	81.6 (25.6)	82.7 (26.3)
Non-COVID controls	77.2 (27.3)	76.4 (28.8)	76.5 (29.0)	76.3 (28.7)	77.9 (29.0)	79.2 (28.6)
Category 3: Administrative staff and managers						
Total valid N ^a	3,274	3,000	3,204	1,114	3,245	3,147
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
PCC CASES						
Mild PCC	82.1 (16.8)	80.4 (21.6)	82.7 (19.2)	83.5 (21.9)	80.9 (18.2)	83.7 (17.5)
Moderate PCC	73.7 (25.1)	70.5 (28.2)	73.7 (27.3)	63.8 (29.2)	72.9 (25.7)	75.6 (28.1)
Severe PCC	70.6 (20.7)	69.7 (21.4)	70.2 (23.7)	61.1 (22.8)	71.3 (22.8)	70.3 (26.2)
Very severe PCC	56.6 (20.0)	49.6 (23.1)	60.3 (25.2)	43.8 (23.7)	56.9 (23.7)	59.9 (25.6)
COVID controls	83.9 (21.2)	83.2 (22.7)	83.7 (22.7)	86.7 (24.0)	83.5 (21.8)	84.3 (23.1)
Non-COVID controls	78.1 (25.3)	78.9 (25.8)	77.7 (26.6)	76.0 (29.4)	77.5 (26.9)	78.1 (27.5)

^a Valid N for each score or subscore excluding those with > 20% of items missing responses or marked as not applicable.

Abbreviations: PCC: post COVID-19 condition; SD: standard deviation; WRFQ: Work Role Functioning Questionnaire

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