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Post COVID-19 Condition, Work Ability and Occupational Changes: Results from a Population-based Cohort

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Short Title: Post COVID-19 Condition and Work Ability

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Abstract

Background: Evidence from population-based studies on the impact of post COVID-19 condition (PCC) on ability to work is limited but critical due to its high prevalence among individuals of working-age.

Objective: To evaluate the association between PCC, work ability, and occupational changes.

Design: Population-based, longitudinal cohort.

Setting: General population, Canton of Zurich, Switzerland.

Participants: 672 adults of working-age with SARS-CoV-2 infection.

Measurements: Current work ability, work ability related to physical and mental demands, and estimated future work ability in 2 years (assessed using Work Ability Index), as well as PCC-related occupational changes at one year after infection.

Results: There was very strong evidence that current work ability scores were 0.62 (95% confidence interval (CI) 0.30 to 0.95) points lower among those with PCC compared to those without. Similarly, there was very strong evidence for lower odds of reporting higher work ability with respect to physical (odds ratio (OR) 0.30, 95% CI 0.20 to 0.46) and mental (OR 0.40, 0.27 to 0.62) demands among those with PCC compared to those without. Higher age and history of psychiatric diagnosis were associated with a more substantial reduction in current work ability. 5.8% of those with PCC reported direct effects of PCC on their occupational situation, with 1.6% of those with PCC completely dropping out of the workforce and 43% of those with PCC-related occupational changes reporting financial difficulties as a result.

Limitations: Selection, use of self-reported outcome measures, and limited generalizability to individuals with most severe COVID-19 or following vaccination.

Conclusions: These findings highlight the need for providing support and interdisciplinary interventions to individuals affected by PCC to help them maintain or regain their work ability and productivity.

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Introduction

Post COVID-19 condition (PCC) affects 10-20% of individuals infected with SARS-CoV-2 (1–11). Symptoms associated with PCC are varied and can be physical (e.g., fatigue, post-exertional malaise, pain, and dyspnea) or mental (most commonly memory and concentration difficulties) (2,12,13). Many of these symptoms adversely impact individuals' everyday functioning, including impairments to their ability to engage in physical activities and participate in social life and work (1,2,14). The prevalence of PCC is highest among those of working age (11,12) and the resulting socioeconomic implications are likely considerable (15,16). While it is important to develop effective management strategies and interventions to reduce the health burden of PCC, it is thus critical to also consider its impact on the workforce and establish sensible pathways to restore occupational participation in those severely affected.

Few studies have evaluated the association of PCC with work-related functioning or subsequent occupational changes (17–27). Most focused on describing work absenteeism and found that 11%-50% of workers do not return to work several months after COVID-19 (2,14). Various individual, organizational, and systemic aspects (e.g., supportive return-to-work policies) contribute to successful return to work after an illness, including having sufficient actual work ability (28–30). Work ability is a multifactorial measure frequently used in clinical practice and research to assess the degree to which an individual is physically and mentally able to cope with demands at work (31–33). In addition to short- and long-term sickness absence (34–37), poor work ability is also associated with early retirement (38,39) and disability at work (39,40), all of which carry large repercussions for the labor market and economy. Rehabilitation programs targeted at the working-age population generally aim to improve or preserve work ability. Given the substantial prevalence of PCC and its potential for long-term work-related consequences, understanding the association of PCC with work ability is crucial for the development of policies and multidisciplinary strategies aimed at supporting affected individuals in their recovery.

In this study, we aimed to comprehensively evaluate the association between PCC, work ability, and occupational changes in a working-age population within a prospective population-based cohort of SARS-CoV-2 infected individuals.

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Methods

Study Design and Participants

We used data from a population-based, prospective, observational cohort of individuals with diagnosed SARS-CoV-2 infection from the Canton of Zurich, Switzerland (Zurich SARS-CoV-2 Cohort; ISRCTN14990068) (41). Based on mandatory reporting of all SARS-CoV-2 infections to the Department of Health of the Canton of Zurich, we prospectively invited on a daily basis an age-stratified (18–39 years, 40–64 years, ≥65 years), random sample of eligible individuals diagnosed between 06 August 2020 and 19 January 2021 for study participation. Eligibility criteria were being 18 years or older, able to follow study procedures, residing in the Canton of Zurich, and having sufficient knowledge of the German language. All participants were enrolled upon or shortly after diagnosis, infected with wildtype SARS-CoV-2, and were unvaccinated at time of infection. In this study we included individuals of working age (18–64 years old; the retirement age is 65 years in Switzerland (42)) who did not report being retired at enrollment. To ensure that evaluated outcomes were not related to reinfection with SARS-CoV-2 over the course of follow-up, we excluded individuals reporting a reinfection event. The study was approved by the ethics committee of the Canton of Zurich (BASEC-Nr. 2020-01739) and we obtained written or electronic consent from all participants.

Data Sources

We collected data using electronic questionnaires. At baseline immediately after enrollment, we collected data on the acute primary infection (i.e., symptoms, severity), pre-existing comorbidities (any of hypertension, diabetes, cardiovascular disease, chronic respiratory disease, chronic kidney disease, malignancy, or immune suppression), pre-infection health status, and socio-demographic characteristics. In this ongoing cohort, we collect follow-up data on participants' health trajectories in regular intervals after infection (9,10). At 12 months, we additionally elicited measures of work ability and asked participants to report any occupational changes over the first 12 months post-infection. Simultaneously, we asked participants to report any pre-existing psychiatric diagnoses before infection and any new or worsened psychiatric diagnoses during follow-up. Participants were also asked to provide further details in free text fields. One researcher (DM) additionally conducted personal phone interviews with participants for whom questionnaire information was not unequivocal (n=4).

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104

105 **Outcome Measurement**

106 We assessed self-perceived work ability using selected measures from the Work Ability Index, a validated
107 and frequently used instrument for assessing work ability (31,32,34). The primary outcome was the current
108 work ability scale (score from 1–10, with 10 being best ability and 0 no ability to work). In sensitivity
109 analyses, we categorized current work ability into poor (scores ≤6), moderate (scores 7-8), and excellent
110 (scores ≥9) (43). Secondary outcomes included items evaluating work ability related to physical and mental
111 demands (5-point Likert scale) and estimated future work ability in 2 years (3-point Likert scale), and
112 occupational changes related to PCC during follow-up. We defined PCC using two different measures.
113 First, we defined the presence of PCC as participants (self-)reporting any COVID-19 related symptom out
114 of a list of 23 common PCC-related symptoms at 12 months of follow-up (*PCC status*). Second, we used a
115 combined measure of whether participants had fully recovered and how they assessed their current health
116 status (using the EuroQol visual analog scale (EQ-VAS)) at 12 months (*non-recovery and health*
117 *impairment status*); non-recovered participants were categorized into mild (EQ-VAS >70), moderate (EQ-
118 VAS 51–70) and severe health impairment (EQ-VAS ≤50) based on population-normative values from
119 previous research (10,44–46). Further measures indicating potential presence of PCC were individual
120 COVID-19 related symptoms, commonly reported PCC-related symptom clusters (fatigue/physical
121 exertion, cardiorespiratory (defined as dyspnea, palpitation, or chest pain), or neurocognitive (defined as
122 concentration, memory, or sleeping problems)), EuroQol 5-dimension 5-level scale (EQ-5D-5L), Fatigue
123 Assessment Scale (FAS), 21-item Depression, Anxiety and Stress Scale (DASS-21), and modified Medical
124 Research Council (mMRC) dyspnea scale. Further information on evaluated work ability outcomes,
125 occupational changes, and PCC-related outcomes is provided in Supplementary Table S1.

126

127 **Statistical Analysis**

128 We descriptively compared the reported work ability outcomes in individuals with PCC or reporting non-
129 recovery with associated level of health impairment 12 months after diagnosis. We further descriptively
130 analyzed differences between individuals reporting individual symptoms, symptom clusters, or problems
131 in any of the standardized health assessments (EQ-5D-5L overall and subdomains, FAS, DASS-21, mMRC
132 dyspnea scale) and those without. We then used multivariable regression models to evaluate the association

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of PCC-related outcomes with work ability outcomes. Model selection included age, sex, baseline health status, hospitalization during acute infection as a priori covariates, with education level, comorbidity count, and history of psychiatric diagnosis added based on improved model fit using the Bayesian Information criterion (BIC; 2-point change considered relevant). For current work ability, we used linear regression (scores 1–10) in primary and ordinal logistic regression (poor, moderate, excellent work ability) in sensitivity analyses. We used ordinal logistic regression for Likert scale-based work ability outcomes. Correspondingly, we report adjusted linear model estimates and odds ratios (ORs) with corresponding 95% confidence intervals (CIs). We evaluated differences in the strength of association (i.e., effect modification) between participant subgroups based on sex (male vs. female), age (40–64 years vs. 18–39 years), comorbidity count (0–1 comorbidity vs. ≥2 comorbidities), and history of psychiatric diagnosis (present vs. absent), descriptively and by using interaction models. Additionally, we descriptively analyzed differences in work ability based on the occurrence of new or worsened psychiatric diagnoses. And last, we described the occupational changes by participants overall and specifically related to PCC. We performed all statistical analyses using R (v4.2.2) (47).

Results

Participant Characteristics

Of 1106 Zurich SARS-CoV-2 Cohort participants, 306 were not part of the working-age population, 15 were excluded due to reinfection, and 113 did not provide data at 12 months (Figure 1). Of 672 participants, included in this study, 364 (54.2%) were female, 390 (58.0%) were aged 40-64 years, 79 (11.8%) were asymptomatic, and 9 (1.3%) were hospitalized at initial infection (Table 1). 19 participants (2.8%) reported being unemployed and 4 (0.6%) reported receiving disability insurance benefits at baseline. There were differences in age, sex, severity of acute infection, comorbidities, and history of psychiatric diagnoses between those categorized as having PCC and those without (Supplementary Table S2).

Work Ability

In descriptive analyses of current work ability, ability related to physical and mental demands at work, and estimated future work ability in 2 years, there was a relevant reduction in work ability across all four outcomes among those with PCC (based on reporting COVID-19 related symptoms) compared to those

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without and among those reporting non-recovery compared to those that had recovered at 12 months (Figure 2, Supplementary Table S3). Work ability among those reporting non-recovery was more strongly reduced in those with moderate and severe health impairment compared to those with mild health impairment.

In adjusted regression analyses, there was very strong evidence that current work ability scores were 0.62 (95% CI 0.30 to 0.95) points lower among those with PCC compared to those without (Figure 3). Current work ability scores were 0.55 (0.21 to 0.88), 3.37 (2.58 to 4.16), and 5.10 (4.16 to 6.04) points lower among those with non-recovery and mild, moderate, and severe health impairment, respectively, compared to those reporting full recovery (very strong evidence). Similarly, there was very strong evidence for a lower odds of having higher work ability with respect to physical (OR 0.30, 95% CI 0.20 to 0.46) and mental (OR 0.40, 0.27 to 0.62) demands among those with PCC compared to those without. Results were similar when evaluating non-recovered individuals compared to those reporting recovery, while reductions in work ability were more pronounced with higher levels of health impairment. There was no evidence for lower odds of having higher estimated future work ability in 2 years (OR 0.52, 0.26 to 1.06) among those with PCC compared to those without and among those with non-recovery and mild health impairment compared to those reporting recovery, but very strong evidence for a reduction in those with moderate or severe health impairment compared to recovered participants. Sensitivity analyses treating current work ability as an ordinal outcome showed similar results (Supplementary Figure S1).

Further analyses demonstrate the association between the presence of specific symptom clusters, individual COVID-19 related symptoms, and presence of health problems in EQ-5D-5L, FAS, DASS-21, and mMRC dyspnea scale and current work ability at 12 months (Supplementary Figures S2–S4, Supplementary Tables S4–S8). Across these analyses, there was very strong evidence for an association between most of the outcomes and current work ability, although not for all individual symptoms.

Work Ability in Participant Subgroups

In subgroup analyses, there was strong evidence for a difference in the association (i.e., effect modification) of PCC with current work ability and work ability related to physical demands between participants aged 40–64 years and those aged 18–39 years, with a higher reduction in work ability in the older group (Table

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2, Supplementary Tables S9–S12). Meanwhile, there was no evidence for a difference in the association of PCC with any work ability outcome between male and female participants, or between participants with 0–1 comorbidity and participants with ≥2 comorbidities. Last, there was a stronger association of PCC with current work ability (strong evidence) and work ability related to mental demands (weak evidence) in participants with history of psychiatric diagnosis compared to those without. Further descriptive analyses demonstrated relevant differences between participants with different mental health trajectories, indicating a stronger reduction in work ability among participants with history of psychiatric diagnosis and those with a new or worsened psychiatric diagnosis compared to those without history or new or worsened diagnosis, respectively (Supplementary Table S13).

Occupational Changes

When evaluating occupational changes up to 12 months, overall 119 (18.1%) participants reported to have had such a change during follow-up (Table 3), with a slightly higher proportion among participants with PCC (31/120, 25.8%) compared to those without PCC (88/552, 16.3%). 7 participants (1.1% of all participants, 5.8% of those with PCC) reported to have faced direct effects by PCC on their occupational situation. Work ability at 12 months was relevantly reduced among those 7 participants with occupational changes related to PCC compared to those without occupational changes and those with PCC-unrelated occupational changes (Supplementary Table S14).

The 7 participants with PCC-related occupational changes reported various individual stories in how PCC affected their work life. One participant lost their work due to PCC. Another reported to be on permanent sick leave at 12 months and being severely affected in daily life. One participant reported that they were unemployed at baseline and could not take on a new position due to PCC, and one was in a job re-integration program but was unable to re-enter the job market due to PCC. Another participant was so severely impacted cognitively that they could no longer use their professional skills (university level) and had to switch to doing simple administrative tasks. One health care worker reported that they had to take a different position that did not require working night shifts. And one participant reported that they had to discontinue their self-employed work as an instructor and seek another part-time job to cope financially because of

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PCC. Overall, 3 participants (43%) with PCC-related occupational changes reported to have some financial difficulties as a result of their condition and their resulting occupational situation.

Discussion

Main Findings in Context

In this prospective population-based cohort of working-age individuals previously infected with SARS-CoV-2, we found that the presence of PCC was strongly associated with a reduction in work ability at 12 months after diagnosis. Among non-recovered, higher levels of health impairment were also associated with substantially lower current work ability and work ability related to physical and mental demands. We found strong evidence that higher age and a history of psychiatric diagnosis was associated with a stronger reduction in current work ability. About 1 in 15 of those with PCC reported having had occupational changes due to PCC within one year, with 1.6% completely dropping out of the workforce.

Evidence on the impact of PCC on the occupational situation and work-related impairments due to PCC is limited and heterogenous (17–27). Prior studies have reported that between 11% and 50% of individuals do not return to work (2,14,26) and that 10% to 72% do not fully regain their work capacity 6 to 12 months after infection (7,23,26,27). Our estimate of 5.8% with occupational changes related to PCC falls in the lower bound of these estimates, which is likely explained by differences in the evaluated populations (e.g., many studies focused on healthcare workers or severely ill patients) and timepoint of assessment (very few with follow-up six months or longer). Differences between countries in terms of sickness and disability benefits systems, as well as cultural and organizational factors, may also explain the wide range of estimates in the literature. Nevertheless, the impact of PCC on the working-age population appears to be substantial and will likely lead to long-term burdens on economic and healthcare systems.

An important factor that determines sustainable return to work is the perceived work ability, which is also more independent of the specific context than return to work and occupational changes. To date, few studies have evaluated work ability in the context of PCC within specific populations of health-care workers and patients attending a post COVID-19 clinic (17,22). Evidence from this study and other studies demonstrated lower work ability scores among those with PCC, with a higher reduction among those with occupational

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248 changes. However, it is important to note that although most of the participants with PCC did not have
249 occupational changes and remained at work, decreased work ability in this group may still indicate reduced
250 productivity and efficiency. Sickness presenteeism (i.e., continuing to work while sick) may have negative
251 effects on both the individuals and their employers (48). Sick employees usually need extra efforts to cope
252 with job demands which may lead to additional worsening of their health, and the costs of having a sick
253 employee are estimated to be the same as or even higher than their actual absence (48). Strategies that
254 improve work-related capacity in individuals affected by PCC and promote return to work are urgently
255 needed. In addition, since reduced work ability also is a predictor of early retirement (38,39), it will be vital
256 in the coming years to continuously monitor whether there are increases in the number of people retiring
257 early due to PCC.
258
259 In line with other studies, we found a more substantial decrease in current work ability among individuals
260 aged 40-64 years compared to younger individuals. This is concerning since the middle-aged population is
261 typically viewed as the foundation of most economies, as they account for a significant proportion of the
262 workforce, tax revenue, and gross domestic product. We also found that individuals with a history of
263 psychiatric diagnosis had a greater reduction in work ability than those without. The relationship between
264 work and mental health is well-established in the literature (30,49). Targeted strategies and support
265 measures from occupational and rehabilitation medicine, possibly leveraging pre-existing programs for
266 individuals with chronic illnesses, should be put in place to support individuals affected by PCC. In
267 addition, both employees and employers need to be made aware of the mental health aspects of PCC and
268 the impact of mental health on work, as health-promoting working conditions and, for example, supportive
269 leadership may be relevant to the re-integration of relevant subgroups of employees (50).
270
271 Fallout from reduced work capacity results not only in financial and health challenges for individuals
272 affected by PCC, but can also have substantial consequences for the economy and society in the longer
273 term. Altogether, our findings underline the necessity for interdisciplinary interventions aimed at
274 individuals affected by PCC, including those with moderate or even mild health impairment. Given that
275 early intervention is a core principle of occupational rehabilitation, further research is warranted to
276 determine whether earlier rehabilitation could improve work outcomes in people with persistent symptoms

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after COVID-19 but who are not yet diagnosed with PCC. Identifying specific COVID-19 symptoms that predict impairment in work ability will help to develop and provide such early interventions. We consider this study to be part of that effort.

Limitations

Strengths of the study include its population-based approach, the large sample size, and the high retention rate at one year (90%) limiting emigrative selection bias arising from loss to follow-up. In addition, the granularity of the data and the use of a validated, internationally used, and context-independent measure of work ability strengthens our evaluation. However, some limitations need to be considered. First, immigrative selection may have occurred if individuals who were more health literate were more likely to participate or if individuals who had PCC and more severely impacted were more likely to be retained in the study. This may have led to an overestimation of the impact of PCC on work ability. In contrast, our findings may be biased towards lower estimates since only a small proportion of the participants were hospitalized for COVID-19. Second, the relatively low proportion of hospitalized participants also limits the generalizability of our results to those with the most severe acute disease, who may also suffer from more severe medical complications and sequelae of the hospital stay (e.g., post intensive care syndrome). Additionally, the generalizability of our findings to individuals infected with emerging SARS-CoV-2 variants of concern or who were vaccinated prior to infection is limited, since our participants were all infected with wildtype SARS-CoV-2 and unvaccinated at infection. The risk of PCC and severe health impairment is substantially reduced with vaccination and infection with newer variants, but still present (51–54). As the impact of PCC on work ability is likely comparable in these contexts, this may have significant socioeconomic implications given that more than 45% of the global population is estimated to have been infected with the Omicron variant (55). Further research is needed to evaluate whether similar reduced work ability and occupational changes are observed in vaccinated populations and in the context of emerging variants of concern. Nonetheless, the population from the early stages of the pandemic included in this study remains highly relevant since these are the individuals experiencing long-term health consequences at present, posing a challenge to public health. Third, we assessed PCC using self-reported measures. Since we could not conduct a clinical validation of PCC, we cannot fully exclude that reported symptoms and health impairment were related to the presence or worsening of other infections or

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conditions. Meanwhile, self-reported measures are key for capturing the lived experience of those affected, and the comparable results across two different definitions of PCC strengthen the credibility of our findings. Fourth, we did not have data on participants' work ability prior to SARS-CoV-2 infection. Thus, we cannot be fully certain that the reduced work ability is entirely due to infection and not other preexisting conditions. However, we at least partially accounted for this in our models by adjusting for baseline health status, and the detailed evaluation of the individual stories supports our finding of a reduced work ability related to PCC.

Conclusion

In this population-based study, we found that PCC significantly reduced the work ability of a relevant proportion of individuals a year after SARS-CoV-2 infection and in some instances led to an inability to work altogether. Such loss of productivity and incapacity to work can have severe implications for individuals, families, and society as a whole. It is critical that policymakers, healthcare professionals, and employers recognize the impact of PCC on the workforce and develop effective strategies and interventions that can support and enable affected individuals in regaining and retaining their work ability.

Declarations

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Ethical Approval: The study was approved by the responsible ethics committee of the Canton of Zurich, Switzerland (BASEC-Nr. 2020-01739). Written or electronic informed consent was obtained from all participants.

Competing Interests: The authors declare no conflicts of interest.

Author Contributions: TB, DM, JSF, and MAP conceived and planned the Zurich SARS-CoV-2 Cohort study. TB, DM, and MAP coordinated the Zurich SARS-CoV-2 Cohort study. PK, TB, MAP, and DM conceived and designed this analysis. TB, DM, AD, and MAP contributed to participant recruitment and data collection. MAP supervised the project. JSF and MAP obtained funding. TB and DM prepared the analytic datasets. DM performed the statistical analysis and SH provided input on the statistical analysis. All authors contributed to the interpretation of the data. PK, TB, and DM wrote the draft manuscript. All authors critically revised and provided feedback on the draft manuscript. All authors read and approved the final manuscript.

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References

1. Living with Covid19 – Second review [Internet]. NIHR Evidence. 2021 [cited 2022 Jun 16]. Available from: https://evidence.nihr.ac.uk/themedreview/living-with-covid19-second-review/
2. Nittas V, Gao M, West EA, Ballouz T, Menges D, Wulf Hanson S, et al. Long COVID Through a Public Health Lens: An Umbrella Review. Public Health Rev. 2022 Mar 15;43:1604501.
3. Global Burden of Disease Long COVID Collaborators. Estimated Global Proportions of Individuals With Persistent Fatigue, Cognitive, and Respiratory Symptom Clusters Following Symptomatic COVID-19 in 2020 and 2021. JAMA. 2022 Oct 10;
4. Ballering AV, Zon SKR van, Hartman TC olde, Rosmalen JGM. Persistence of somatic symptoms after COVID-19 in the Netherlands: an observational cohort study. The Lancet. 2022 Aug 6;400(10350):452–61.

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5. Perlis RH, Santillana M, Ognyanova K, Safarpour A, Lunz Trujillo K, Simonson MD, et al. Prevalence and Correlates of Long COVID Symptoms Among US Adults. JAMA Network Open. 2022 Oct 27;5(10):e2238804.
6. Bull-Otterson L. Post–COVID Conditions Among Adult COVID-19 Survivors Aged 18–64 and ≥65 Years — United States, March 2020–November 2021. MMWR Morb Mortal Wkly Rep. 2022;71(21):713–7.
7. Peter RS, Nieters A, Kräusslich HG, Brockmann SO, Göpel S, Kindle G, et al. Post-acute sequelae of covid-19 six to 12 months after infection: population based study. BMJ. 2022 Oct 13;379:e071050.
8. Hastie CE, Lowe DJ, McAuley A, Winter AJ, Mills NL, Black C, et al. Outcomes among confirmed cases and a matched comparison group in the Long-COVID in Scotland study. Nat Commun. 2022 Oct 12;13(1):5663.
9. Menges D, Ballouz T, Anagnostopoulos A, Aschmann HE, Domenghino A, Fehr JS, et al. Burden of post-COVID-19 syndrome and implications for healthcare service planning: A population-based cohort study. PLOS ONE. 2021 Jul 12;16(7):e0254523.
10. Ballouz T, Menges D, Anagnostopoulos A, Domenghino A, Aschmann HE, Frei A, et al. Natural course of post COVID-19 condition and implications for trial design and outcome selection: A population-based longitudinal cohort study. medRxiv. 2022;
11. Thompson EJ, Williams DM, Walker AJ, Mitchell RE, Niedzwiedz CL, Yang TC, et al. Long COVID burden and risk factors in 10 UK longitudinal studies and electronic health records. Nat Commun. 2022 Jun 28;13(1):3528.
12. Crook H, Raza S, Nowell J, Young M, Edison P. Long covid—mechanisms, risk factors, and management. BMJ. 2021 Jul 26;374:n1648.
13. Davis HE, McCorkell L, Vogel JM, Topol EJ. Long COVID: major findings, mechanisms and recommendations. Nat Rev Microbiol. 2023 Jan 13;1–14.
14. Gualano MR, Rossi MF, Borrelli I, Santoro PE, Amantea C, Daniele A, et al. Returning to work and the impact of post COVID-19 condition: A systematic review. Work. 2022 Jan 1;73(2):405–13.
15. Cutler DM. The Costs of Long COVID. JAMA Health Forum. 2022 May 12;3(5):e221809.
16. Office for National Statistics. Self-reported long COVID and labour market outcomes, UK: 2022 [Internet]. 2023 Dec [cited 2023 Mar 28]. Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/bulletins/selfreportedlongcovidandlabourmarketoutcomesuk2022/selfreportedlongcovidandlabourmarketoutcomesuk2022
17. Peters C, Dulon M, Westermann C, Kozak A, Nienhaus A. Long-Term Effects of COVID-19 on Workers in Health and Social Services in Germany. International Journal of Environmental Research and Public Health. 2022 Jan;19(12):6983.
18. Buonsenso D, Gualano MR, Rossi MF, Valz Gris A, Sisti LG, Borrelli I, et al. Post-Acute COVID-19 Sequelae in a Working Population at One Year Follow-Up: A Wide Range of Impacts from an Italian Sample. International Journal of Environmental Research and Public Health. 2022 Jan;19(17):11093.
19. Hodgson CL, Higgins AM, Bailey MJ, Mather AM, Beach L, Bellomo R, et al. The impact of COVID-19 critical illness on new disability, functional outcomes and return to work at 6 months: a prospective cohort study. Critical Care. 2021 Nov 8;25(1):382.
20. Perlis RH, Lunz Trujillo K, Safarpour A, Santillana M, Ognyanova K, Druckman J, et al. Association of Post–COVID-19 Condition Symptoms and Employment Status. JAMA Network Open. 2023 Feb 15;6(2):e2256152.
21. Jacobsen PA, Andersen MP, Gislason G, Phelps M, Butt JH, Køber L, et al. Return to work after COVID-19 infection – A Danish nationwide registry study. Public Health. 2022 Feb 1;203:116–22.
22. Sansone D, Tassinari A, Valentinotti R, Kontogiannis D, Ronchese F, Centonze S, et al. Persistence of Symptoms 15 Months since COVID-19 Diagnosis: Prevalence, Risk Factors and Residual Work Ability. Life. 2023 Jan;13(1):97.
23. Davis HE, Assaf GS, McCorkell L, Wei H, Low RJ, Re'em Y, et al. Characterizing long COVID in an international cohort: 7 months of symptoms and their impact. EClinicalMedicine. 2021 Aug 1;38:101019.

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24. O' Mahony L, Buwalda T, Blair M, Forde B, Lunjani N, Ambikan A, et al. Impact of Long COVID on health and quality of life. HRB Open Res. 2022 Apr 22;5:31.
25. O'Brien K, Townsend L, Dowds J, Bannan C, Nadarajan P, Kent B, et al. 1-year quality of life and health-outcomes in patients hospitalised with COVID-19: a longitudinal cohort study. Respiratory Research. 2022 May 4;23(1):115.
26. Vaes AW, Goërtz YMJ, Herck MV, Machado FVC, Meys R, Delbressine JM, et al. Recovery from COVID-19: a sprint or marathon? 6-month follow-up data from online long COVID-19 support group members. ERJ Open Research. 2021 Apr 1;7(2).
27. Ziauddeen N, Gurdasani D, O'Hara ME, Hastie C, Roderick P, Yao G, et al. Characteristics and impact of Long Covid: Findings from an online survey. PLOS ONE. 2022 Mar 8;17(3):e0264331.
28. Cancelliere C, Donovan J, Stochkendahl MJ, Biscardi M, Ammendolia C, Myburgh C, et al. Factors affecting return to work after injury or illness: best evidence synthesis of systematic reviews. Chiropr Man Therap. 2016 Sep 8;24(1):32.
29. Figueredo JM, García-Ael C, Gragnano A, Topa G. Well-Being at Work after Return to Work (RTW): A Systematic Review. International Journal of Environmental Research and Public Health. 2020 Jan;17(20):7490.
30. Gragnano A, Negrini A, Miglioretti M, Corbière M. Common Psychosocial Factors Predicting Return to Work After Common Mental Disorders, Cardiovascular Diseases, and Cancers: A Review of Reviews Supporting a Cross-Disease Approach. J Occup Rehabil. 2018 Jun 1;28(2):215–31.
31. Ilmarinen J. Work ability—a comprehensive concept for occupational health research and prevention. Scandinavian Journal of Work, Environment & Health. 2009;35(1):1–5.
32. van den Berg TIJ, Elders L a. M, Zwart BCH de, Burdorf A. The effects of work-related and individual factors on the Work Ability Index: a systematic review. Occupational and Environmental Medicine. 2009 Apr 1;66(4):211–20.
33. Tuomi K, Ilmarinen J, Jahkola A, Katajarinne L, Tulkki A. Work Ability Index. Finnish institute of occupational health. 1997;19.
34. Ahlstrom L, Grimby-Ekman A, Hagberg M, Dellve L. The work ability index and single-item question: associations with sick leave, symptoms, and health – a prospective study of women on long-term sick leave. Scandinavian Journal of Work, Environment & Health. 2010;36(5):404–12.
35. Kujala V, Tammelin T, Remes J, Vammavaara E, Ek E, Laitinen J. Work ability index of young employees and their sickness absence during the following year. Scandinavian Journal of Work, Environment & Health. 2006;32(1):75–84.
36. Kinnunen U, Nätti J. Work ability score and future work ability as predictors of register-based disability pension and long-term sickness absence: A three-year follow-up study. Scand J Public Health. 2018 May 1;46(3):321–30.
37. Gustafsson K, Marklund S. Consequences of sickness presence and sickness absence on health and work ability: A Swedish prospective cohort study. IJOMEH. 2011 Jun 1;24(2):153–65.
38. van den Berg TIJ, Elders LAM, Burdorf A. Influence of Health and Work on Early Retirement. Journal of Occupational and Environmental Medicine. 2010;52(6):576–83.
39. Sell L. Predicting long-term sickness absence and early retirement pension from self-reported work ability. Int Arch Occup Environ Health. 2009 Oct 1;82(9):1133–8.
40. Alavinia SM, de Boer AGEM, van Duivenbooden JC, Frings-Dresen MHW, Burdorf A. Determinants of work ability and its predictive value for disability. Occupational Medicine. 2009 Jan 1;59(1):32–7.
41. ISRCTN14990068: Zurich Coronavirus Cohort: an observational study to determine long-term clinical outcomes and immune responses after coronavirus infection (COVID-19), assess the influence of virus genetics, and examine the spread of the coronavirus in the population of the Canton of Zurich, Switzerland. ISRCTN Registry. 2020;
42. Central Compensation Office. Old-age pensions [Internet]. [cited 2023 Mar 28]. Available from: https://www.zas.admin.ch/zas/en/home/particuliers/rentes-de-vieillesse.html

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467 43. von Bonsdorff MB, Seitsamo J, Ilmarinen J, Nygård CH, von Bonsdorff ME, Rantanen T. Work ability
468 in midlife as a predictor of mortality and disability in later life: a 28-year prospective follow-up study.
469 CMAJ. 2011 Mar 8;183(4):E235–42.

470 44. Perneger TV, Combescure C, Courvoisier DS. General Population Reference Values for the French
471 Version of the EuroQol EQ-5D Health Utility Instrument. Value in Health. 2010 Jul;13(5):631–5.

472 45. Zanini A, Aiello M, Adamo D, Casale S, Cherubino F, Patrona SD, et al. Estimation of Minimal
473 Clinically Important Difference in EQ-5D Visual Analog Scale Score After Pulmonary Rehabilitation
474 in Subjects With COPD. Respiratory Care. 2015 Jan 1;60(1):88–95.

475 46. Wacker ME, Jörres RA, Karch A, Wilke S, Heinrich J, Karrasch S, et al. Assessing health-related
476 quality of life in COPD: comparing generic and disease-specific instruments with focus on
477 comorbidities. BMC Pulmonary Medicine. 2016 May 10;16(1):70.

478 47. R Core Team. R: a language and environment for statistical computing [Internet]. 2018 [cited 2021
479 Nov 19]. Available from: Http://www.r-project.org/

480 48. Kinman G. Sickness presenteeism at work: prevalence, costs and management. 2019 Jan 11;

481 49. van den Berg S, Burdorf A, Robroek SJW. Associations between common diseases and work ability
482 and sick leave among health care workers. Int Arch Occup Environ Health. 2017 Oct 1;90(7):685–93.

483 50. Bavel JJV, Baicker K, Boggio PS, Capraro V, Cichocka A, Cikara M, et al. Using social and
484 behavioural science to support COVID-19 pandemic response. Nat Hum Behav. 2020 May;4(5):460–
485 71.

486 51. Ballouz T, Menges D, Kaufmann M, Amati R, Frei A, Wyl V von, et al. Post COVID-19 condition
487 after Wildtype, Delta, and Omicron SARS-CoV-2 infection and prior vaccination: Pooled analysis of
488 two population-based cohorts. PLOS ONE. 2023 Feb 22;18(2):e0281429.

489 52. Azzolini E, Levi R, Sarti R, Pozzi C, Mollura M, Mantovani A, et al. Association Between BNT162b2
490 Vaccination and Long COVID After Infections Not Requiring Hospitalization in Health Care Workers.
491 JAMA. 2022 Aug 16;328(7):676–8.

492 53. Notarte KI, Catahay JA, Velasco JV, Pastrana A, Ver AT, Pangilinan FC, et al. Impact of COVID-19
493 vaccination on the risk of developing long-COVID and on existing long-COVID symptoms: A
494 systematic review. eClinicalMedicine. 2022 Nov 1;53:101624.

495 54. Antonelli M, Pujol JC, Spector TD, Ourselin S, Steves CJ. Risk of long COVID associated with delta
496 versus omicron variants of SARS-CoV-2. The Lancet. 2022 Jun 18;399(10343):2263–4.

497 55. COVID-19 Forecasting Team. Forecasting the trajectory of the COVID-19 pandemic into 2023 under
498 plausible variant and intervention scenarios: a global modelling study [Internet]. Institute for Health
499 Metrics and Evaluation. 2023 [cited 2023 Mar 28]. Available from:
500 https://www.healthdata.org/research-article/forecasting-trajectory-covid-19-pandemic-2023-under-
501 plausible-variant-and

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505 # Tables & Figures

506 **Table 1: Study participant characteristics.**

	Overall (N=672)
Age (years)	
Mean (SD)	42.1 (12.2)
Median (IQR)	43.0 (31.0 to 53.0)
Range	18 to 63
Age group	
18-39 years	282 (42.0%)
40-64 years	390 (58.0%)
Sex	
female	364 (54.2%)
male	308 (45.8%)
Symptom count at infection	
Asymptomatic	79 (11.8%)
1-5 symptoms	266 (39.6%)
≥6 symptoms	327 (48.7%)
Hospitalization at infection	
Non-hospitalized	662 (98.5%)
Hospitalized	9 (1.3%)
with ICU stay	1 (0.1%)
Smoking status	
Non-smoker	413 (61.6%)
Ex-smoker	156 (23.3%)
Smoker	101 (15.1%)
Missing	*2 (0.3%)*
BMI (kg/sqm)	
Mean (SD)	24.4 (4.5)
Median (IQR)	23.7 (21.5 to 26.2)
Range	13 to 63
Missing	*6 (0.9%)*
Comorbidity*	
None	532 (79.2%)
1 comorbidity	113 (16.8%)
≥2 comorbidities	27 (4.0%)
History of psychiatric diagnosis	
None	565 (86.8%)
Any	86 (13.2%)
Missing	*21 (3.1%)*

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Education level	
None or mandatory school	22 (3.3%)
Vocational training or specialized baccalaureate	249 (37.2%)
Higher technical school or college	194 (29.0%)
University	205 (30.6%)
Missing	*2 (0.3%)*
Employment at infection	
Employed or self-employed	587 (87.4%)
Student	46 (6.8%)
Housewife/family manager	10 (1.5%)
Unemployed	19 (2.8%)
Disability insurance benefits	4 (0.6%)
Other	6 (0.9%)
Income	
<6'000 CHF	189 (29.2%)
6'000 - 12'000 CHF	283 (43.7%)
>12'000 CHF	176 (27.2%)
Missing	*24 (3.6%)*
Nationality	
Swiss	562 (83.6%)
Non-Swiss	110 (16.4%)

Legend: BMI, body mass index; CHF, Swiss Francs; ICU, intensive care unit; IQR, interquartile range; SD, standard deviation. * Comorbidities were assessed as any of the following: hypertension, diabetes, cardiovascular disease, chronic respiratory disease, chronic kidney disease, past or present malignancy, or immune suppression.

Table 2: Results from multivariable regression analyses for the association of post COVID-19 condition (PCC, defined as presence of COVID-19 related symptoms) with work ability outcomes (PCC vs. no PCC) within subgroups based on sex, age group, comorbidity count, or history of psychiatric diagnosis.

	Current work ability		Physical demands		Mental demands		Future (2 years)	
Interaction	**Estimate (95% CI)**	**p-value**	**OR (95% CI)**	**p-value**	**OR (95% CI)**	**p-value**	**OR (95% CI)**	**p-value**
Male vs. female								
Female	-0.82 (-1.23 to -0.42)	<0.001	0.37 (0.22 to 0.62)	<0.001	0.40 (0.23 to 0.67)	<0.001	0.54 (0.23 to 1.27)	0.159
Male	-0.30 (-0.81 to 0.21)	0.254	0.22 (0.11 to 0.43)	<0.001	0.42 (0.22 to 0.81)	0.009	0.48 (0.14 to 1.64)	0.243
Difference[*]	*0.53 (-0.12 to 1.17)*	*0.106*	*0.60 (0.26 to 1.38)*	*0.229*	*1.06 (0.46 to 2.42)*	*0.894*	*0.89 (0.21 to 3.88)*	*0.881*
40-64 years vs. 18-39 years								
18-39 years	-0.27 (-0.86 to 0.32)	0.372	0.74 (0.33 to 1.65)	0.460	0.69 (0.33 to 1.44)	0.322	0.93 (0.19 to 4.45)	0.924
40-64 years	-0.78 (-1.16 to -0.40)	<0.001	0.20 (0.12 to 0.34)	<0.001	0.33 (0.20 to 0.55)	<0.001	0.43 (0.19 to 0.96)	0.040
Difference[*]	*-0.51 (-1.20 to 0.19)*	*0.149*	*0.27 (0.11 to 0.71)*	*0.006*	*0.48 (0.20 to 1.17)*	*0.107*	*0.46 (0.08 to 2.67)*	*0.369*
≥2 comorbidities vs. 0-1 comorbidity[†]								
0-1 comorbidity	-0.64 (-0.97 to -0.31)	<0.001	0.31 (0.20 to 0.47)	<0.001	0.39 (0.26 to 0.60)	<0.001	0.46 (0.22 to 0.96)	0.040
≥2 comorbidities	-0.92 (-2.34 to 0.50)	0.202	0.10 (0.01 to 0.79)	0.028	0.52 (0.08 to 3.34)	0.490	1.19 (0.10 to 14.80)	0.894
Difference[*]	*-0.28 (-1.74 to 1.18)*	*0.702*	*0.34 (0.04 to 2.67)*	*0.308*	*1.32 (0.20 to 8.90)*	*0.776*	*2.59 (0.19 to 36.17)*	*0.462*
History of psychiatric diagnosis vs. no history of psychiatric diagnosis								
No history of psychiatric diagnosis	-0.39 (-0.74 to -0.04)	0.031	0.28 (0.17 to 0.44)	<0.001	0.35 (0.22 to 0.55)	<0.001	0.49 (0.22 to 1.08)	0.077
History of psychiatric diagnosis	-1.73 (-2.47 to -0.99)	<0.001	0.49 (0.18 to 1.31)	0.155	0.88 (0.33 to 2.35)	0.803	0.65 (0.15 to 2.76)	0.563
Difference[*]	*-1.34 (-2.15 to -*	*0.001*	*1.76 (0.60 to*	*0.303*	*2.55 (0.88 to*	*0.086*	*1.33 (0.27 to 6.67)*	*0.725*

	0.54)	*5.17)*	*7.38)*

Legend: CI, confidence interval; OR, odds ratio. * P-values for differences calculated using likelihood ratio test for models with and without interaction term for the respective stratification variable. Models are multivariable linear regression models (current work ability) or multivariable ordinal logistic regression models (work ability related to physical and mental demands, estimated future work ability in 2 years) including an interaction term for the respective stratification variable and adjusted for age (or age group for the corresponding analysis), sex, education status, baseline EuroQol visual analog scale (EQ-VAS), comorbidity count (as a continuous variable, or as a categorical variable for the corresponding analysis), history of psychiatric diagnosis, and hospitalization due to COVID-19. † Comorbidities were assessed as any of the following: hypertension, diabetes, cardiovascular disease, chronic respiratory disease, chronic kidney disease, past or present malignancy, or immune suppression.

Table 3: Occupational changes related to post COVID-19 condition and overall, stratified by post COVID-19 condition and (non-)recovery and health impairment status.

	PCC status		(Non-)recovery and health impairment status				Overall
	No PCC (N=552)	PCC (N=120)	Recovered (N=562)	Mild (N=72)	Moderate (N=13)	Severe (N=8)	(N=672)
Occupational change							
No occupational change	451 (83.7%)	89 (74.2%)	468 (83.9%)	58 (80.6%)	6 (46.2%)	3 (37.5%)	540 (81.9%)
Occupational change unrelated to PCC	88 (16.3%)	24 (20.0%)	90 (16.1%)	13 (18.1%)	4 (30.8%)	3 (37.5%)	112 (17.0%)
Occupational change related to PCC	0 (0.0%)	7 (5.8%)	0 (0.0%)	1 (1.4%)	3 (23.1%)	2 (25.0%)	7 (1.1%)
Missing	*13 (2.4%)*	*0 (0%)*	*4 (0.7%)*	*0 (0%)*	*0 (0%)*	*0 (0%)*	*13 (1.9%)*
Reason for occupational change*							
Retired	4 (4.6%)	2 (6.5%)	5 (5.6%)	0 (0.0%)	0 (0.0%)	1 (20.0%)	6 (5.1%)
On permanent sick leave	3 (3.4%)	1 (3.2%)	2 (2.2%)	0 (0.0%)	1 (14.3%)	0 (0.0%)	4 (3.4%)
Receiving disability benefits	0 (0.0%)	1 (3.2%)	0 (0.0%)	0 (0.0%)	1 (14.3%)	0 (0.0%)	1 (0.8%)
Work leave for different reason	3 (3.4%)	0 (0.0%)	3 (3.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (2.5%)
Newly self-employed	2 (2.3%)	0 (0.0%)	2 (2.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (1.7%)
Changed workplace	42 (48.3%)	14 (45.2%)	46 (51.7%)	7 (50.0%)	3 (42.9%)	0 (0.0%)	56 (47.5%)
Changed position within same workplace	13 (14.9%)	4 (12.9%)	11 (12.4%)	4 (28.6%)	0 (0.0%)	1 (20.0%)	17 (14.4%)
Started training or university studies	5 (5.7%)	0 (0.0%)	4 (4.5%)	1 (7.1%)	0 (0.0%)	0 (0.0%)	5 (4.2%)
Reduced working hours	2 (2.3%)	0 (0.0%)	2 (2.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (1.7%)
Lost employment	4 (4.6%)	2 (6.5%)	5 (5.6%)	0 (0.0%)	1 (14.3%)	0 (0.0%)	6 (5.1%)
Other	9 (10.3%)	7 (22.6%)	9 (10.1%)	2 (14.3%)	1 (14.3%)	3 (60.0%)	16 (13.6%)
Missing	*1 (1.1%)*	*0 (0%)*	*1 (1.1%)*	*0 (0%)*	*0 (0%)*	*0 (0%)*	*1 (0.8%)*
Financial difficulties due to occupational change*							
No	57 (64.8%)	17 (54.8%)	56 (62.2%)	10 (71.4%)	4 (57.1%)	3 (60.0%)	74 (62.2%)

Rather not	12 (13.6%)	6 (19.4%)	15 (16.7%)	3 (21.4%)	0 (0.0%)	0 (0.0%)	18 (15.1%)
Yes, a little	14 (15.9%)	7 (22.6%)	15 (16.7%)	1 (7.1%)	3 (42.9%)	1 (20.0%)	21 (17.6%)
Yes, very much	5 (5.7%)	0 (0.0%)	4 (4.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	5 (4.2%)
Unclear/no answer	0 (0.0%)	1 (3.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (20.0%)	1 (0.8%)

523 Legend: PCC, post COVID-19 condition. * Percentages calculated within total of individuals with any occupational change (N=119).

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525 **Figure 1: Flow chart of participant enrollment and inclusion in this study.**

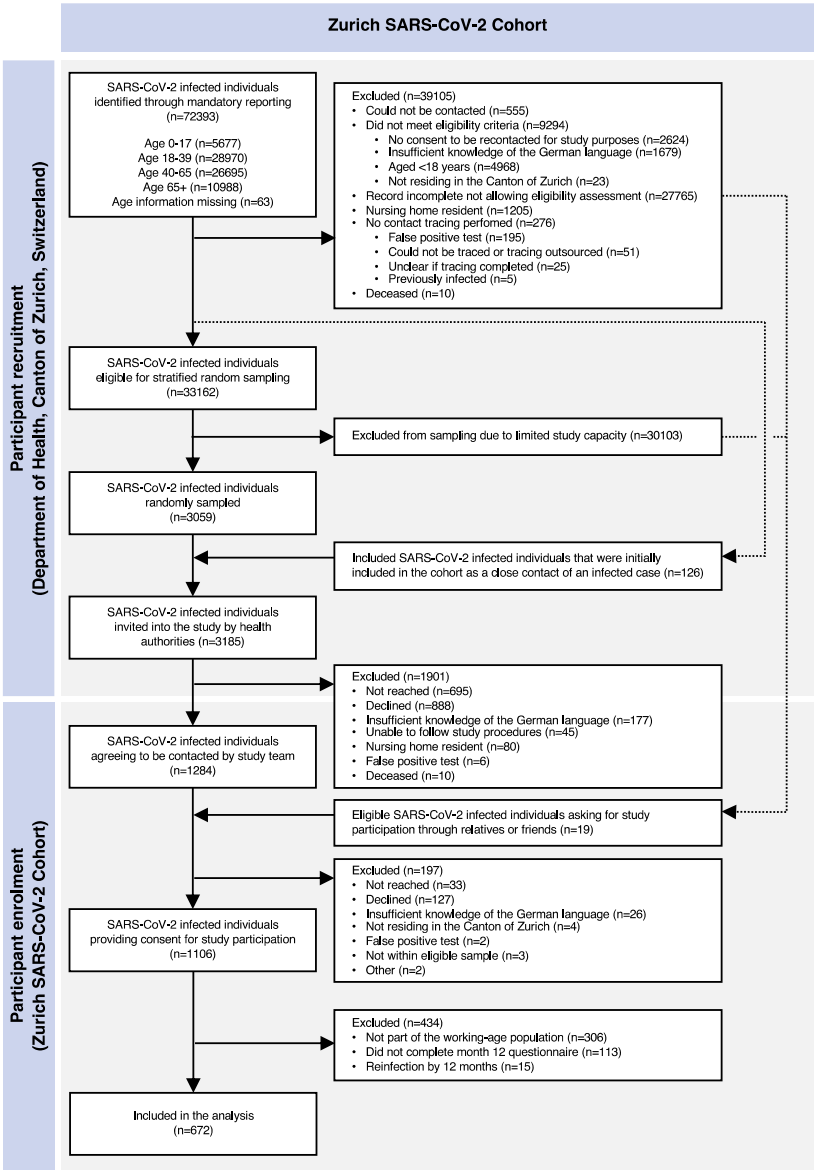

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Figure 2: Current work ability, work ability related to physical and mental demands, and estimated future work ability in 2 years by presence of post COVID-19 condition and non-recovery and health impairment at 12 months after diagnosis of primary infection. Panels A–D demonstrate the level of current work ability (A), work ability related to physical (B) and mental (C) demands, and estimated work ability in 2 years (D) between individuals with post COVID-19 condition (PCC)-related symptoms at 12 months compared to those without PCC. Panels E–H show the level of current work ability (E), work ability related to physical (F) and mental (G) demands, and estimated work ability in 2 years (H) between individuals reporting non-recovery with mild, moderate, or severe health impairment at 12 months compared to those reporting full recovery at 12 months. Legend: PCC, post COVID-19 condition; WAI, work ability index.

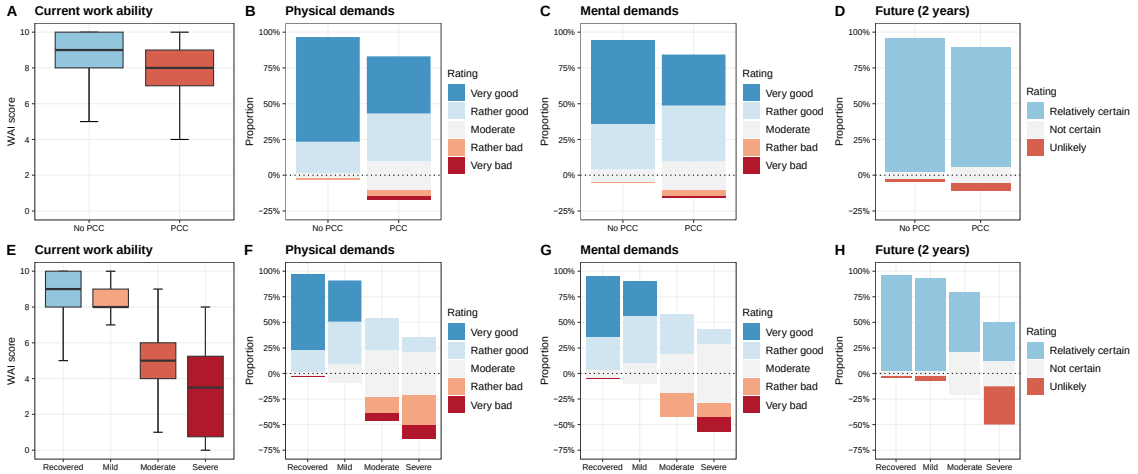

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Figure 3: Results from multivariable regression analyses of the association between presence of post COVID-19 condition and current work ability, work ability related to physical and mental demands, and estimated future work ability in 2 years at 12 months after diagnosis of primary infection. Each panel demonstrates results from multivariable linear regression (current work ability) or ordinal logistic regression (work ability related to physical and mental demands, estimated work ability in future) adjusted for sex, age, education level, baseline EuroQol visual analog scale (EQ-VAS), comorbidity count, history of psychiatric diagnosis, and hospitalization at acute infection. Separate models were estimated for the two definitions based on COVID-19 related symptoms (PCC vs. no PCC) and (non-)recovery (severe, moderate or mild health impairment vs. recovery). Legend: CI, confidence interval; OR, odds ratio; PCC, post COVID-19 condition; Ref., reference.