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Work participation and the COVID-19 pandemic: an observational study in people with inflammatory rheumatic diseases and population controls

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Abstract

Objective: During the coronavirus disease 2019 (COVID-19) crisis, people with inflammatory rheumatic diseases (iRDs) might have been more vulnerable for adverse work outcomes (AWOs) and restrictions in work ability and work performance. Our objectives were to compare AWOs during the pandemic and current work ability between iRD patients and controls, understand which patients are most vulnerable for these outcomes and (3) explore the role of work characteristics on work performance while working remotely.

Methods: Patients and population controls in a Dutch COVID-19 cohort study provided information in March 2022 on work participation in March 2020 (pre-pandemic, retrospective) and March 2022 (current). AWOs comprised withdrawal from paid work, working hours reduction or long-term sick leave. Multivariable logistic/linear regression analyses compared outcomes (AWOs/work ability) between groups (patients/controls) and within patients.

Results: Of the pre-pandemic working participants, 227/977 (23%) patients and 79/430 (18%) controls experienced AWOs following pandemic onset. A minority of AWOs (15%) were attributed to COVID-19. Patients were more likely to experience any-cause AWOs (odds ratio range 1.63–3.34) but not COVID-related AWOs, with female patients and patients with comorbidities or physically demanding jobs being most vulnerable. Current work ability was lower in female patients compared with controls [$\beta = -0.66$ (95% CI −0.92 to −0.40)]. In both groups, when working remotely, care for children and absence of colleagues had varying effects on work performance (positive 19% and 24%, negative 34% and 57%, respectively), while employer support and reduced commuting had mainly positive effects (83% and 86%, respectively).

Conclusion: During the pandemic, people with iRDs remained at increased risk of AWOs. COVID-related AWOs, however, were infrequent.

Lay Summary

What does this mean for patients?

People with inflammatory rheumatic diseases (iRDs), such as RA or SpA, often experience restrictions in their work. In times of crises, such as the COVID-19 pandemic, people with iRDs might be more vulnerable in their work situation. We were interested to know whether people with iRDs were more likely to stop working, reduce their working hours or were on long-term sick leave during the pandemic compared with the general population. In the Amsterdam COVID-19-cohort, we found that 23% of people with iRDs and 18% of the general population had to stop work, reduce work hours or were on long-term sick leave, 2 years after the onset of the pandemic. Only a small portion of these adverse work outcomes were directly related to COVID-19 (illness, containment measures, etc.). Female patients, those suffering from other health issues (along with iRDs) or patients with physically demanding jobs experienced the greatest impact. Additionally, we explored which working conditions influenced work performance if working from home. Childcare responsibilities and the absence of colleagues had both positive and negative effects. Support from employers and reduced commuting had overall positive impacts for both people with iRDs and the general population. This study contributes to a better understanding on how to support people with iRDs in healthy and sustainable paid work, now and in the future.

Keywords: work participation, COVID-19, pandemic, rheumatic disease.

Key messages

- During the pandemic, people with iRDs remained at increased risk of adverse work outcomes.
- A past SARS-CoV-2 infection is not associated with worse work outcomes.
- When working remotely, both employer support and reduced work commute positively influenced work performance.

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Introduction

Inflammatory rheumatic diseases (iRDs) are a group of chronic conditions characterized by pain, stiffness and limitations in physical function. Common iRDs include RA and SpA [1, 2]. Past studies have repeatedly shown that individuals with iRDs experience restrictions in work participation when compared with the general population, including reduced work ability and productivity while at work (presenteeism) and increased sick leave or work disability (absenteeism) [3–6].

Times of crisis tend to bring out the vulnerabilities of people with chronic disease, as drastic decisions in the context of great uncertainty likely affect specific subgroups differently. The coronavirus disease 2019 (COVID-19) pandemic is a prime example. In the Netherlands, on 27 February 2020, the first case of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection was identified, which resulted in national containment measures on 12 March 2020. People with certain job types and work sectors were strongly urged to work from home [7–9]. Concurrently, warnings that working people with pre-existing medical conditions or of advanced age were at additional risk of COVID-19 raised anxiety on safety at work among working patients [10, 11]. Fortunately, government-imposed lockdowns of public services and reduced production (industry/services) led the government to take measures to subsidize companies and institutions to continue employment contracts [12, 13]. During 2020, additional restrictions were introduced in the Netherlands, with lockdowns initiated towards the end of 2020 and in 2021. In early 2022, containment measures were progressively reduced [13].

Several studies reported on work participation in patients with iRDs during the pandemic. In a Canadian study, work rates ($N = 133$) fell from 86% to 71% among younger adults (18–35 years) with rheumatic and musculoskeletal diseases, even though health- or work-related factors did not change [14]. In a worldwide study, changes in work status were reported in 27% of 9300 iRD patients, with a decrease of 14% in the full-time work rate immediately after pandemic onset [15]. Importantly, none of these previous studies compared work participation outcomes of patients with iRDs with the general population, nor did they study the role of COVID-19 (COVID-19 disease and national containment measures, such as lockdowns) *vs* the role of having an iRD when considering work participation. Also, they did not explore whether remote working offers advantages for patients with iRDs in terms of work performance.

In the Netherlands, the Amsterdam Rheumatology and Immunology Center (ARC) COVID-19 cohort was established in 2020 to prospectively compare the impact of COVID-19 disease and vaccination between people with iRDs and population controls [16–21]. This cohort offers a unique opportunity to study the impact of COVID-19 on work participation outcomes in patients with iRDs, as the population controls facilitate the interpretation of findings. The current study had three objectives: to compare work participation outcomes between people with iRDs and population controls in the Netherlands (objective 1), to understand which subgroups are most vulnerable to incur these work participation outcomes (objective 2) and to explore the role of typical characteristics of remote work on work performance (objective 3).

Methods

Design

An online, cross-sectional questionnaire on work outcomes (work status, presenteeism and sick leave) and work characteristics was developed and distributed within the Amsterdam COVID cohort in March 2022 [22]. Questions concerned participants' pre-pandemic (March 2020, before national COVID-19 measures) and current (March 2022, 2 years after the COVID-19 outbreak) work status and work characteristics. In March 2022, the pandemic was beyond its last peak in the Netherlands and containment measures had largely been removed. Participants provided written informed consent. The study was approved by the Medical Ethical Committee of the VU University Medical Center (2020.169) and complies with the Declaration of Helsinki.

Population

All patients with a known diagnosis of iRD under the care of the ARC were invited between 26 April 2020 and 1 March 2021 to participate in the cohort. They were asked to invite their own control (without an iRD; other diseases were allowed), of the same sex and a similar age (≤5 years difference) to participate. For the current study, only people of working age (18–67 years, i.e. Dutch retirement age) were considered, without exclusion.

Variables

A detailed overview of variables is presented in Supplementary Table S1, available at *Rheumatology Advances in Practice* online.

Outcomes

AWOs were defined as at least one of the following: shift from full- or part-time paid work (March 2020) to no paid work (March 2022), shift from full-time (March 2020) to part-time work (March 2022), reduction of weekly working hours of ≥4 h (March 2022 compared with March 2020) or ongoing long-term sickness absence (≥3 months) in March 2022. In case of a shift to part-time or no paid work, the reason for this shift in work status was determined. Of note, in case of retirement, it was not known whether this was earlier than planned. For each AWO, participants were asked to indicate if work outcomes had changed due to COVID-19, with an additional option for COVID-19 disease opposed to national measures (e.g. lockdown), other health-related circumstances (non-COVID-19 related) or other reasons.

In those with paid work, additional work participation outcomes were assessed. Work ability (presenteeism) was measured for both time points (March 2020, March 2022) using the single-item Work Ability Index [WAI; range 0–10 (worst–best)], asking participants to rate their work ability compared with their lifetime best [23]. The effect of the pandemic on work productivity while at work in March 2022 was assessed using a single question (productivity improved/unchanged/worsened). The effect of four typical characteristics of remote work on remote work performance in March 2022 was scored on a Likert scale [range −5 to +5 (very negative to very positive effect)]. These characteristics comprised caring for children while working at home; absence of colleagues; employer support in remote work, such as facilitating devices, desk or chair; and less commuting to work.

Participants could indicate if a characteristic was not applicable (e.g. no children). Finally, exploratory questions on preferred future work location (at home/workplace/combined) and on income reduction since the pandemic (yes/no) were included. Questions on remote work characteristics and future work preference were self-developed.

Covariables

Sociodemographics included sex, age and education (three levels grouped into higher and lower) [24].

Health-related characteristics comprised the type of iRD, time since diagnosis (years), overall quality of life [QoL; numeric rating scale (NRS) of 0–10 (worst–best)] and satisfaction with health [range 1–4 (very satisfied–very dissatisfied)] among patients only, and among all participants, comorbidities (cardiovascular diseases, diabetes, obesity, pulmonary disease), medication use (rheumatic and non-rheumatic), past SARS-CoV-2 infection (yes/no) and number of SARS-CoV-2 vaccinations.

Work-related characteristics, assessed for March 2020 and March 2022, included the type of employment contract [7 categories (e.g. permanent contract or on-call contract)], grouped for further analyses into vulnerable employment (permanent contract *vs* other types, e.g. not fully protected by social security system: yes/no), job type (7 categories grouped into physically demanding job: yes/no), working sector (13 categories grouped into healthcare sector: yes/no), working hours per week, work location (at workplace, at home, combined), remote working hours per week, importance of work for QoL [NRS of 0–10 (not important at all to extremely important)] and perceived COVID-related safety at work or while commuting [Likert scale −5 to 5 (very unsafe to very safe)]. Questions were self-developed, unless specified.

Analysis

Descriptive and comparative analyses of AWOs 2 years after onset of the pandemic (March 2022), (transitions in) employment status and (change in) work ability in those with paid work were performed in patients and controls.

To understand the effect of iRDs on AWOs (objective 1), multivariable logistic regression analyses of AWOs [due to any cause or only COVID-related (COVID disease or national containment measures) in separate analyses] on group (iRD patients *vs* controls) were conducted, adjusted for confounders. Group was the primary determinant, as we wanted to compare patients and controls. These potential confounders were considered: education, comorbidities, SARS-CoV-2 infection and vaccination, work sector, job demands, type of employment contract, working hours and work location. Age and sex were always included in the multivariable models. Given the number of outcome events, sample size and potential confounders, a manual forward selection method was used, starting with group (primary determinant) as the independent variable. Covariables ($P < 0.10$ in univariable logistic regression) were added one by one in a prespecified order and retained only if they were either statistically significant upon model entry ($P < 0.05$) or acted as a confounder of group (changed the regression coefficient of the group variable by >10% upon entry). If group was associated with AWO in logistic regression analyses, predicted probabilities were generated to facilitate the interpretation of results. Interactions between group and all other variables were checked for and, if present ($P < 0.10$), analyses were stratified. As the objective was to both compare patients and controls, but also to investigate the role of determinants, this stratification was done in several ways to explore associations (either stratified by group or stratified by the other determinant).

To understand the role of iRDs in the change in work ability and on current (2022) work ability, linear regression analyses with (change in) work ability as the outcome were performed using a similar approach as for AWO, and including similar covariables (see above) (objective 1).

In case of interaction, results from any stratified analyses for AWO or work ability answered the question of which patients are most vulnerable (objective 2). In addition, analyses on current work ability were repeated in patients only, while additionally exploring the effect of perceived safety at work or during public transport commute on work ability.

Finally, to explore the role of remote work characteristics on work performance if working—at least partially—from home, and preferred future working location, descriptive analyses were performed in patients and controls (objective 3).

Missing data were not imputed. *P*-values <0.05 were considered statistically significant. Analyses were performed using Stata 14.2 (StataCorp, College Station, TX, USA).

Results

Sociodemographic and health-related characteristics

In March 2022, 3328 participants were still included in the cohort (of 3747 participants ever enrolled) and invited to participate in the current study, of which 2692 responded (83%). The characteristics of non-responders were comparable to those of responders. Among responders, 728 were excluded from the analyses as they reached the Dutch retirement age, resulting in 1438 patients and 526 population controls of working age. Among these 1438 patients, 1222 (85%) had RA or SpA (including PsA). Compared with controls, patients were less frequently female, less frequently had a higher education and had more comorbidities (Table 1). SARS-CoV-2 vaccination rates were comparable between groups, yet patients were less likely to report a past SARS-CoV-2 infection. These between-group differences were similar in the paid workers subgroup (Supplementary Table S2, available at *Rheumatology Advances in Practice* online). The extent of missing data was very limited (<10%), except for education (≈30%).

Employment and work characteristics pre-pandemic and current

Pre-pandemic, patients were less likely to have paid work compared with controls [992/1438 (69%) *vs* 443/526 (85%); $P < 0.01$] (Table 1). A similar proportion of patients [281/992 (28%)] and controls [124/443 (28%)] were working (partially or completely) from home, and this proportion increased 2 years after onset of the pandemic to 507 (55%) in 927 patients and 217 (51%) in 428 controls (Table 2). Groups did not differ in frequency or reason for changes in employment contract, job type or sector (Table 2, Supplementary Table S3 and S4, available at *Rheumatology Advances in Practice* online).

Work was of similar importance for QoL among groups before the pandemic (8.2 in patients, 8.3 in controls) and 2 years after onset of the pandemic (8.3 in both groups). A

Table 1. Characteristics of participants

Variables	Total ($N = 1964$)	Patients ($n = 1438$)	Controls ($n = 526$)
Age, years, mean (S.D.)	53.8 (10.3)	53.9 (10.2)	53.8 (10.4)
Female, *n* (%)	1322 (67.3)	941 (65.5)	381 (72.4)
Education, *n* (%)[a,b]			
Lower	207 (15.5)	158 (16.4)	49 (13.1)
Middle	455 (34.1)	345 (35.9)	110 (29.5)
Higher	673 (50.4)	459 (47.7)	214 (57.4)
Working (pre-pandemic), *n* (%)			
Full time	794 (40.4)	568 (39.5)	226 (43.0)
Part time	641 (32.6)	424 (29.5)	217 (41.3)
No	529 (26.9)	446 (31.0)	83 (15.8)
Quality of life (VAS 0–10)	NA	7.3 (1.5)	NA
Satisfaction with health, *n* (%)			
Very satisfied	NA	130 (9.4)	NA
Satisfied	NA	831 (60.0)	NA
Dissatisfied	NA	381 (27.5)	NA
Very dissatisfied	NA	42 (3.0)	NA
Comorbidities, *n* (%)			
Cardiovascular disease	151 (7.7)	136 (9.5)	15 (2.9)
Diabetes	80 (4.1)	70 (4.9)	10 (1.9)
Obesity	313 (15.9)	255 (17.7)	58 (11.0)
Pulmonary disease	186 (9.5)	156 (10.8)	30 (5.7)
COVID-19 related, *n* (%)			
Past SARS-CoV-2 infection	897 (45.7)	630 (43.8)	267 (50.8)
SARS-CoV-2 vaccinated	1876 (95.5)	1374 (95.5)	502 (95.4)
Diagnosis (iRD), *n* (%)			
RA	NA	734 (51.0)	NA
PsA	NA	235 (16.3)	NA
Axial/peripheral SpA	NA	253 (17.6)	NA
SLE	NA	94 (6.5)	NA
SS	NA	76 (5.3)	NA
Gout	NA	44 (3.1)	NA
PMR	NA	42 (2.9)	NA
Other iRD	NA	185 (12.9)	NA
Disease duration, years, mean (S.D.)	NA	14.5 (11.1)	NA
Medication use, *n* (%)			
csDMARD	788 (40.1)	785 (54.6)	3 (0.6)
bDMARD	635 (32.3)	633 (44.0)	2 (0.4)
tsDMARD	18 (0.9)	18 (1.3)	0 (0.0)
Glucocorticoid	172 (8.8)	169 (11.8)	3 (0.6)
Other immunosuppressant	48 (2.4)	47 (3.3)	1 (0.2)
No immunosuppressant	760 (38.7)	241 (16.8)	519 (98.7)

[a] Classified according to the International Standard Classification of Education: lower: none/primary/lower secondary; middle; upper secondary/post-secondary non-tertiary; higher: bachelor/master/doctoral education.
[b] Missing data for education in the total population: 32.0% (patients: 33.1%; controls: 29.1%).
bDMARD: biologic DMARD; csDMARD: conventional synthetic DMARD; NA: not available; tsDMARD: targeted synthetic DMARD.

relevant proportion of participants (11–14%) reported an income reduction due to the pandemic (Table 2).

Adverse work outcome (objectives 1 and 2)

AWOs occurred in 227 (23%) of 977 patients and 79 (18%) of 430 controls during the pandemic, of which a minority was COVID-related (Table 3, Supplementary Table S5, available at *Rheumatology Advances in Practice* online). Between-group differences were similar when excluding participants that indicated retirement as the reason for not having paid work anymore (data not shown). AWO rates for the specific iRDs showed only minor variation, and it should be noted that certain iRD subgroups were very small.

Logistic regression analyses of any-cause AWOs revealed relevant interactions ($P < 0.10$) for group*sex, group*comorbidities and group*job demands, indicating that the contribution of these determinants to AWOs differed between patients and controls. In all stratified models, except the male subgroup model, patients were consistently and significantly more likely to experience AWOs compared with controls (OR range 1.63–3.34), with the highest likelihoods for patients compared with controls in females and those having physically demanding jobs or comorbidity (Table 4, Supplementary Tables S6–S8, available at *Rheumatology Advances in Practice* online). Based on predicted probabilities, any-cause AWOs were expected to occur in 19–29% of patients (25–29% of the more vulnerable subgroups of females and those with physically demanding jobs or comorbidity) *vs* 11–15% of controls (Supplementary Table S9, available at *Rheumatology Advances in Practice* online). The absolute difference between patients and controls ranged from 5 to 17%. Of note, past SARS-CoV-2 infection was not associated with AWOs in any model.

When only COVID-related AWOs were considered, regression analyses did not show an increased risk in patients compared with controls. However, older participants and those with vulnerable employment contracts were significantly more likely to experience COVID-related AWOs [OR_{age} 1.05 (95% CI 1.01, 1.09) and $OR_{contract}$ 2.33 (95% CI 1.23, 4.41); Supplementary Table S10, available at *Rheumatology Advances in Practice* online].

Of note, when exploring transitions in paid work status, patients were more likely to withdraw from paid work during the pandemic (9.6% patients *vs* 5.9% controls; $P = 0.02$), while controls more often gained paid work (6.7% patients *vs* 13.3% controls; $P = 0.04$) (Supplementary Table S11, available at *Rheumatology Advances in Practice* online). In both groups, participants themselves attributed only a minority of transitions (11.4% overall) to the pandemic (COVID-19 disease or national containment measures).

Work ability (objectives 1 and 2)

Current work ability was worse in patients [8.1 (S.D. 2.0) *vs* 8.7 (S.D. 1.6) in controls; $P < 0.01$] (Supplementary Table S12, available at *Rheumatology Advances in Practice* online). Work ability was mostly similar for the specific iRDs. Neither the change in work ability scores from pre-pandemic to current [−0.3 (S.D. 1.8) in patients *vs* −0.2 (S.D. 1.6) in controls] nor the self-perceived effect of the pandemic on current work productivity [worsening in 139/864 and 62/397 (both 16%) and improvement in 119/864 and 56/397 (both 14%) of both groups] differed between groups (Supplementary Table S12, available at *Rheumatology Advances in Practice* online).

Multivariable regression analyses for current work ability (2022) revealed a group*sex interaction. Female patients experienced significantly worse work ability compared with female controls [$\beta = -0.66$ (95% CI −0.92, −0.40)], while for males this association was less strong and not significant. Interestingly, working (partially) remotely, being female, having comorbidities and working fewer hours was associated with lower work ability (Table 5, Supplementary Table S13, available at *Rheumatology Advances in Practice* online). Change in work ability (2020–2022) did not differ between groups in regression analyses (Supplementary Tables S14 and S15, available at *Rheumatology Advances in Practice* online).

When limiting analyses to patients only (objective 2), comorbidities were associated with worse current work ability [$\beta = -0.34$ (95% CI −0.56, −0.12)], while a greater

Table 2. Characteristics or work pre-pandemic (March 2020) and current (March 2022)

Variable	Pre-pandemic (March 2020)		Current (March 2022)	
	Patients ($n=992$)	Controls ($n=443$)	Patients ($n=927$)	Controls ($n=428$)
Working in healthcare sector, *n* (%)	200 (20.2)	123 (27.8)	196 (21.1)	132 (30.8)
Physically demanding job, *n* (%)	142 (15.5)	69 (17.4)	129 (15.1)	66 (17.1)
Vulnerable employment, *n* (%)	228 (23.0)	120 (27.1)	240 (25.9)	124 (29.0)
Work hours per week, mean (S.D.)	31.5 (9.6)	30.5 (9.0)	30.8 (10.6)	30.0 (9.3)
Work location, *n* (%)				
Only at workplace	699 (71.3)	293 (70.3)	409 (44.7)	207 (48.8)
Only from home	52 (5.3)	19 (4.6)	107 (11.7)	43 (10.1)
Combined (at workplace + home)	229 (23.4)	105 (25.2)	399 (43.6)	174 (41.0)
Working from home				
Employer supports remote work, *n* (%)[a]	NA	NA	292 (60.0)	123 (59.1)
Hours working from home[a], mean (S.D.)	14.9 (12.1)	14.0 (11.4)	19.2 (11.0)	18.6 (10.1)
Income decreased since pandemic, *n* (%)[§b]	NA	NA	122 (14.0)	44 (11.1)
Importance of work (0–10)[c], mean (S.D.)	8.3 (1.7)	8.3 (1.7)	8.2 (1.9)	8.3 (1.7)
Perceived safety (−5/+5)[d], mean (S.D.)				
At workplace	0.2 (3.3)[d]	0.9 (3.1)[d]	2.5 (2.4)	2.8 (2.2)
During work commute (public transport)[e]	−1.8 (3.0)[d]	−1.4 (2.9)[d]	1.2 (2.6)	1.0 (2.6)

NA: not available.
Values were calculated in those with pre-pandemic ('Pre-pandemic' columns) or current ('Current' columns) employment. Vulnerable employment is considered as any employment other than a permanent contract (e.g. self-employed, workers with temporary contract), see Supplementary Table S1 and S3, available at *Rheumatology Advances in Practice* online.
[a] In those working (partially) from home.
[b] In those with paid work at both pre-pandemic and current time points.
[c] Range of 0 (completely unimportant) to 10 (extremely important).
[d] Range of −5 (very unsafe) to +5 (very safe). Retrospective questions on safety pertained not to the pre-pandemic period, but to the early months after onset of the pandemic.
[e] Only in those who commuted to work with public transport (pre-pandemic: 190 patients, 70 controls; current: 136 patients, 51 controls).

Table 3. AWO by type and cause

Variables	Any reason[e]		COVID-related[e]		Not COVID-related[d,e]		Unknown[d]	
	Patients ($n=977$)	Controls ($n=430$)	Patients ($n=977$)	Controls ($n=430$)	Patients ($n=977$)	Controls ($n=430$)	Patients ($n=977$)	Controls ($n=430$)
Any adverse work outcome, *n* (%)[a]	227 (23.2)	79 (18.4)	35 (3.6)	12 (2.8)	161 (16.5)	56 (13.0)	31 (3.2)	11 (2.6)
Withdrawal from paid work, *n* (%)[b]	95 (9.6)	26 (5.9)	13 (1.3)	1 (0.2)	75 (7.6)	22 (5.0)	7 (0.7)	3 (0.7)
Full time to part time, *n* (%)	34 (6.5)	17 (7.8)	4 (0.8)	3 (1.4)	19 (3.6)	10 (4.6)	11 (2.1)	4 (1.8)
Reduced work hours, *n* (%)[c]	105 (11.7)	45 (10.8)	18 (2.0)	10 (2.4)	64 (7.1)	28 (6.7)	23 (2.6)	7 (1.7)
Current long-term absence from work, *n* (%)	40 (4.4)	8 (1.9)	5 (0.6)	2 (0.5)	35 (3.9)	6 (1.4)	0 (0)	0 (0)

Percentages reflect the proportion of participants within a group having the AWO.
[a] Participants could have multiple types of AWOs, e.g. going from full-time to part-time employment and also being currently on long-term absence from work.
[b] From full-time or part-time employment to without paid work.
[c] Reduction of ≥4 work hours per week.
[d] If participants gave multiple reasons for AWOs, including COVID-related reasons among others, their AWO was considered to be COVID-related.
[e] Comparison of patients *vs* controls: $P=0.04$ (AWO due to any reason), $P=0.36$ (AWO COVID related), $P=0.08$ (AWO not COVID related).

number of working hours was associated with better work ability [$\beta=0.05$ (95% CI 0.04, 0.07)] (Supplementary Table S16, available at *Rheumatology Advances in Practice* online). In additional analyses in patients that worked (partially) at the workplace, perceived safety at the work location was positively associated with work ability [$\beta=0.10$ (95% CI 0.04, 0.16), Supplementary Table S17, available at *Rheumatology Advances in Practice* online]. Perceived safety during commuting was not associated with work ability (Supplementary Table S18, available at *Rheumatology Advances in Practice* online), although the number of patients in this subanalysis was low ($n=120$).

Remote work (objective 3)

Those who worked at least partially at home ($n=506$ patients, $n=217$ controls) reported that care for children while working remotely and the absence of colleagues had varying effects (positive in 19% and 24%, negative in 34% and 57%, respectively) on remote work performance. The experienced effects on work performance of employer support and reduced commuting time were mainly positive (83% and 86%, respectively; Fig. 1).

Toward the future, patients more frequently reported a preference to work completely or partially remotely compared with controls (completely remote: 8.2% of patients *vs* 5.7% of controls; partially remotely: 50.4% of patients *vs* 44.5% of controls; $P<0.01$; Supplementary Table S19, available at *Rheumatology Advances in Practice* online).

Discussion

In this cross-sectional study, iRD patients more frequently experienced AWOs compared with population controls. After adjustment for other variables, female patients and patients

Table 4. Regression analysis of AWO (any), stratified by job demand type

Variable	Univariable ($n = 1407$)			Multivariable (physically demanding job[a]) ($n = 208$)			Multivariable (non-physically demanding job[a]) ($n = 1065$)		
	OR	95% CI	*P*-value	OR	95% CI	*P*-value	OR	95% CI	*P*-value
Group, patients	1.34	1.01, 1.79	0.04	2.97	1.18, 7.49	0.02	1.67	1.17, 2.40	<0.01
Age	1.05	1.03, 1.06	<0.01	1.06	1.02, 1.11	<0.01	1.04	1.02, 1.05	<0.01
Sex, female	1.24	0.94, 1.62	0.13	2.59	1.21, 5.54	0.01	1.33	0.95, 1.85	0.10
High education	0.98	0.72, 1.34	0.90	–[b]			–[b]		
Comorbidities (0–4)	1.28	1.04, 1.58	0.02	2.04	1.21, 3.42	<0.01	–[c]		
Past SARS-CoV-2 infection	0.74	0.57, 0.95	0.02	–[c]			–		
Vaccinated against SARS-CoV-2	0.63	0.36, 1.12	0.12	–[b]			–[b]		
Healthcare work sector, pre-pandemic	1.29	0.96, 1.73	0.09	–[c]			–[c]		
Physically demanding job, pre-pandemic	1.01	0.71, 1.44	0.96	NA			NA		
Vulnerable employment contract, pre-pandemic	1.17	0.87, 1.57	0.30	–[b]			–[b]		
Working hours per week, pre-pandemic	0.99	0.98, 1.01	0.22	–[b]			–[b]		
Work location, pre-pandemic (*vs* at workplace)									
Only at home	2.00	1.17, 3.40	0.01	2.31[d]	0.47, 11.49	0.31	1.69[d]	0.93, 3.08	0.08
Combined (at workplace + at home)	1.22	0.90, 1.65	0.21	0.59[d]	0.17, 2.02	0.41	1.26[d]	0.90, 1.77	0.19

NA: not applicable (analysis stratified by job type).
OR >1 indicates an increased likelihood of an AWO. Outcome (AWO) could be COVID-related or not COVID-related.
See Supplementary Table S10 available at *Rheumatology Advances in Practice* online, for results of regression analysis of COVID-related adverse work outcome.
[a] Multivariable analysis was stratified by job demands due to interaction of job demands*group. See Supplementary Tables S6–S8 for multivariable models stratified by group, sex or presence of comorbidities.
[b] Not associated with outcome in the univariable analysis ($P \geq 0.10$).
[c] Associated with outcome in the univariable analysis ($P < 0.10$), but not significant or confounder for association group and outcome when entered in the multivariable model.
[d] Confounder for association group and outcome.

Table 5. Regression analysis of current work ability, stratified by sex

Variable	Univariable ($n = 1267$)			Multivariable (male[a], $n = 426$)			Multivariable (female[a], $n = 841$)		
	β	95% CI	*P*-value	β	95% CI	*P*-value	β	95% CI	*P*-value
Group, patients	−0.57	−0.79, −0.35	<0.01	−0.37	−0.76, 0.01	0.06	−0.66	−0.92, −0.40	<0.01
Age, years	0.00	−0.01, 0.01	0.67	0.00	−0.02, 0.02	0.99	0.00	−0.01, 0.01	0.63
Sex, female	−0.22	−0.44, 0.00	0.05	NA			NA		
High education	0.08	−0.17, 0.33	0.53	–[b]			–[b]		
Comorbidities (0–4)	−0.32	−0.51, −0.13	<0.01	–[c,e]			−0.36	−0.61, −0.12	<0.01
Past SARS-CoV-2 infection	0.12	−0.09, 0.32	0.27	–[b,d]			–[b,d]		
Vaccinated against SARS-CoV-2	0.30	−0.23, 0.82	0.26	–[b]			–[b]		
Healthcare work sector, current	−0.15	−0.39, 0.09	0.22	–[b]			–[b]		
Physically demanding job, current	0.03	−0.27, 0.33	0.84	–[b]			–[b]		
Vulnerable employment contract, current	−0.13	−0.36, 0.11	0.29	–[b]			–[b]		
Working hours per week, current	0.05	0.04, 0.06	<0.01	0.05	0.03, 0.07	<0.01	0.05	0.03, 0.06	<0.01
Work location, current (*vs* at workplace)									
Only at home	−0.39	−0.74, −0.04	0.03	–[c,e]			−0.55	−0.95, −0.15	<0.01
Combined (at workplace + at home)	−0.09	−0.31, 0.13	0.42	–[c,e]			−0.28	−0.55, −0.01	0.04
Hours working from home per week, current	0.01	0.00, 0.01	0.16	–[b]			–[b]		

NA: not applicable (analysis stratified by sex).
Work ability on a scale of 0–10 (worst–best). Coefficients <0 indicate worse work ability.
[a] Multivariable analysis was stratified by sex due to interaction sex*group.
[b] Not associated with outcome in univariable analysis ($P \geq 0.10$).
[c] Associated with outcome in univariable analysis ($P < 0.10$), but not significant when entered in the multivariable model.
[d] Past SARS-CoV-2 infection not associated with the outcome if forced and retained in the multivariable mode [$\beta_{males} = -0.03$ (95% CI −0.37, 0.31); $\beta_{females} = 0.15$ (95% CI −0.10, 0.40)].
[e] If the same variables were retained in both subgroup models (age, sex, comorbidities, working hours, work location), regardless of significance when entered, this variable was not significantly associated with the outcome [$\beta_{comorbidities\_males} = -0.17$ (95% CI −0.44, 0.10), $\beta_{worklocation\_home\_males} = 0.14$ (95% CI −0.48, 0.77), $\beta_{worklocation\_work/home\_males} = -0.10$ (95% CI −0.45, 0.24)].

with physically demanding jobs or comorbidities were especially at additional risk, with a predicted probability that was 12–17% higher (absolute) compared with controls. Patients were not only more likely to withdraw fully from paid work during the pandemic, but were also less likely to be working before the pandemic. Further, the pandemic showed no overall effect on work ability, but current work ability was notably worse, especially in female patients. Interestingly, past SARS-CoV-2 infection was not related to any of the work participation outcomes, and only a minority of AWOs was perceived as COVID-related.

An explanation for the low frequency of COVID-related AWOs in both groups could be the extensive governmental financial support for employers. In the Netherlands, these measures were intended to protect workers by preventing loss of employment and income and to protect employers from

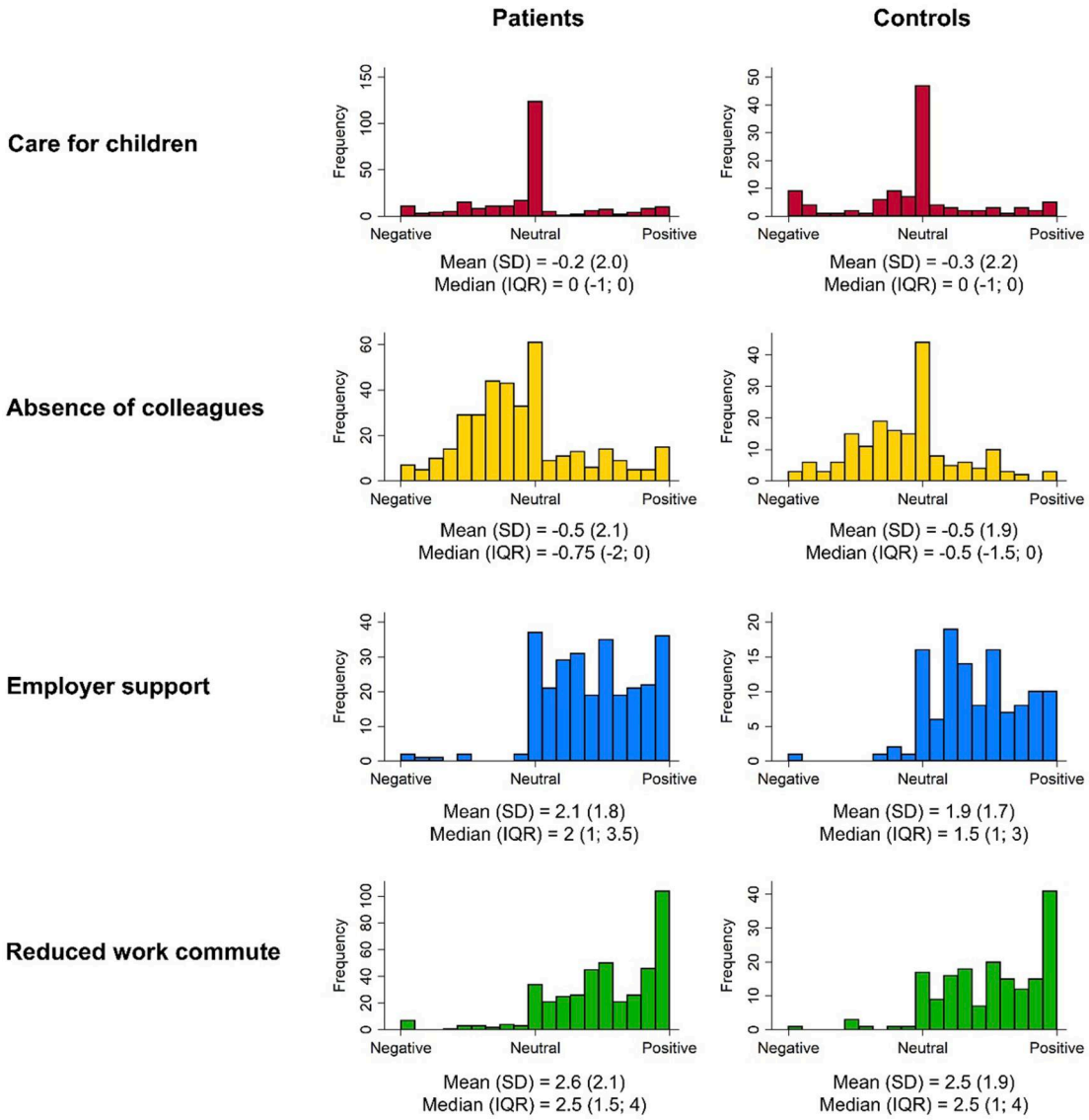

Figure 1. Effect of various typical characteristics of remote work on work performance. Participants were asked to indicate (on a scale ranging from −5 to +5 (very negative to very positive) the effects of these characteristics, if applicable, on work performance while working at home

bankruptcy, downscaling or business closure [12]. Clearly, governmental measures did not cover all risk of AWOs, as 9.6% of patients and 5.9% of controls lost paid work, independent of COVID-19. Likely, this stronger negative shift not related to COVID-19 in patients is explained by their disease. Some transitions might have been voluntary, e.g. (early) retirement. Still, differences persisted when retirement was not considered.

Interestingly, during the pandemic the change in work ability was very small and comparable in patients and controls. Also, a similar proportion of participants experienced positive or negative effects on work productivity. Of note, we might have underestimated the pandemic impact on work ability/productivity in patients, as more patients had withdrawn from work and likely the healthier were working. Still, when exploring current work ability, a negative effect of iRDs was observed, especially in females. Other studies on work and COVID-19 showed that women were more often responsible for caring and educating children when day care and schools closed and had less suitable workplaces at home than men [25–27]. This might also explain why remote work was associated with worse work ability in women in our study, although we could not further explore this. Confounding by indication might play a role, as those with pre-existing worse work ability might prefer remote work. In our study, care for children at home but also the absence of colleagues were experienced as barriers by some but as facilitators by others. On the other hand, employer support and reduced commuting time was experienced quite universally as a facilitator of remote work performance. These facilitators and barriers deserve further study.

The vulnerable subgroups we identified are in line with findings from pre-pandemic studies. Previous studies in RA have shown that female patients more frequently stop working, and patients with physically demanding jobs are at higher risk for absenteeism and job loss [28, 29]. Rather than pointing to new mechanisms, the pandemic likely acted as a catalyst in patients to bring out their pre-existing vulnerabilities.

The main strength of this study is the sample size and availability of controls, which allowed for comparison and facilitated the interpretation of results. To our knowledge, this is

the first controlled study on COVID-19 and work participation in iRDs. An additional strength included being nested in an ongoing cohort study, meaning that the risk of selection bias was reduced and that previously collected data could supplement the newly collected work data. Finally, a substantial number of participants had paid work (studies where work is a secondary outcome often suffer from power issues).

Still, there are limitations. First, the cross-sectional and retrospective character and the potential reduction of the baseline population to the current study sample might affect internal validity, although response rates were acceptable. Information was limited to two time points, meaning that we might not have captured all work-related events in the period in-between. Nonetheless, our results provide a perspective on the longer-term work situation, which might be more predictive of future work outcomes. Second, when establishing the cohort, matching patients and controls was not conditional on work status. Together with the absence of some data among controls (e.g. satisfaction with health), this hindered full comparison of groups. Third, even though our study was large enough to explore subgroup effects, certain subgroups were small. Post hoc power analysis showed the power exceeded 80% to detect relevant effects for the major analyses, including stratified analyses, with the exception of COVID-related AWOs. Fourth, selection bias could have occurred, as iRD patients might be more at risk for severe consequences of COVID-19, such as hospitalization or death (preventing them from participating in the current study). However, previous studies in this cohort showed low rates of hospitalization, intensive care unit admission and mortality, making the impact on our results (if any) negligible [18, 30].

The governmental support measures offered during the pandemic have largely been withdrawn, and a delayed effect of the pandemic cannot be excluded. It will be worthwhile to continue monitoring work participation in this cohort and to investigate the effects of specific supportive measures.

In conclusion, this study highlights the persisting gap in work participation between iRD patients and population controls. Examples include AWOs during the pandemic and current work ability, which are worse in patients. However, past SARS-CoV-2 infection seems not related to work participation outcomes in this population. This suggests that it is especially the chronic disease that makes one prone to suboptimal work outcomes, and it is these persons who should be supported in healthy and sustainable paid work.

Supplementary material

Supplementary material is available at *Rheumatology Advances in Practice* online.

Data availability

We intend to share de-identified participant-level data upon reasonable request. Researchers who are interested in doing additional analyses using these data can contact the corresponding author.

Authors' contributions

M.B. was responsible for investigation, formal analysis and writing the original draft. L.B. was responsible for resources, investigation and reviewing and editing the manuscript. A.B. was responsible for conceptualization, investigation, formal analysis, supervision and reviewing and editing the manuscript. A.d.R. was responsible for investigation, formal analysis and reviewing and editing the manuscript. G.W. was responsible for conceptualization, resources, investigation and reviewing and editing the manuscript. C.W. was responsible for investigation, formal analysis, supervision and reviewing and editing the manuscript.

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