

Original research

Association of changes in work due to COVID-19 pandemic with psychosocial work environment and employee health: a cohort study of 24 299 Finnish public sector employees

Jenni Ervasti ¹, Ville Aalto,² Jaana Pentti,^{1,3,4} Tuula Oksanen,⁵ Mika Kivimäki,^{1,3,6} Jussi Vahtera ^{4,7}

► Additional supplemental material is published online only. To view, please visit the journal online (<http://dx.doi.org/10.1136/oemed-2021-107745>).

¹Finnish Institute of Occupational Health, Helsinki, Finland

²Finnish Institute of Occupational Health, Turku, Finland

³Helsingin Yliopisto, Helsinki, Finland

⁴Department of Public Health, Turun Yliopisto, Turku, Finland

⁵University of Eastern Finland, Joensuu, Finland

⁶Department of Epidemiology and Public Health, University College London, London, UK

⁷Turku University Hospital, Turku, Finland

Correspondence to

Dr Jenni Ervasti, Finnish Institute of Occupational Health, Helsinki, Finland; jenni.ervasti@ttl.fi

Received 14 May 2021

Accepted 19 August 2021

Published Online First

14 September 2021



© Author(s) (or their employer(s)) 2022. No commercial re-use. See rights and permissions. Published by BMJ.

To cite: Ervasti J, Aalto V, Pentti J, et al. *Occup Environ Med* 2022;**79**:233–241.

ABSTRACT

Objectives To examine the associations of COVID-19-related changes in work with perceptions of psychosocial work environment and employee health.

Methods In a cohort of 24 299 Finnish public sector employees, psychosocial work environment and employee well-being were assessed twice before (2016 and 2018=reference period) and once during (2020) the COVID-19 pandemic. Those who reported a change (=‘Exposed’) in work due to the pandemic (working from home, new tasks or team reorganisation) were compared with those who did not report such change (=‘Non-exposed’).

Results After adjusting for sex, age, socioeconomic status and lifestyle risk score, working from home (44%) was associated with greater increase in worktime control (standardised mean difference (SMD)_{Exposed}=0.078, 95% CI 0.066 to 0.090; SMD_{Non-exposed}=0.025, 95% CI 0.014 to 0.036), procedural justice (SMD_{Exposed}=0.101, 95% CI 0.084 to 0.118; SMD_{Non-exposed}=0.053, 95% CI 0.038 to 0.068), workplace social capital (SMD_{Exposed}=0.094, 95% CI 0.077 to 0.110; SMD_{Non-exposed}=0.034, 95% CI 0.019 to 0.048), less decline in self-rated health (SMD_{Exposed}=−0.038, 95% CI −0.054 to −0.022; SMD_{Non-exposed}=−0.081, 95% CI −0.095 to −0.067), perceived work ability (SMD_{Exposed}=−0.091, 95% CI −0.108 to −0.074; SMD_{Non-exposed}=−0.151, 95% CI −0.167 to −0.136) and less increase in psychological distress (risk ratio (RR)_{Exposed}=1.06, 95% CI 1.02 to 1.09; RR_{Non-exposed}=1.16, 95% CI 1.13 to 1.20). New tasks (6%) were associated with greater increase in psychological distress (RR_{Exposed}=1.28, 95% CI 1.19 to 1.39; RR_{Non-exposed}=1.10, 95% CI 1.07 to 1.12) and team reorganisation (5%) with slightly steeper decline in perceived work ability (SMD_{Exposed}=−0.151, 95% CI −0.203 to −0.098; SMD_{Non-exposed}=−0.124, 95% CI −0.136 to −0.112).

Conclusion Employees who worked from home during the pandemic had more favourable psychosocial work environment and health, whereas those who were exposed to work task changes and team reorganisations experienced more adverse changes.

INTRODUCTION

The COVID-19 pandemic has drastically affected work and working environments.¹ Particularly in healthcare, mental health of the employees has

Key messages

What is already known about this subject?

- Working from home, transfer into new tasks and team reorganisations have increased due to COVID-19 pandemic, but it is unclear how they may affect perceptions of psychosocial work environment and employee well-being.
- Previous studies suggest that organisational changes and restructuring may have adverse effects on employee well-being.

What are the new findings?

- Our results point to heterogeneous and socially stratified effects of changes at work due to the COVID-19 pandemic.
- Working from home slightly improved perceptions of psychosocial work environment as compared to pre-pandemic situation, and as compared to on-site workers during the pandemic.
- Transfer into new work tasks and team reorganisations due to COVID-19 were associated with less favourable changes in perceptions of psychosocial work environment, and a slight decrease in employee health.

How might this impact on policy or clinical practice in the foreseeable future?

- The differing psychosocial and health-related effects in those working from home and those present at workplace suggest a further occupation-related polarisation of working life.
- The well-being of workers on the frontline of pandemic seems to be at risk, and should be a focus of COVID-19 exit strategies.

declined.^{2 3} In addition to psychological effects of higher work load, fear of getting sick and the adverse consequences of lockdowns, there have been many tangible changes in work arrangements. The number of employees working from home has increased drastically, potentially counted as millions of workers globally who at least temporarily have been working from home.⁴ A recent review concluded that this massive switch to working from home has required adaptation from both employers

and employees.¹ Work has decreased due to lockdowns in some sectors but increased in others, particularly healthcare. The majority of pre-pandemic studies suggest that organisational downsizing, mergers and changes may adversely affect health of employees,^{5–13} but in some cases also favourable changes have been detected.^{14 15} However, it is unclear how changes caused by COVID-19 pandemic at workplaces may have affected perceptions of psychosocial work environment and employee well-being.

We used repeat data from three surveys before and during the COVID-19 pandemic to examine whether working from home, assignment into new tasks and team reorganisations in response to the pandemic were associated with employees' perceptions of psychosocial work environment and health during the pandemic.

Table 1 Descriptive characteristics of participants by changes made at work due to COVID-19 in 2020

	Working from home (n=10 683)	Not working from home (n=13 616)	P for difference
Sex			
Men	2651 (25)	2708 (20)	
Women	8032 (75)	10 908 (80)	<0.001
SES			
High	8029 (75)	4605 (34)	
Intermediate	2310 (22)	41 331 (30)	
Low	344 (3)	4878 (36)	<0.001
Mean age (SD)	50.6 (8.6)	50.7 (9.2)	0.40
Mean number of lifestyle risk factors (SD)	0.83 (0.77)	0.98 (0.83)	<0.001
New tasks			
	New tasks (n=1527)	No new tasks (n=22 772)	
Sex			
Men	165 (11)	5194 (23)	
Women	1362 (89)	17 578 (77)	<0.001
SES			
High	402 (26)	12 232 (54)	
Intermediate	691 (45)	5752 (25)	
Low	434 (29)	4788 (21)	<0.001
Mean age, SD	49.5 (9.6)	50.8 (8.9)	<0.001
Mean number of lifestyle risk factors (SD)	0.90 (0.80)	0.92 (0.81)	0.46
Team reorganisation			
	Team reorganisation (n=1147)	No team reorganisation (n=23 152)	
Sex			
Men	214 (19)	5145 (22)	
Women	933 (81)	18 007 (78)	0.0045
SES			
High	508 (44)	12 126 (52)	
Intermediate	333 (29)	6110 (26)	
Low	306 (27)	4916 (22)	<0.001
Mean age, SD	51.0 (8.7)	50.7 (9.0)	0.18
Mean number of lifestyle risk factors (SD)	0.91 (0.78)	0.92 (0.81)	0.90

Values are given as frequency (%).
SES, socioeconomic status.

METHODS

Study design and population

The design is retrospective. Participants were employees of 11 cities from the Finnish Public Sector study,^{5–7} which represented about 22% of Finnish public sector workers. These employees worked in a wide range of occupations from administrative personnel and professional to semiskilled and unskilled workers. The most common occupations in the Finnish municipal sector were those related to healthcare, social services and education, representing nearly 50% of all occupational groups. We used data from surveys in 2016 (n=65 089, response rate 72%), 2018 (n=64 066, response rate 71%) and 2020 (n=65 179, response rate 72%). In every data collection, the survey questionnaire was sent in September to all employees who had been employed in the study organisations for at least 6 months. We included participants who had responded to all of the three surveys, belonged to only one of the exposure groups (n=32 435), had complete data on exposure and outcome variables (n=31 054), had register-based information on sex, age and occupation (n=28 564), and consented to linkage of survey and register data (the final analytic sample n=24 299).

Changes due to COVID-19

In the 2020 survey, we enquired whether the COVID-19 pandemic had caused any changes in the respondent's work. The changes were: (1) the employee was transferred partially or totally into working from home; (2) the employee was transferred to other work tasks within the same occupation sector or to another occupational sector and (3) the work unit/team in which the employee work was reorganised into smaller or larger unit. Each participant could only belong to one group. In all these three changes, employees that reported such a change were compared with those not reporting the change.

Outcomes

Worktime control

Worktime control was measured using a standard questionnaire in which the participants were asked to evaluate on a scale from 1 (very little) to 5 (very much) how much they could influence the following aspects of their working time: length, starting and ending times, breaks, and handling of private matters during the workday, scheduling of work shifts, vacations and paid days off, and the taking of unpaid leave.^{16 17}

Job strain

Job strain was measured as a combination of high demands, and low job control.^{18 19} Job demands scale consisted of five items, which considered time pressures and deadlines, lack of time to do what was expected and work overload. The job control scale combines two concepts, skill discretion (the opportunities of an individual to develop his or her special abilities within the job, six items) and decision authority (individual's abilities to be part of the decision-making process within the organisation, three items). These subscales were combined for the analysis. Responses were given along a five-point scale from 5=strongly agree to 1=strongly disagree. Job strain was defined as high demands (higher than median score in 2010–2014) and low control (lower than median score in 2010–2014); all other combinations of job demands and job control were assigned to no strain.^{20 21}

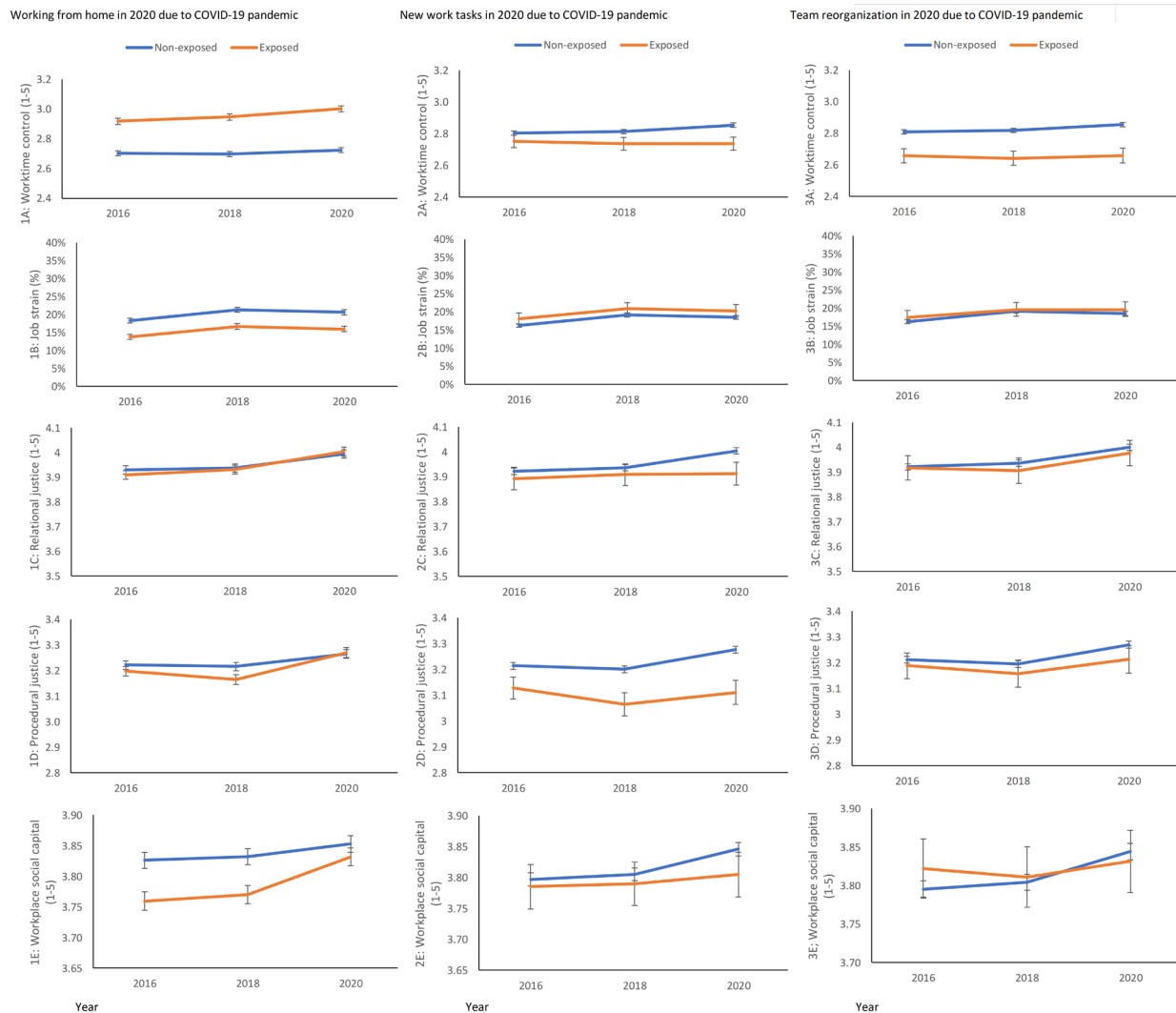


Figure 1 Sex-, age-, and SES-adjusted means (error bars represent 95% CIs) in psychosocial work environment factors in 2016, 2018 and 2020 stratified by (1A–1E) working from home in 2020 (=Exposed) and not working from home in 2020 (=Non-exposed); (2A–2E) new work tasks in 2020 (=Exposed) and no new tasks in 2020 (=Non-exposed) and (3A–3E) team reorganisation in 2020 (=Exposed) and no reorganisation in 2020 (=Non-exposed). SES, socioeconomic status.

Procedural justice

The seven-item scale considers whether the decision-making procedures at the workplace are accurate, correctable, consistently applied and whether the procedures include opinions from the people involved.²²

Relational justice

The six-item scale refers to the quality of treatments employees experience in their interpersonal interactions during the completion of organisational processes.²² The scale includes items evaluating whether the supervisors use kindness and consideration, are truthful and can suppress personal biases. The response format was a five-point scale from 5=strongly agree to 1=strongly disagree for both justice dimensions.

Team climate

The work unit cooperation and interaction was measured using the short version²³ of the Team Climate Inventory (TCI).²⁴ TCI conceptualises team climate into four dimensions: participations safety, support for innovation, vision and task orientation. All dimensions were combined in the analysis. Responses were

given on a five-point scale (from 5=strongly agree to 1=strongly disagree).

Workplace social capital

Social capital was measured with a validated measure comprising eight items. These items indicate whether people feel that they are respected, valued and treated as equals at work, rather than feeling that it is all a matter of seniority in their hierarchy. Responses were given on a five-point scale (from 1=strongly disagree to 5=strongly agree).²⁵

Psychological distress

We used the 12-item General Health Questionnaire (GHQ-12) to measure psychological distress (symptoms of depression and anxiety).²⁶ In GHQ-12, respondents rate the extent to which they are affected by each of the 12 symptoms of distress (0=not at all, 0=as much as usual, 1=slightly more than usual, 1=much more than usual). Participants with a rating of 1 in at least four items of the total measure were coded as cases of psychological distress (1=case, 0=non-case).

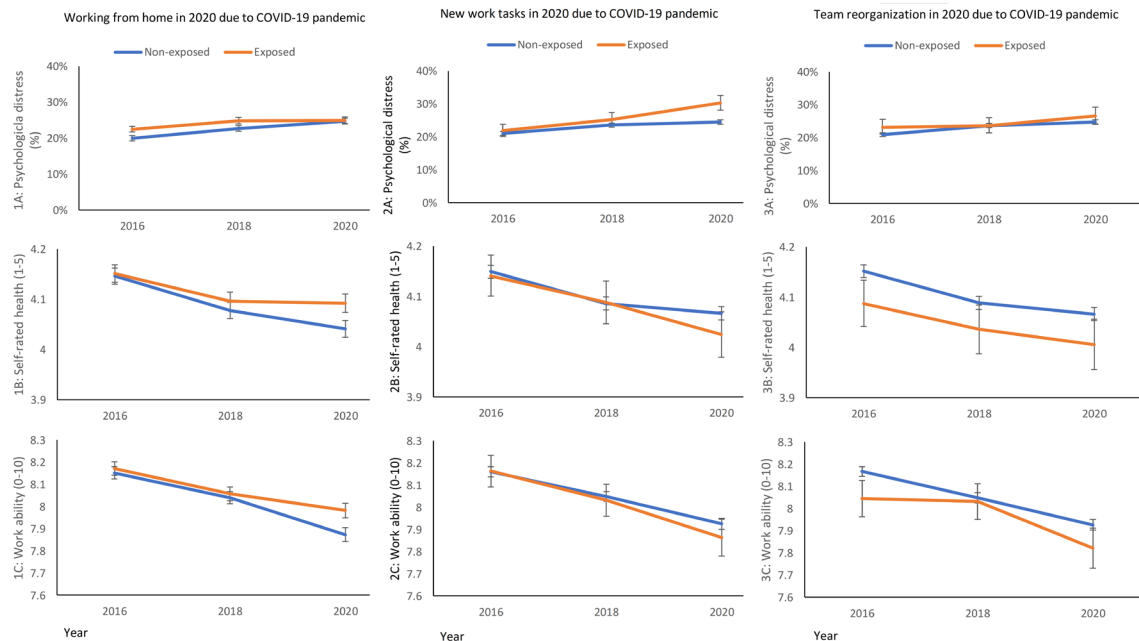


Figure 2 Sex-adjusted, age-adjusted and SES-adjusted means (error bars represent 95% CIs) in well-being factors in 2016, 2018 and 2020 stratified by (1A–1E) working from home in 2020 (=Exposed) and not working from home in 2020 (=Non-exposed); (2A–2E) new work tasks in 2020 (=Exposed) and no new tasks in 2020 (=Non-exposed) and (3A–3E) team reorganisation in 2020 (=Exposed) and no reorganisation in 2020 (=Non-exposed). SES, socioeconomic status.

Self-rated health

We used a single-item measure ‘How do you rate your health?’ with response options; 1=poor; 2=fairly poor; 3=average; 4=fairly good; 5=good. The question is widely used and recommended for standard indicator of health in surveys.²⁷

Self-rated work ability

We used a single-item measure from the Work Ability Index (WAI)^{28,29}: ‘Let’s assume that your work ability at its all-time best would be given 10 points, and 0 points would indicate that you are completely unable to work. How would you score your current work ability?’ with response options from 0 to 10. A very strong association between the WAI and the single-item question has been shown, and both the WAI and the single-item question showed similar patterns of associations with sick leave, health and symptoms.³⁰

Covariates

Information on sex, age and occupation was register-based. The occupations were classified according to the 2001 International Standard Classification of Occupations codes and were categorised into three levels of socioeconomic status (SES): high (upper-grade nonmanual worker including managers, administrators and specialists), intermediate (lower-grade nonmanual workers including office workers, clerks, customer service and sales workers, registered and public health nurses) and low (manual workers including construction workers, manufacturing, transportation workers and practical nurses).

We also included lifestyle risk factors (smoking, at-risk alcohol use, overweight and physical inactivity) as possible confounding factors. Smoking was dichotomised into current smoker and non-smoker (including never smokers and ex-smokers).³¹ Alcohol use was elicited by questions on weekly consumption. One drink was approximately equivalent to one unit or one glass of alcoholic drink or 12 g of alcohol. Alcohol use was dichotomised

into no use or moderate use (a maximum of 140 g or 11 units for women and 280 g or 23 units for men) versus alcohol use greater than this.³² Body mass index (weight in kg divided by height in m²) was dichotomised as less than 25 (non-overweight) and 25 or more (overweight).³³ Participants were categorised as being physically inactive if they reported <2 metabolic equivalent task hours per day (approximately 30 min of walking) and active if more than this.³⁴ Lifestyle risk score was calculated as number of risk factors from 0 to 4. All lifestyle factors were self-reported.

Statistical analysis

We calculated the annual (2016, 2018, 2020) least square (sex-, age-, and SES-adjusted) means for employees whose work had changed due to coronavirus in 2020 comparing to those who had not experienced such change (working from home vs not working from home; new tasks vs no new tasks; team reorganisation vs no team reorganisation).

To determine the change in psychosocial work environment and well-being from 2016 to 2018 (two measures) (ie, before the emergence of COVID-19) relative to 2020, we applied a repeated-measures linear regression analysis for continuous outcomes, and binomial regression analysis with log link function for binary outcomes, using the generalised estimating equations method with exchangeable correlation structure. This method considers the intraindividual correlation between the measurements. In linear models, outcome variables were standardised: (variable–variable mean in 2016)/variable SD in 2016. We calculated standardised mean differences (SMD), also known as Cohen’s d, and their 95% CIs by contrasting year 2020 with years 2016 and 2018. In binomial models, we calculated risk ratios (RR) and their 95% CI by contrasting year 2020 with years 2016 and 2018. Analyses were adjusted for sex, age and SES, and in sensitivity analysis, also for lifestyle risk factors.

To analyse whether the trends differed in 2020 versus 2016–2018 among those having experienced a change at work in

Table 2 Psychosocial work characteristics during COVID-19 pandemic versus before

	Working from home				New tasks				Team reorganisation							
	Exposed		Non-exposed		Exposed		Non-exposed		Exposed		Non-exposed					
	SMD*	95% CI	SMD*	95% CI	SMD*	95% CI	SMD*	95% CI	SMD*	95% CI	SMD*	95% CI				
	Group×time	95% CI	Group×time	95% CI	Group×time	95% CI	Group×time	95% CI	Group×time	95% CI	Group×time	95% CI				
	RR†	95% CI	RR†	95% CI	RR†	95% CI	RR†	95% CI	RR†	95% CI	RR†	95% CI				
Worktime control 2020 versus 2016–2018																
Model 1	0.076	0.065 to 0.087	0.014	0.004 to 0.024	<0.001	0.004 to 0.024	0.044	−0.040 to 0.018	0.044	0.036 to 0.051	<0.001	0.003	−0.032 to 0.037	0.042	0.035 to 0.042	0.041
Model 2	0.078	0.066 to 0.090	0.026	0.015 to 0.037	<0.001	0.015 to 0.037	0.051	−0.039 to 0.024	0.051	0.042 to 0.060	<0.001	0.011	−0.026 to 0.047	0.049	0.040 to 0.057	0.057
Model 3	0.078	0.066 to 0.090	0.025	0.014 to 0.036	<0.001	0.014 to 0.036	0.051	−0.039 to 0.024	0.051	0.042 to 0.059	<0.001	0.010	−0.026 to 0.047	0.048	0.040 to 0.057	0.059
Relational justice 2020 versus 2016–2018																
Model 1	0.088	0.071 to 0.105	0.066	0.052 to 0.081	0.069	0.052 to 0.081	0.080	−0.033 to 0.053	0.080	0.06 to 0.091	0.008	0.067	0.019 to 0.115	0.076	0.064 to 0.087	0.54
Model 2	0.094	0.076 to 0.111	0.067	0.052 to 0.083	0.054	0.052 to 0.083	0.084	−0.033 to 0.059	0.084	0.071 to 0.096	0.013	0.073	0.022 to 0.124	0.079	0.067 to 0.091	0.65
Model 3	0.093	0.076 to 0.110	0.068	0.052 to 0.084	0.069	0.052 to 0.084	0.084	−0.033 to 0.059	0.084	0.071 to 0.096	0.013	0.072	0.022 to 0.112	0.079	0.067 to 0.091	0.67
Procedural justice 2020 versus 2016–2018																
Model 1	0.113	0.097 to 0.129	0.072	0.058 to 0.086	<0.001	0.058 to 0.086	0.094	−0.016 to 0.067	0.094	0.083 to 0.105	<0.001	0.069	0.021 to 0.117	0.090	0.080 to 0.101	0.57
Model 2	0.101	0.084 to 0.118	0.053	0.038 to 0.068	<0.001	0.038 to 0.068	0.079	−0.028 to 0.060	0.079	0.067 to 0.090	0.003	0.045	−0.006 to 0.097	0.075	0.064 to 0.087	0.48
Model 3	0.101	0.084 to 0.118	0.053	0.038 to 0.068	<0.001	0.038 to 0.068	0.079	−0.028 to 0.060	0.079	0.067 to 0.091	0.004	0.046	−0.005 to 0.097	0.076	0.064 to 0.087	0.50
Workplace social capital 2020 versus 2016–2018																
Model 1	0.087	0.072 to 0.103	0.032	0.019 to 0.046	<0.001	0.019 to 0.046	0.058	−0.023 to 0.058	0.058	0.048 to 0.068	0.16	0.016	−0.032 to 0.064	0.057	0.048 to 0.068	0.17
Model 2	0.094	0.078 to 0.110	0.033	0.019 to 0.048	<0.001	0.019 to 0.048	0.063	−0.020 to 0.068	0.063	0.051 to 0.074	0.25	0.021	−0.030 to 0.072	0.062	0.051 to 0.074	0.21
Model 3	0.094	0.077 to 0.110	0.034	0.019 to 0.048	<0.001	0.019 to 0.048	0.063	−0.019 to 0.069	0.063	0.051 to 0.075	0.26	0.020	−0.031 to 0.071	0.063	0.051 to 0.074	0.20
Job strain 2020 versus 2016–2018																
Model 1	1.06	1.01 to 1.10	1.02	1.00 to 1.05	0.27	1.00 to 1.05	1.03	0.96 to 1.11	1.03	1.01 to 1.06	0.92	1.05	0.95 to 1.16	1.03	1.01 to 1.05	0.74
Model 2	1.05	1.01 to 1.10	1.05	1.01 to 1.07	0.38	1.01 to 1.07	1.05	0.96 to 1.13	1.05	1.02 to 1.07	0.89	1.06	0.96 to 1.18	1.05	1.02 to 1.07	0.65
Model 3	1.06	1.01 to 1.11	1.04	1.01 to 1.07	0.37	1.01 to 1.07	1.05	0.96 to 1.13	1.05	1.02 to 1.07	0.89	1.07	0.96 to 1.18	1.05	1.02 to 1.07	0.63

Years 2016 and 2018 are contrasted to 2020.

Model 1 is unadjusted; Model 2 is adjusted for sex, age and SES; and Model 3 is adjusted as Model 2+lifestyle risk factors.

*SMD >0 indicates an increase between 2020 and 2016–2018; SMD <0 indicates a decrease between 2020 and 2016–2018.

†RR <1 indicates increased risk of job strain between 2020 and 2016–2018.

RR, risk ratio; SMD, standardised mean difference.

Table 3 Employee well-being during COVID-19 pandemic versus before

	Working from home				New tasks				Team reorganisation			
	Exposed		Non-exposed		Exposed		Non-exposed		Exposed		Non-exposed	
	RR*	95% CI	RR*	95% CI	RR*	95% CI	RR*	95% CI	RR*	95% CI	RR*	95% CI
Psychological distress 2020 versus 2016–2018												
Model 1	1.03	0.99 to 1.06	1.11	1.08 to 1.15	1.22	1.14 to 1.32	1.07	1.04 to 1.09	1.11	1.01 to 1.22	1.07	1.05 to 1.10
Model 2	1.06	1.02 to 1.09	1.16	1.13 to 1.20	1.29	1.19 to 1.39	1.10	1.07 to 1.13	1.14	1.03 to 1.26	1.11	1.09 to 1.14
Model 3	1.06	1.02 to 1.09	1.16	1.13 to 1.20	1.28	1.19 to 1.39	1.10	1.07 to 1.12	1.14	1.03 to 1.25	1.11	1.09 to 1.14
	SMD†	95% CI	SMD†	95% CI	Group×time	95% CI	SMD†	95% CI	Group×time	95% CI	SMD†	95% CI
Self-rated health 2020 versus 2016–2018												
Model 1	-0.095	-0.110 to -0.080	-0.137	-0.150 to -0.125	<0.001	-0.158 to -0.119	-0.117	-0.127 to 0.107	-0.126	-0.170 to -0.081	-0.119	-0.129 to -0.109
Model 2	-0.038	-0.054 to -0.022	-0.084	-0.098 to -0.070	<0.001	-0.107 to -0.149 to -0.066	-0.061	-0.072 to 0.050	-0.066	-0.114 to -0.019	-0.064	-0.075 to -0.053
Model 3	-0.038	-0.054 to -0.022	-0.081	-0.095 to -0.067	<0.001	-0.108 to -0.149 to -0.066	-0.059	-0.048 to 0.059	-0.068	-0.115 to -0.020	-0.062	-0.073 to -0.051
	Work ability 2020 versus 2016–2018											
Model 1	-0.139	-0.156 to -0.123	-0.192	-0.207 to -0.178	<0.001	-0.197 to -0.240 to -0.154	-0.168	-0.179 to 0.157	-0.200	-0.250 to -0.150	-0.169	-0.180 to -0.157
Model 2	-0.091	-0.108 to -0.074	-0.154	-0.170 to -0.138	<0.001	-0.162 to -0.208 to -0.156	-0.124	-0.136 to 0.112	-0.150	-0.203 to -0.097	-0.125	-0.137 to -0.113
Model 3	-0.091	-0.108 to -0.074	-0.151	-0.167 to -0.136	<0.001	-0.162 to -0.207 to -0.115	-0.123	-0.135 to 0.110	-0.151	-0.203 to -0.098	-0.124	-0.136 to -0.112

Years 2016 and 2018 are contrasted to 2020.
 Model 1 is unadjusted; Model 2 is adjusted for sex, age and SES; and Model 3 is adjusted as Model 2+ lifestyle risk factors
 *RR > 1 indicates increased risk of psychological distress between 2020 and 2016–2018.
 †SMD > 0 indicates an increase between 2020 and 2016–2018; SMD < 0 indicates a decrease between 2020 and 2016–2018.
 RR, risk ratio; SMD, standardised mean difference.

2020 due to COVID-19, we tested time \times group interaction. We performed occupation-specific sensitivity analysis within the largest public sector occupational groups that have particularly been affected by the pandemic: teachers ($n=6314$) and nurses ($n=2044$). SAS software package (V.9.4; SAS Institute) was used for statistical analyses.

RESULTS

In 2020, a total of 44% of our respondents had been transferred into working from home; 6% reported having had new work tasks and 5% reported team reorganisation as employers' response to COVID-19 pandemic. Employees transferred into working from home were more often men, had a high SES and lower lifestyle risk factor score compared with those not working from home. Employees transferred into new tasks were slightly younger. Those transferred into new tasks or having experienced a team reorganisation were more often women and with intermediate or low SES compared with those who had not been transferred into new tasks or had not experienced a team reorganisation (table 1).

The annual sex-adjusted, age-adjusted and SES-adjusted means of psychosocial work environment and employee health stratified by groups experiencing a change versus not experiencing the change are illustrated in figures 1 and 2. Tables 2 and 3 show the SMD/RR of psychosocial work characteristics and employee well-being in 2020 compared with 2016–2018 and whether the estimates are different between groups experiencing a change versus not experiencing the change.

Working from home during the pandemic

Employees who changed to working from home in 2020 had better worktime control throughout the follow-up. The mean of worktime control was 2.9 in 2016–2018 and 3.0 in 2020 among those working from home in 2020, whereas the corresponding mean in those not working from home was 2.7 throughout the follow-up (figure 1, panel 1A). Working from home in 2020 was thus associated with a greater increase in worktime control in 2020 compared with corresponding increase among those who did not work from home in 2020 (SMD_{Exposed} = 0.078, 95% CI 0.066 to 0.090; SMD_{Non-exposed} = 0.025, 95% CI 0.014 to 0.036) (table 2).

Before the pandemic, procedural justice and workplace social capital were slightly higher among employees who did not work from home in 2020 than among those who did (figure 1, panels 1D and 1E). Working from home in 2020 was associated with a slightly larger increase in procedural justice (SMD_{Exposed} = 0.101, 95% CI 0.084 to 0.118; SMD_{Non-exposed} = 0.053, 95% CI 0.038 to 0.068) and workplace social capital (SMD_{Exposed} = 0.094, 95% CI 0.077 to 0.110; SMD_{Non-exposed} = 0.034, 95% CI 0.019 to 0.048) among employees who worked from home in 2020 compared with those who did not (table 2). The trends in job strain and relational justice were similar between employees who changed to working from home in 2020 and those who did not (figure 1, panels 1B, 1C, table 2).

Before the pandemic, employees who changed to working from home in 2020 had higher levels of psychological distress compared to those who did not. During 2016–2020, 23–25% of those who changed to working from home in 2020 experienced psychological distress. In those who remained on-site, the level of psychological distress increased from 20%–23% to 25% in 2020 (figure 2, panel 1A). In 2020, not working from home was associated with steeper increase in psychological distress compared with working from home (RR_{Exposed} = 1.06, 95% CI 1.02 to 1.09;

RR_{Non-exposed} = 1.16, 95% CI 1.13 to 1.20), and in 2020, the level of psychological distress was similar in both groups. In 2020, working from home was associated with smaller decrease in self-rated health (SMD_{Exposed} = -0.038, 95% CI -0.054 to -0.022; SMD_{Non-exposed} = -0.081, 95% CI -0.095 to -0.067) and in work ability (SMD_{Exposed} = -0.091, 95% CI -0.108 to -0.074; SMD_{Non-exposed} = -0.151, 95% CI -0.167 to -0.136) compared with employees not working from home (figure 2, panels 1B and 1C; table 3).

Assignment into new work tasks during the pandemic

Worktime control was slightly better throughout the follow-up among employees who were not assigned into new work tasks in 2020 (mean 2.8 vs 2.7, figure 1, panel 2A). There was no change in worktime control among employees assigned to new work tasks in 2020 (SMD_{Exposed} = -0.008, 95% CI -0.039 to 0.024), whereas worktime control increased in 2020 among those not assigned into new tasks (SMD_{Non-exposed} = 0.051, 95% CI 0.042 to 0.059).

Similar trends were observed also for relational and procedural justice (figure 1, panels 2C and 2D). There were no changes in justice perceptions among employees assigned to new tasks in 2020, whereas both dimensions of organisational justice slightly increased among employees not assigned into new tasks in 2020 (relational justice: SMD_{Non-exposed} = 0.084, 95% CI 0.071 to 0.096; procedural justice SMD_{Non-exposed} = 0.079, 95% CI 0.067 to 0.091). No differences between the groups were observed for job strain or workplace social capital (table 2).

Before the pandemic, there were no differences in psychological distress between employees assigned into new tasks in 2020 and those not (figure 2, panel 2A). However, in 2020, a total of 30% of those assigned into new tasks reported psychological distress. The corresponding percentage was 24% for those not assigned into new tasks. Assignment into new work tasks was thus associated with steeper increase in psychological distress compared with those not assigned into new tasks (RR_{Exposed} = 1.28, 95% CI 1.19 to 1.39; RR_{Non-exposed} = 1.10, 95% CI 1.07 to 1.12). No differences between groups were observed regarding self-rated health status or work ability (table 3).

Team reorganisation during the pandemic

No differences between employees experiencing team reorganisation versus not were observed for psychosocial work characteristics (figure 1, panel 3A; table 2). Psychological distress increased, and self-rated health decreased regardless of team reorganisation in 2020 (table 3, figure 2, panels 3A and 3B). Team reorganisation in 2020 was associated with slightly steeper decrease in work ability compared with employees who did not experience a team reorganisation (SMD_{Exposed} = -0.151, 95% CI -0.203 to -0.098; SMD_{Non-exposed} = -0.124, 95% CI -0.136 to -0.112, figure 2, panel 3C, table 3).

Additional analysis among nurses and teachers

We performed additional analysis among two occupational groups that are both common among public sector, and particularly affected by the COVID-19 pandemic: teachers and nurses. Our data included 6314 class teachers, subject teachers and special education teachers. Of them, 61% reported having worked from home in 2020 due to COVID-19 pandemic. In 2020, worktime control slightly improved among teachers working from home, whereas it remained on the same level among teachers who did not work from home. Also job strain increased among teachers working from home, but not among

teachers who did not work from home. Social capital, relational and procedural justice increased, and self-rated health and work ability decreased among all teachers irrespective of working from home (online supplemental table S1).

Our data included 2044 registered nurses, public health nurses and practical nurses. Of them, 12% reported assignment into new work tasks in 2020. For workplace social capital and relational justice, time trends (2016–2020) were statistically significantly different ($p < 0.001$), but the contrast estimates (2020 vs 2016–2018) were non-significant. Psychological distress increased and work ability decreased in 2020 among all nurses, irrespective of assignment into new tasks (online supplemental table S2).

DISCUSSION

In this study, we examined how changes made at Finnish public sector workplaces in response to COVID-19 pandemic were associated with a range of outcomes related to psychosocial work environment and employee well-being. Overall, the effect sizes of changes in psychosocial factors and well-being in the exposed compared with the non-exposed employees (in terms of employers' response to the pandemic) were small,³⁵ although statistically significant. We found that working from home was associated with slight improvements in psychosocial work environment in 2020. Working from home was also associated with smaller increase in psychological distress, and smaller decrease in self-rated health and work ability. Assignments into new work tasks and team reorganisations, in turn, were associated with no change in psychosocial work environment. Assignment into new work tasks was associated with increased psychological distress and team reorganisation was associated with decreased work ability.

Our results point to heterogeneous and socially stratified effects of changes at work during the COVID-19 pandemic. Those working from home have gained more flexibility in working time arrangements, and somewhat surprisingly, also evaluate other aspects of psychosocial work environment in a slightly more positive manner than before the pandemic. It thus seems that, at least in the rather short timespan from March to September in 2020 (ie, from the beginning of the pandemic to the 2020 survey), the worries of declining trust and cooperation between employees¹ were not fulfilled. Working from home seemed to buffer against the negative changes in well-being observed among those with new work tasks or team reorganisations. This finding is in agreement with earlier studies on the health benefits of worktime flexibility.^{36–40} However, working from home did seem to increase job strain among teachers, a result that was not evident from main analysis including all occupations, and which demonstrated heterogeneity in working from home-related outcomes across occupations.

Working from home is not possible in many occupations. COVID-19 forced employers to make many work rearrangements, and these rearrangements have particularly affected employees in on-site jobs. Employees were assigned into new tasks, particularly to tasks directly related to the pandemic. Many public sector employees from different sectors were transferred into healthcare sector, and in healthcare sector from non-urgent treatment to COVID-19-related tasks. This placed many of our study participants who reported being assigned into new tasks to front line of the battle against COVID-19. Against this background, our finding that these employees experience more psychological distress seems unsurprising. Our results also corroborated earlier results of mental distress among healthcare

workers.^{2,3} Team reorganisations, in turn, have been found to increase the risk of adverse health outcomes also in previous studies.^{9,11} The reorganisations reported in our study were directly related to the pandemic, and thus may have caused worry and anxiety reflected in work ability.

The strengths of the study include nearly 25 000 participants representing a wide variety of public sector occupations measured at three time points during 4 years with validated measures of psychosocial work environment and employee well-being. Our study has also limitations. Our data included only Finnish public sector employees, so generalisability to private sector is uncertain. The final analytic sample included 75% of those participants who responded to all three surveys. Part of those who dropped out were those who died, retired or changed employer during the 4-year follow-up and thus were no longer eligible to re-surveys. Selection bias may have affected our estimates, although the response rate among those employed in the target organisations and thus eligible to this study was relatively high throughout the follow-up (71%–72%). We collected latest data in September 2020 when the pandemic had lasted about 7 months in Finland. It is possible that as the pandemic prolonged and in countries more severely affected by the pandemic, more extreme outcomes will be detected in later studies. Our grouping of employees to groups of changes due to COVID-19 and measures of psychosocial work environment and health, although based on validated measures, were self-reported and thus subject to reporting bias. Finally, residual confounding is possible due to unmeasured covariates including length of commute time and substance abuse.

Employees who worked from home during the pandemic perceived their psychosocial work environment and health as better than those with on-site jobs. Their perceptions of psychosocial work environment even improved during the pandemic, and their health was less affected by the pandemic. Employees who experienced work task changes and team reorganisations had less favourable perceptions compared with those with no change in work or team structure during the pandemic, and their health was more affected by the pandemic.

Twitter Jenni Ervasti @JenniErvasti1

Contributors JE is the principal investigator, drafted the manuscript and analysed the data. JE, MK, TO and JV planned the study design. VA and JP contributed to data management and statistical analysis. JE, VA, JP, TO, MK, JV provided critical interpretation of the data and revised the manuscript.

Funding The Finnish Public Sector study is funded by the participating organizations and the Finnish Institute of Occupational Health. JE and VA report no other funding relevant to this study. TO is funded by the Finnish Work Environment Fund (200335). MK was supported by the Academy of Finland (329202), the Finnish Work Environment Fund (190424) and the NordForsk Nordic Programme on Health and Welfare (75021); JP by the Academy of Finland (329202) and the Finnish Work Environment Fund, Finland (190424) and JV by the Academy of Finland (grants 321409 and 329240).

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval Ethics approval is from the Ethical Committee of the Helsinki and Uusimaa hospital district (HUS/1210/2016).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. The deidentified data and statistical analysis code that support the findings of this study are available on reasonable request from the corresponding author, JE. The data are not publicly available due to legislative restrictions, as the data contains information that could compromise the privacy of the research participants.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those

of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

This article is made freely available for personal use in accordance with BMJ's website terms and conditions for the duration of the covid-19 pandemic or until otherwise determined by BMJ. You may download and print the article for any lawful, non-commercial purpose (including text and data mining) provided that all copyright notices and trade marks are retained.

ORCID iDs

Jenni Ervasti <http://orcid.org/0000-0001-9113-2428>

Jussi Vahtera <http://orcid.org/0000-0002-6036-061X>

REFERENCES

- Kniffin KM, Narayanan J, Anseel F, et al. COVID-19 and the workplace: implications, issues, and insights for future research and action. *Am Psychol* 2021;76:63–77.
- Giorgi G, Lecca LI, Alessio F, et al. COVID-19-Related mental health effects in the workplace: a narrative review. *Int J Environ Res Public Health* 2020;17. doi:10.3390/ijerph17217857. [Epub ahead of print: 27 10 2020].
- Adams JG, Walls RM. Supporting the health care workforce during the COVID-19 global epidemic. *JAMA* 2020;323:1439–40.
- Bouziri H, Smith DRM, Descatha A, et al. Working from home in the time of COVID-19: how to best preserve occupational health? *Occup Environ Med* 2020;77:509–10.
- Vahtera J, Kivimäki M, Pentti J. Effect of organisational downsizing on health of employees. *Lancet* 1997;350:1124–8.
- Vahtera J, Kivimäki M, Pentti J, et al. Organisational downsizing, sickness absence, and mortality: 10-town prospective cohort study. *BMJ* 2004;328:555.
- Kivimäki M, Honkonen T, Wahlbeck K, et al. Organisational downsizing and increased use of psychotropic drugs among employees who remain in employment. *J Epidemiol Community Health* 2007;61:154–8.
- Andreeva E, Brenner MH, Theorell T, et al. Risk of psychological ill health and methods of organisational downsizing: a cross-sectional survey in four European countries. *BMC Public Health* 2017;17:758.
- Fløvik L, Knardahl S, Christensen JO. Organizational change and employee mental health: a prospective multilevel study of the associations between organizational changes and clinically relevant mental distress. *Scand J Work Environ Health* 2019;45:134–45.
- Frone MR, Blais A-R. Organizational downsizing, work conditions, and employee outcomes: identifying targets for workplace intervention among survivors. *Int J Environ Res Public Health* 2020;17. doi:10.3390/ijerph17030719. [Epub ahead of print: 22 01 2020].
- Greubel J, Kecklund G. The impact of organizational changes on work stress, sleep, recovery and health. *Ind Health* 2011;49:353–64.
- Blomqvist S, Alexanderson K, Vahtera J, et al. Downsizing and purchases of psychotropic drugs: a longitudinal study of stayers, changers and unemployed. *PLoS One* 2018;13:e0203433.
- Kaspersen SL, Pape K, Carlsen F, et al. Employees' drug purchases before and after organizational downsizing: a natural experiment on the Norwegian working population (2004-2012). *Scand J Work Environ Health* 2017;43:307–15.
- Grønstad A, Kjekshus LE, Tjerbo T, et al. Organizational change and the risk of sickness absence: a longitudinal multilevel analysis of organizational unit-level change in hospitals. *BMC Health Serv Res* 2019;19:895.
- Grønstad A, Kjekshus LE, Tjerbo T, et al. Work-Related moderators of the relationship between organizational change and sickness absence: a longitudinal multilevel study. *BMC Public Health* 2020;20:1218.
- Ala-Mursula L, Vahtera J, Pentti J, et al. Effect of employee worktime control on health: a prospective cohort study. *Occup Environ Med* 2004;61:254–61.
- Vahtera J, Laine S, Virtanen M, et al. Employee control over working times and risk of cause-specific disability pension: the Finnish public sector study. *Occup Environ Med* 2010;67:479–85.
- Karasek RA. Job demands, job decision latitude, and mental strain: implications for job redesign. *Adm Sci Q* 1979;24:285–308.
- Karasek R, Theorell T. *Stress Healthy work: stress, productivity, and the reconstruction of working life*. New York: Basic Books, 1990.
- Kivimäki M, Nyberg ST, Batty GD, et al. Job strain as a risk factor for coronary heart disease: a collaborative meta-analysis of individual participant data. *Lancet* 2012;380:1491–7.
- Nyberg ST, Fransson EI, Heikkilä K, et al. Job strain and cardiovascular disease risk factors: meta-analysis of individual-participant data from 47,000 men and women. *PLoS One* 2013;8:e67323.
- Moorman RH. Relationship between organizational justice and organizational citizenship behaviors: do fairness perceptions influence employee citizenship? *J Appl Psychol* 1991;76:845–55.
- Kivimäki M, Elovainio M. A short version of the team climate inventory: development and psychometric properties. *J Occup Organ Psychol* 1999;72:241–6.
- Anderson N, West MA. The team climate inventory: development of the TCI and its applications in teambuilding for innovativeness. *European Journal of Work and Organizational Psychology* 1996;5:53–66.
- Kouvonen A, Kivimäki M, Vahtera J, et al. Psychometric evaluation of a short measure of social capital at work. *BMC Public Health* 2006;6:251.
- Goldberg DP, Gater R, Sartorius N, et al. The validity of two versions of the GHQ in the WHO study of mental illness in general health care. *Psychol Med* 1997;27:191–7.
- Robine J-M, Jagger C, Group TE-R, Euro-REVES Group. Creating a coherent set of indicators to monitor health across Europe: the Euro-REVES 2 project. *Eur J Public Health* 2003;13:6–14.
- Ilmarinen J, Tuomi K, Klockars M. Changes in the work ability of active employees over an 11-year period. *Scand J Work Environ Health* 1997;23 Suppl 1:49–57.
- Tuomi K, Ilmarinen J, Martikainen R, et al. Aging, work, life-style and work ability among Finnish municipal workers in 1981-1992. *Scand J Work Environ Health* 1997;23 Suppl 1:58–65.
- Ahlstrom L, Grimby-Ekman A, Hagberg M, et al. 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. *Scand J Work Environ Health* 2010;36:404–12.
- Heikkilä K, Nyberg ST, Fransson EI, et al. Job strain and tobacco smoking: an individual-participant data meta-analysis of 166,130 adults in 15 European studies. *PLoS One* 2012;7:e35463.
- Ervasti J, Kivimäki M, Head J, et al. Sickness absence diagnoses among abstainers, low-risk drinkers and at-risk drinkers: consideration of the U-shaped association between alcohol use and sickness absence in four cohort studies. *Addiction* 2018;113:1633–42.
- Halonen JJ, Kivimäki M, Pentti J, et al. Green and blue areas as predictors of overweight and obesity in an 8-year follow-up study. *Obesity* 2014;22:1910–7.
- Fransson EI, Heikkilä K, Nyberg ST, et al. Job strain as a risk factor for leisure-time physical inactivity: an individual-participant meta-analysis of up to 170,000 men and women: the IPD-Work Consortium. *Am J Epidemiol* 2012;176:1078–89.
- Faraone SV. Interpreting estimates of treatment effects: implications for managed care. *PT* 2008;33:700–11.
- Albrecht SC, Kecklund G, Rajaleid K, et al. The longitudinal relationship between control over working hours and depressive symptoms: results from SLOSH, a population-based cohort study. *J Affect Disord* 2017;215:143–51.
- Beckers DGJ, Kompier MAJ, Kecklund G, et al. Worktime control: theoretical conceptualization, current empirical knowledge, and research agenda. *Scand J Work Environ Health* 2012;38:291–7.
- Costa G, Akerstedt T, Nachreiner F, et al. Flexible working hours, health, and well-being in Europe: some considerations from a SALTSA project. *Chronobiol Int* 2004;21:831–44.
- Costa G, Sartori S, Akerstedt T. Influence of flexibility and variability of working hours on health and well-being. *Chronobiol Int* 2006;23:1125–37.
- Moen P, Kelly EL, Tranby E, et al. Changing work, changing health: can real work-time flexibility promote health behaviors and well-being? *J Health Soc Behav* 2011;52:404–29.

SUPPLEMENTAL MATERIAL

Table S1. Psychosocial work characteristics and employee wellbeing during Covid-19 pandemic versus before in teaching occupations (n=6,314). Years 2016 and 2018 are contrasted to 2020. SMD=Standardized Mean Difference, RR=Risk Ratio, CI=Confidence Interval. Models are adjusted for sex, age, SES, and lifestyle risk score.

	Working from home Exposed (n=3874)		Non-exposed (n=2440)		Group*time
	SMD/RR	95% CI	SMD/RR	95% CI	
Worktime control					
2016, 2018	1		1		
2020	0.028	0.011, 0.046	-0.018	-0.041, 0.005	<0.001
Job strain					
2016, 2018	1		1		
2020	1.24	1.14-1.35	1.04	0.95-1.14	0.007
Relational justice					
2016, 2018	1		1		
2020	0.069	0.040, 0.099	0.074	0.037, 0.110	0.063
Procedural justice					
2016, 2018	1		1		
2020	0.087	0.056, 0.117	0.088	0.051, 0.125	0.43
Workplace social capital					
2016, 2018	1		1		
2020	0.050	0.024, 0.076	0.059	0.025, 0.094	0.32
Psychological distress					
2016, 2018	1		1		
2020	1.01	0.95-1.07	1.04	0.96-1.12	0.64
Self-rated health					
2016, 2018	1		1		
2020	-0.036	-0.063, -0.009	-0.045	-0.079, -0.011	0.75
Work ability					
2016, 2018	1		1		
2020	-0.106	-0.135, -0.076	-0.124	-0.162, -0.086	0.76

Table S2. Psychosocial work characteristics and employee wellbeing during Covid-19 pandemic versus before in nursing occupations (n=2,044). Years 2016 and 2018 are contrasted to 2020. SMD=Standardized Mean Difference, RR=Risk Ratio, CI=Confidence Interval. Models are adjusted for sex, age, SES, and lifestyle risk score.

	New tasks Exposed (n=246)		Non-exposed (n=1798)		Group*time
	SMD/RR	95% CI	SMD/RR	95% CI	
Worktime control					
2016, 2018	1		1		
2020	-0.021	-0.107, 0.065	0.014	-0.017, 0.045	0.37
Job strain					
2016, 2018	1		1		
2020	1.15	0.96, 1.37	1.14	1.06, 1.23	0.62
Relational justice					
2016, 2018	1		1		
2020	0.056	-0.068, 0.179	0.044	-0.001, 0.089	0.001
Procedural justice					
2016, 2018	1		1		
2020	-0.147	-0.268, -0.027	-0.016	-0.059, 0.028	0.12
Workplace social capital					
2016, 2018	1		1		
2020	0.062	-0.052, 0.176	0.008	-0.032, 0.049	0.002
Psychological distress					
2016, 2018	1		1		
2020	1.55	1.27-1.89	1.30	1.20-1.41	0.22
Self-rated health					
2016, 2018	1		1		
2020	-0.021	-0.120, 0.079	-0.094	-0.133, -0.055	0.40
Work ability					
2016, 2018	1		1		
2020	-0.122	-0.233, -0.011	-0.176	-0.221, -0.132	0.67