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COVID-19-induced changes in the workplace, psychosocial work environment and employee well-being: a longitudinal study

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Background: In many workplaces, the coronavirus disease 2019 pandemic changed work arrangements, but there is scarce longitudinal evidence on whether psychosocial work environment and employee well-being were affected.

Aims: To examine the psychosocial work environment and employee well-being before, during and after the pandemic in relation to pandemic-induced changes (working from home, change to other tasks and team reorganization).

Methods: Survey data from a cohort of 20 944 public sector employees in Finland were collected before (2016–2018), during (2020) and after the pandemic (2022). Multilevel linear and logistic regression was used to examine group differences between the before–during and during–after periods of the pandemic.

Results: Working from home was associated with a small but favourable change in worktime control, organizational justice and social capital (scale 1–5) during the pandemic and after the pandemic (marginal mean difference ranging from 0.02 to 0.09 with 95% confidence intervals [CIs] from 0.01 to 0.10). There was a post-pandemic increase in work time control, even among participants with a transfer into other tasks (0.11, 95% CI 0.07, 0.14) or team reorganization (0.06, 95% CI 0.02, 0.10). The decline in self-rated work ability (scale 0–10) before and during the pandemic was greater in those transferred into other tasks (−0.10, 95% CI −0.13, −0.06) than in those not (−0.05, 95% CI −0.06, −0.04).

Conclusions: Working from home during the pandemic was accompanied by small favourable changes in the psychosocial work environment during the pandemic, whereas transition to different tasks was associated with a decline in self-rated work ability.

INTRODUCTION

Exposure to stressful events, uncertainty and rapid changes at workplace can adversely affect work ability, health and well-being of employees, as well as the functioning and productivity of teams and organizations [1–7]. The coronavirus disease 2019 (COVID-19) pandemic caused many such changes at work [8,9]. A large proportion of employees were transferred to remote work [10]. While working from home was increasing already before the pandemic, it was in most cases occasional and voluntary [11]. In pre-pandemic period (2018) in Finland, for example, 41–50% of the labour force reported working from home occasionally but only 13% of employed people reported working usually from home [12]. Low-skilled, service and high labour-intensive work was less likely to be done from home [10,11].

A systematic review on mostly cross-sectional studies reported high psychological distress in healthcare workers in on-site work during the COVID-19 pandemic [13]. Similarly, a Polish study observed higher stress levels in on-site workers compared to those working remotely during the same period [14]. To date, few studies have examined pandemics-related changes in work factors longitudinally, and the results have been mixed. For instance, a recent study on US desk workers found both positive and negative changes in the health behaviours of remote workers [15]. In our prospective study of Finnish employees, using pre-pandemic times as the reference, working from home during the pandemic was associated with an improved psychosocial work environment. Conversely, other changes in work, such as transfers to other tasks and team reorganizations, were linked to poorer health outcomes [16]. However, this study did not extend to the post-pandemic period.

Key learning points

What is already known about this subject:

- Exposure to stressful events and uncertainty may decrease employee well-being.
- During the coronavirus disease 2019 pandemic, various changes in work arrangements, such as working from home, transfer to other tasks and team reorganization, were implemented.
- Few studies have examined the extent to which these arrangements were associated with changes in psychosocial work environment and employee well-being in post-pandemic period.

What this study adds:

- Working from home during the 2020 coronavirus disease 2019 pandemic was associated with small favourable changes in worktime control, perceptions of organizational justice and workplace social capital, with these effects largely persisting into the post-pandemic period.
- No consistent associations were observed between transfer into other tasks and team reorganization in 2020 and changes in psychosocial work environment.
- Transfer into other tasks was associated with a decline in self-rated work ability.

What impact this may have on practice, policy or procedure:

- Opportunity to work from home might protect from some negative impacts of the pandemic, but this opportunity was less often available for women and those in a lower socioeconomic position.
- No clear associations were observed between coronavirus disease 2019-related changes, such as transitions to different tasks, and perceptions of work ability.
- Occupational healthcare and the management of organizations need to support the resilience of vulnerable employee groups during pandemics.

To provide further insights into the consequences of COVID-19 on the public sector working life, we analysed updated data to examine whether changes induced by the COVID-19 pandemic at work were associated with employees' perceptions of psychosocial work environment, health and health behaviours during and after the pandemic. We utilized data collected at three time points—pre-pandemic, during the pandemic and post-pandemic.

METHODS

Data were collected as a part of the ongoing Finnish Public Sector Study [17–19]. The study population included the employees of 11 cities and was representative of public sector workers. In Finland, public sector employees comprise 25% of the national labour force. The most common occupations were those related to healthcare, social services and education, representing nearly 50% of all employees. In the Finnish Public Sector study, socio-demographic background information in 2020 was obtained from the registers of the employers, and self-reported survey data from employees were collected in the pre-pandemic period (autumn of 2016 and 2018), during the pandemic (autumn 2020) and after the pandemic (autumn 2022). We classified occupations according to the 2001 International Standard Classification of Occupations codes and categorized them into three levels of socioeconomic status (SES): high (upper-grade non-manual workers including managers, administrators and specialists), intermediate (lower-grade non-manual 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).

During the pandemic in 2020, we asked the participants whether the COVID-19 pandemic had caused the following changes in their work: (i) the employee was transferred partially or totally to working from home; (ii) the employee was transferred to other work tasks within the same occupational sector or to another occupational sector and/or (iii) their work unit/team was reorganized into a smaller or larger unit. Each participant could have faced none, one or more of these changes.

Information on baseline levels of outcome variables (psychosocial work environment, employee well-being and health behaviours) was collected in two surveys before the pandemic (2016 and 2018), during (2020) and after the pandemic (2022) (for details, see Ervasti *et al.* [16]). The characteristics of the psychosocial work environment examined were work time control [20–22], job strain [23,24], procedural justice [25], relational justice [25] and social capital [26]. Worktime control was measured using a standard questionnaire on aspects of their working time [20]. Self-rated health was measured with a single-item measure 'How do you rate your health?' [27]. Self-rated work ability was measured with a single-item measure from the Work Ability Index [28,29].

Factors related to health behaviours were body mass index (BMI), alcohol use, smoking and physical inactivity [16,30]. Excessive alcohol consumption was determined based on weekly alcohol units [31]. Smoking status was based on a question: do you smoke? and it was dichotomized into 'smokers' (daily or occasional smokers) and 'non-smokers' (never or former smokers, reference group) [32]. Physical activity was inquired by asking respondents how much they exercised in general and transformed into weekly metabolic equivalent task (MET) hours [33]. Physical inactivity was categorized as 'inactive' if weekly MET hours were less than 14, and as 'active' (the reference group) if more than that.

We examined the changes in the outcomes from pre- to during and from during to post-pandemic periods in employees exposed to pandemic-induced changes at work (working from home, change to other tasks and team reorganization) compared to employees not exposed to such change. We estimated changes in psychosocial work environment, self-rated health, self-rated work ability, and health behaviours for the exposed and non-exposed groups using multilevel models accounting for autocorrelation between observations. Linear regression was applied for continuous outcome variables and logistic regression for dichotomous outcome variables. We estimated marginal mean differences (MMD) with 95% confidence intervals (CIs) contrasting

time periods before (2016, 2018), during (2020) and after the pandemic (2022) for continuous outcome variables for the exposed and non-exposed to a pandemic-induced change. For dichotomous outcome variables, we calculated risk differences (RD) with 95% CI for the exposed and the non-exposed contrasting the three periods. We present within-group estimates from crude models for all outcomes, models adjusted for socio-demographic factors and health behaviours for psychosocial work characteristics and self-rated work ability and health, and models adjusted for socio-demographic factors and psychosocial work characteristics for health behaviour. Statistical significance of the differences between periods in outcomes for the exposed and non-exposed to a pandemic-induced change was estimated by computing 'group × period' interaction terms in each model. The MDDs can be interpreted as an estimated mean change in the outcome between pre- and post-pandemic periods. RDs represent percentage point change in risk for a given outcome between the periods. For all analyses, we used R 4.3.0 with lmer- and emmeans-packages.

The study followed the Finnish Public Sector Study (FPS) protocol in line with the EU and Finnish data legislation. The Ethical Committee of the Helsinki and Uusimaa Hospital approved the FPS study (HUS/1210/2016).

RESULTS

We included participants who responded to the study questionnaire in all four surveys, 2016 (n = 65 089, response rate 72%), 2018 (n = 64 066, 71%), 2020 (n = 65 179, 72%) and 2022 (n = 57 752, 62%), had complete data on the exposure and outcome variables, had register-based information on sex, age and occupation, and consented to linkage of survey and register data. The resulting analytic sample included 20 944 participants (Figure 1, available as Supplementary data at *Occupational Medicine* online).

Descriptive characteristics at baseline in 2016 for employees who experienced COVID-19-related changes at work (i.e. working from home, transfer to other tasks or team reorganization) in 2020, and for those who did not, are shown in Table 1 (available as Supplementary data at *Occupational Medicine* online). Women represented the majority of the total sample of employees, and they most often worked in social and healthcare, and in education and culture. During the pandemic, 47% reported being transferred partially or totally to working from home, 7% reported being transferred to other work tasks within the same occupational sector or to another occupational sector, and 5% reported that the work unit/team in which they worked was reorganized into a smaller or larger unit in 2020 due to the COVID-19 pandemic. In men and women, 55% and 44%, respectively, were transferred to working from home. A transfer to other work tasks was more common in women and less common in high SES compared to those who had not faced such a change. Also, a reorganization of work unit or team into smaller or larger unit was less common in those with high SES compared to others.

Work time control was higher throughout the follow-up among those transferred to working from home during the pandemic than among on-site workers. The largest, although small in absolute terms, increase was observed from before to during pandemic period among employees working from home (MMD 0.07, 95% CI 0.06, 0.08), and from during to after among on-site workers (MMD 0.06, 95% CI 0.05, 0.07) (Table 1, Figure 1A).

From before to during pandemic, procedural justice increased more among those working from home (MMD = 0.09, 95% CI 0.07, 0.10) than among on-site workers (MMD = 0.06, 95% CI 0.04, 0.07). After the pandemic, procedural justice slightly decreased in both groups (Table 1, Figure 1B). As a sensitivity analysis, we separated those who remained working from home in 2022 (n = 8237) from those who returned to on-site work in 2022 (n = 2197). Procedural justice decreased in both groups (remained in working from home MMD = −0.04, 95% CI −0.06, −0.03; returned to on-site work MMD = −0.08, 95% CI −0.11, −0.04, P-value for interaction = 0.09).

Workplace social capital increased from before to during the pandemic, particularly among those working from home (MMD = 0.07, 95% CI 0.05, 0.08). From during to after the pandemic, we observed a slight increase in both groups (Table 1, Figure 1C).

The largest decreases in work ability (MMD = −0.07, 95% CI −0.08, −0.05) and self-rated health (MMD = −0.21, 95% CI −0.24, −0.19) were seen among on-site workers from before to during pandemic. However, declining trends were observed in both groups, and they continued until after the pandemic (Table 2, Figure 1D).

We observed no differences between those exposed to transfer to other tasks and the non-exposed, except that non-exposure to transfer to other tasks due to the pandemic was associated with increased work time control (MMD = 0.05, 95% CI 0.04, 0.06) from before to during pandemic (Table 1). Among the exposed, the level of work time control was lower through the follow-up (Figure 2A).

Job strain slightly increased in those not transferred to other tasks from during to after pandemic period (MMD = 0.01, 95% CI 0.00, 0.01) (Table 1, Figure 2B).

Physical inactivity decreased, that is, physical activity increased, among the group not exposed to other tasks (RD = −0.84, 95% CI −1.53, −0.16) from during to after pandemic period compared to the exposed (RD = 0.26, 95% CI −2.28, 2.79) (Table 3, Figure 2C).

Work time control slightly increased among those not exposed to team reorganization (MMD = 0.05, 95% CI 0.04, 0.06) but not among those exposed (MMD = -0.01, 95% CI −0.04, 0.03) from before to during pandemic period. Work time control increased from during to after pandemic in both groups, although slightly more in the exposed group (MMD = 0.06, 95% CI 0.02, 0.10) than among the non-exposed (MMD = 0.05, 95% CI 0.04, 0.06) (Table 1, Figure 3). No differences in self-rated health, work ability or health behaviours were observed between the exposed and non-exposed to team reorganization (Tables 2 and 3).

BMI increased, but alcohol use decreased throughout the follow-up irrespective of pandemic-related changes at workplaces. Smoking decreased, particularly during, but also after the pandemic. Physical activity increased in the entire study population: the estimates suggest that those working from home increased their physical activity during the pandemic, whereas in other groups, the increase was greater after the pandemic (Table 3).

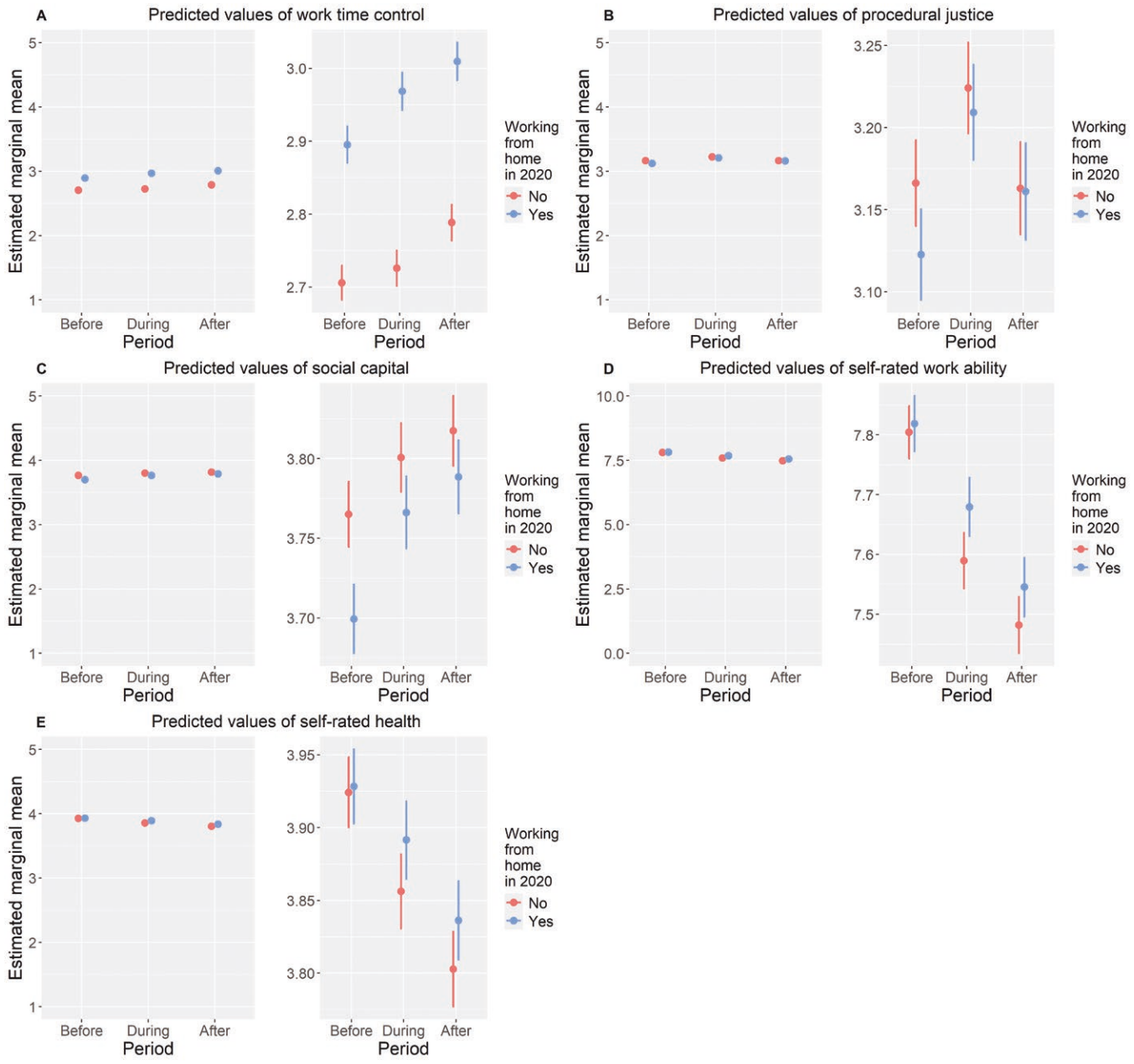

Figure 1. Adjusted means for outcomes per survey year by transfer to working from home in 2020. In each panel, the left-side figures show trends with full scale (x-axis); right-side figures show trend with truncated scale to enable better visualization of 95% confidence intervals.

DISCUSSION

Working from home during COVID-19 in 2020 was associated with positive, although small changes in psychosocial work environment, including improved worktime control and more favourable perceptions of organizational justice and social capital. These changes largely sustained after the pandemic in this group of employees. Transfer into other tasks or a team reorganization in 2020 was not similarly associated with positive changes in psychosocial work environment. In contrast, we observed a steeper decline in work ability in those transferred into new tasks during the pandemic than among those not. Post-pandemic period was also associated with some positive changes irrespective of COVID-19-induced changes in work. For example, work time control improved also for those who experienced a transfer into new tasks or a team reorganization in 2020. Moreover, irrespective of changes made at workplaces in 2020, health behaviours, except for BMI, improved.

A significant proportion of public sector employees in Finland experienced changes at work organization due to the COVID-19 pandemic. Specifically, 47% of the participants reported being transferred partially or totally to working from home, 7% reported transition to different work tasks within the same occupational sector or to another occupational sector, and 5% reported that the work unit/team in which they worked, was reorganized into a smaller or larger unit.

Table 1. Estimated mean differences for psychosocial work characteristics before (2016–2018), during (2020) and after (2022) COVID-19 pandemic by changes at work due to the pandemic

	Working from home in 2020					Other tasks in 2020					Team reorganization in 2020				
	Exposed, *n* = 9793		Non-exposed, *n* = 11151			Exposed, *n* = 1527		Non-exposed, *n* = 19417			Exposed, *n* = 998		Non-exposed, *n* = 19946		
	MMD	95% CI	MMD	95% CI	*P* (group × time)	MMD	95% CI	MMD	95% CI	*P* (group × time)	MMD	95% CI	MMD	95% CI	*P* (group × time)
Work time control															
Before–during—Model 1	0.07	0.06, 0.08	0.01	0.00, 0.02	<0.001	−0.01	−0.03, 0.02	0.04	0.03, 0.05	<0.001	−0.01	−0.04, 0.02	0.04	0.03, 0.05	<0.01
Before–during—Model 2	0.07	0.06, 0.08	0.02	0.01, 0.03	<0.001	0.00	−0.03, 0.03	0.05	0.04, 0.06	<0.001	−0.01	−0.04, 0.03	0.05	0.04, 0.06	<0.01
During–after—Model 1	0.04	0.02, 0.05	0.05	0.04, 0.06	<0.001	0.09	0.06, 0.12	0.04	0.03, 0.05	ns	0.05	0.01, 0.09	0.04	0.03, 0.05	<0.05
During–after—Model 2	0.04	0.03, 0.05	0.06	0.05, 0.06	<0.001	0.11	0.07, 0.14	0.05	0.04, 0.06	ns	0.06	0.02, 0.10	0.05	0.04, 0.06	<0.05
Job strain															
Before–during—Model 1	0.00	0.00, 0.01	0.01	0.00, 0.01	ns	0.00	−0.01, 0.01	0.00	0.00, 0.01	ns	0.01	0.01, 0.03	0.00	0.00, 0.01,	ns
Before–during—Model 2	0.00	0.00, 0.01	0.01	0.00, 0.01	ns	0.00	−0.01, 0.02	0.00	0.00, 0.01	ns	0.02	0.00, 0.03	0.00	0.00, 0.01	ns
During–after—Model 1	0.01	0.01, 0.02	0.01	0.00, 0.01	ns	0.00	−0.02, 0.01	0.01	0.01, 0.01	<0.05	0.00	−0.01, 0.02	0.01	0.00, 0.01	ns
During–after—Model 2	0.01	0.01, 0.02	0.00	0.00, 0.01	ns	−0.01	−0.02, 0.00	0.01	0.00, 0.01	<0.01	0.00	−0.02, 0.02	0.01	0.00, 0.01	ns
Procedural justice															
Before–during—Model 1	0.10	0.08, 0.11	0.07	0.06, 0.09	<0.05	0.04	0.00, 0.07	0.09	0.08, 0.10	<0.05	0.08	0.03, 0.12	0.08	0.07, 0.10	ns
Before–during—Model 2	0.09	0.07, 0.10	0.06	0.04, 0.07	<0.05	0.03	−0.01, 0.07	0.08	0.06, 0.09	ns	0.06	0.01, 0.11	0.07	0.06, 0.08	ns
During–after—Model 1	−0.04	−0.06, −0.03	−0.06	−0.08, −0.04	<0.001	−0.01	−0.05, 0.03	−0.06	−0.07, 0.04	ns	−0.07	−0.13, −0.02	−0.05	−0.06, 0.04	ns
During–after—Model 2	−0.05	−0.07, −0.03	−0.06	−0.08, −0.04	<0.001	−0.01	−0.06, 0.03	−0.06	−0.07, 0.04	ns	−0.07	−0.13, −0.02	−0.05	−0.07, −0.04	ns
Relational justice															
Before–during—Model 1	0.08	0.07, 0.10	0.07	0.05, 0.08	ns	0.04	0.00, 0.08	0.08	0.06, 0.09	ns	0.07	0.02, 0.12	0.07	0.06, 0.08	ns
Before–during—Model 2	0.09	0.07, 0.11	0.07	0.05, 0.08	ns	0.05	0.01, 0.09	0.08	0.07, 0.09	ns	0.08	0.03, 0.14	0.08	0.06, 0.09	ns
During–after—Model 1	0.02	0.00, 0.03	0.02	0.00, 0.04	ns	0.04	−0.01, 0.08	0.02	0.00, 0.03	ns	0.04	−0.02, 0.09	0.02	0.00, 0.03	ns
During–after—Model 2	0.02	0.00, 0.04	0.03	0.01, 0.05	ns	0.04	−0.01, 0.09	0.02	0.01, 0.04	ns	0.04	−0.02, 0.10	0.02	0.01, 0.04	ns
Workplace social capital															
Before–during—Model 1	0.06	0.05, 0.07	0.03	0.02, 0.04	<0.001	0.03	0.00, 0.06	0.05	0.04, 0.06	ns	0.03	−0.01, 0.07	0.05	0.04, 0.06	ns
Before–during—Model 2	0.07	0.05, 0.08	0.04	0.02, 0.05	<0.001	0.04	0.01, 0.07	0.05	0.04, 0.06	ns	0.03	0.00, 0.07	0.05	0.04, 0.06	ns
During–after—Model 1	0.02	0.00, 0.03	0.01	0.00, 0.02	<0.001	0.02	−0.01, 0.06	0.01	0.00, 0.02	ns	0.01	−0.03, 0.05	0.01	0.00, 0.02	ns
During–after—Model 2	0.02	0.01, 0.04	0.02	0.00, 0.03	<0.001	0.03	−0.01, 0.07	0.02	0.01, 0.03	ns	0.02	−0.02, 0.07	0.02	0.01, 0.03	ns

Model 1 is unadjusted, Model 2 is adjusted for socio-demographic factors and health behaviours. *P*-value for group × time interaction indicates a statistically significant difference between groups between two time points (before–during or during–after). ns $P \geq 0.05$.

In an earlier study among the same study population but with a shorter follow-up until 2020 [16], we found that working from home was associated with a small improvement in psychosocial work environment. In addition, working from home seemed to protect from a larger decline of work ability and health. The results of our study, with an extended follow-up until post-pandemic period in 2022, are consistent with the earlier study but also reveal new insights. We observed that the differences in psychosocial resources between on-site workers and those working from home during the pandemic were somewhat

Table 2. Estimated mean differences for self-rated work ability and self-rated health before (2016–2018), during (2020), and after (2022) COVID-19 pandemic

Outcome/ model	Change to work from home in 2020					Change to other tasks in 2020					Team reorganization in 2020				
	Exposed, *n* = 9793		Non-exposed, *n* = 11 151			Exposed, *n* = 1527		Non-exposed, *n* = 19 417			Exposed n = 998		Non-exposed n = 19946		
	MMD	95% CI	MMD	95% CI	*P* (group × time)	MMD	95% CI	MMD	95% CI	*P* (group × time)	MMD	95% CI	MMD	95% CI	p (group × time)
Self-rated work ability															
Before–during—Model 1	−0.08	−0.10, −0.07	−0.12	−0.13, −0.10	<0.001	−0.14	−0.17, −0.11	−0.10	−0.11, −0.09	<0.05	−0.10	−0.14, −0.06	−0.10	−0.11, −0.09	ns
Before–during—Model 2	−0.04	−0.05, −0.02	−0.07	−0.08, −0.05	<0.01	−0.10	−0.13, −0.06	−0.05	−0.06, −0.04	<0.05	−0.06	−0.10, −0.01	−0.05	−0.06, −0.04	ns
During–after—Model 1	−0.09	−0.10, −0.07	−0.08	−0.10, −0.07	<0.01	−0.08	−0.11, −0.03	−0.09	−0.10, −0.08	ns	−0.09	−0.14, −0.04	−0.09	−0.10, −0.07	ns
During–after—Model 2	−0.06	−0.07, −0.04	−0.05	−0.07, −0.04	<0.01	−0.04	−0.08, 0.00	−0.06	−0.07, −0.04	ns	−0.06	−0.11, −0.01	−0.05	−0.07, −0.04	ns
Self–rated health															
Before–during—Model 1	−0.21	−0.23, −0.18	−0.27	−0.29, −0.25	<0.001	−0.29	−0.36, −0.23	−0.24	−0.25, −0.22	ns	−0.26	−0.34, −0.19	−0.24	−0.26, −0.22	ns
Before–during—Model 2	−0.14	−0.17, −0.11	−0.21	−0.24, −0.19	<0.001	−0.23	−0.29, −0.16	−0.17	−0.19, −0.15	ns	−0.20	−0.29, −0.12	−0.18	−0.20, −0.16	ns
During–after—Model 1	−0.17	−0.20, −0.14	−0.16	−0.19, −0.13	<0.01	−0.15	−0.21, −0.07	−0.16	−0.19, −0.14	ns	−0.13	−0.22, −0.04	−0.16	−0.18, −0.14	ns
During–after—Model 2	−0.13	−0.16, −0.10	−0.11	−0.14, −0.08	<0.01	−0.10	−0.18, −0.02	−0.12	−0.14, −0.10	ns	−0.09	−0.18, 0.01	−0.12	−0.14, −0.10	ns

Multilevel models. Model 1 Unadjusted, Model 2 Adjusted for socio-demographic factors and health behaviours. ns $P \geq 0.05$.

diminished after the pandemic. Moreover, this study also explored outcomes related to health behaviours.

Previous studies have suggested that psychosocial risks (social and professional isolation, loneliness, ambiguous work–non-work boundaries, negative effects on sense of community and pro-social behaviour), ergonomic risks (musculoskeletal problems) and behavioural risks (health behaviours) [9,34] increased after pandemic-induced, most often non-voluntary transfer to working from home. Evidence is mixed as regards the outcomes of working from home [14,15]. Our findings suggest that working from home was accompanied by improved perceptions of psychosocial work environment among employees during pre- and post-pandemic period as compared to on-site workers, and thus might have protected them from the negative impacts of the pandemic.

Organizational changes and restructuring can be associated with both negative and positive effects in terms of employee health and well-being [18,19,35–37]. We found that employees who were transferred to other tasks or another work unit at the beginning of the pandemic in 2020, did not report improved psychosocial or well-being-related outcomes after the pandemic whereas not having to transfer to other tasks or to another team was associated with improved psychosocial work environment and well-being. This suggests that the impacts of a pandemic might be heterogeneous and may result in inequality across various population groups [38,39]. In our study, those who worked from home during the pandemic were more often men and in a higher socioeconomic position than on-site workers.

A strength of this study is a large representative cohort of public sector workers in Finland. We utilized comprehensive biannual survey data with validated measures of psychosocial work environment, self-rated health and work ability, and health behaviours. Most previous studies on the effects of COVID have been cross-sectional. We carried out a prospective analysis with a total follow-up of 6 years. The limitations of this study include attrition of the study sample. Although the response rates remained relatively high (62–72%), selection bias may have affected our estimates.

Work in the public sector differs from the private sector in many respects and thus our results may not be generalizable to occupations in the private sector or to other countries with different COVID-19 prevention strategies. Taken together, the COVID-19 pandemic potentially has long-lasting effects

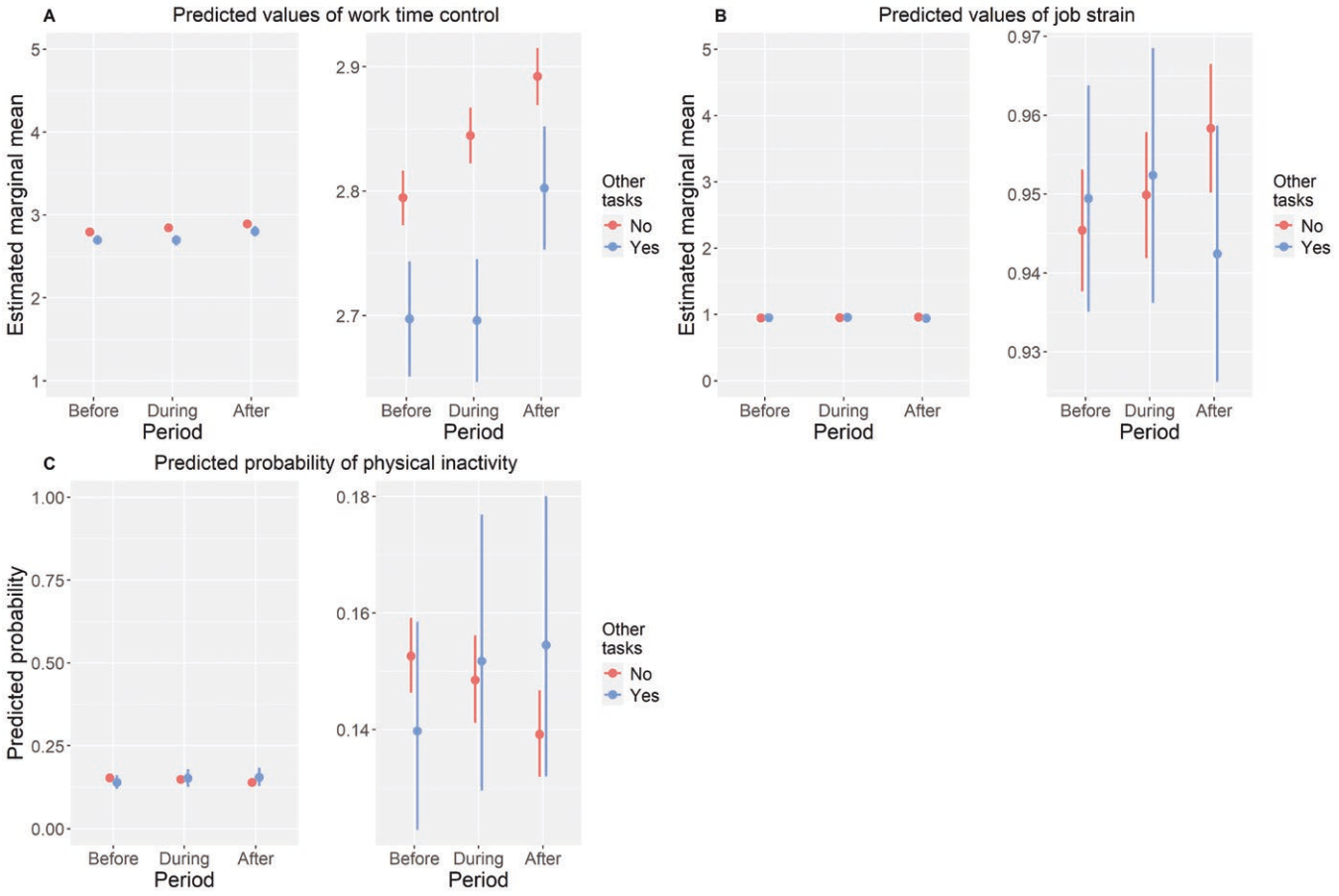

Figure 2. Adjusted means for outcomes per survey year by transfer to other tasks in 2020. In each panel, the left-side figures show trends with full scale (x-axis); right-side figures show trend with truncated scale to enable better visualization of 95% confidence intervals.

on work life, health and well-being at the individual, organizational and societal levels [8,9,38]. Pandemics are likely to change and restructure working life and industries (accelerating digitalization, emergence of hybrid work, continued existence of 'office work', flexible workplace and -time arrangements, importance of work–life balance in remote work, challenges for leadership, etc.). Our results from a longitudinal study in the Finnish public sector covering periods before, during and after the pandemic showed heterogeneous associations between COVID-19-induced changes in work arrangements and subsequent changes in psychosocial work environment and employee well-being.

It is important to acknowledge that the impact of pandemics and other public health crises on employees can vary by occupation, labour market segment and country, as well as between the public and private sectors. This will, in turn, contribute to within-country and cross-country differences. The size of the public sector in each country also matters. While in the European Union, the share of public sector jobs in relation to all jobs is approximately 16%, and in Finland, it is 25% [40]. Moreover, the occupational, age and gender structures differ substantially between the public and private sectors in Finland [41]. In the public sector, most employees are women, and their mean age is higher than in the private sector. Occupations in healthcare and education are more common in the public than the private sector.

We found that employees who were transferred to other tasks or another work unit at the beginning of the pandemic in 2020 did not report improved psychosocial or well-being-related outcomes after the pandemic whereas not having to transfer to other tasks or to another team was associated with improved psychosocial work environment and well-being. This suggests that the impacts of a pandemic might be heterogeneous and may result in deeper occupational health-related inequality across various employee groups [38,39]. In our study, those who worked from home during the pandemic were more often men and in a higher socioeconomic position than on-site workers. Similarly, despite structural differences between public and private sectors in Finland, Erkkola et al. [42] found differing changes in the health behaviours of Finnish private sector service workers from pre- to during the pandemic period. They also found that those workers with low SES faced the most adverse changes.

It is likely that already-existing work-related health inequalities between employees will increase during pandemics and other uncertain times. Resilience is a concept that is used in connection with organizations confronting stressful and unexpected events and uncertain times. It is a process that entails prior knowledge, observation, developing and implementing of new solutions and change [43,44]. In future studies, identifying employee groups that need specific attention and resources during pandemics will add to the prior knowledgebase that is needed in developing the resilience of organizations.

Table 3. Average risk differences for health behaviours before (2016–2018), during (2020) and after (2022) COVID-19 pandemic

Outcome / Model	Change to work from home in 2020					Change to other tasks in 2020					Team reorganization in 2020				
	Exposed *n* = 9793		Non-exposed *n* = 11151			Exposed *n* = 1527		Non-exposed *n* = 19417			Exposed n = 998		Non-exposed n = 19946		
	RD (%)	95% CI	RD (%)	95% CI	*P* (group × time)	RD (%)	95% CI	RD (%)	95% CI	*P* (group × time)	RD (%)	95% CI	RD (%)	95% CI	p (group × time)
BMI															
Before–during—Model 1	4.77	4.16, 5.38	4.90	4.23, 5.48	ns	4.80	3.28, 6.33	4.84	4.40, 5.28	ns	4.20	2.31, 6.09	4.87	4.44, 5.30	ns
Before–during—Model 2	3.68	3.03, 4.34	4.06	3.41, 4.71	ns	3.88	2.23, 5.54	3.88	3.39, 4.38	ns	3.69	1.64, 5.74	3.89	3.40, 4.38	ns
During–after—Model 1	2.72	2.03, 3.42	2.92	2.26, 3.59	ns	3.52	1.76, 5.27	2.77	2.27, 3.27	ns	3.41	1.23, 5.58	2.80	2.30, 3.29	ns
During–after—Model 2	1.97	1.25, 2.70	2.12	1.38, 2.85	ns	2.74	0.82, 4.65	1.99	1.45, 2.54	ns	2.16	−0.21, 4.52	2.04	1.50, 2.58	ns
Alcohol intake															
Before–during—Model 1	−0.37	−0.82, 0.07	−0.15	−0.54, 0.24	ns	0.88	−0.16, 1.92	−0.34	−0.65, −0.04	<0.05	−0.03	−1.38, 1.32	−0.26	−0.57, 0.04	ns
Before–during—Model 2	−0.77	−1.25, −0.30	−0.49	−0.92, −0.07	ns	0.33	−0.76, 1.42	−0.70	−1.04, −0.37	ns	−0.36	−1.80, 1.09	−0.64	−0.97, −0.31	ns
During–after—Model 1	−1.14	−1.65, −0.64	−0.90	−1.38, −0.49	ns	−1.09	−2.28, 0.09	−1.03	−1.38, −0.68	ns	−1.56	−3.07, −0.04	−1.01	−1.35, −0.67	ns
During–after—Model 2	−1.32	−1.83, −0.80	−1.11	−1.58, −0.65	ns	−1.00	−2.22, 0.23	−1.23	−1.59, −0.87	ns	−1.67	−3.27, −0.08	−1.19	−1.54, −0.83	ns
Smoking															
Before–during—Model 1	−1.44	−1.78, −1.10	−1.61	−2.01, −1.21	ns	−1.45	−2.48, −0.42	−1.54	−1.82, −1.27	ns	−1.88	−3.07, −0.69	−1.52	−1.79, −1.24	ns
Before–during—Model 2	−1.33	−1.68, −0.97	−1.31	−1.77, −0.87	ns	−1.05	−2.18, 0.08	−1.35	−1.65, −1.04	ns	−1.83	−3.13, −0.53	−1.30	−1.61, −1.00	ns
During–after—Model 1	−0.06	−0.44, 0.31	−0.68	−1.13, −0.22	<0.05	−0.53	−1.17, 0.65	−0.37	−0.68, −0.06	ns	−1.06	−2.40, 0.27	−0.35	−0.66, −0.04	ns
During–after—Model 2	0.04	−0.38, 0.44	−0.54	−1.05, −0.03	ns	−0.38	−1.67, 0.92	−0.23	−0.57, 0.11	ns	−0.85	−2.31, 0.62	−0.22	−0.55, 0.12	ns
Physical Inactivity															
Before–during—Model 1	−0.15	−0.90, 0.59	1.63	0.84, 2.41	<0.01	1.24	−0.79, 3.27	0.73	0.16, 1.30	ns	0.33	−2.21, 2.86	0.79	0.23, 1.35	ns
Before–during—Model 2	−1.21	−1.99, −0.44	0.65	−0.20, 1.51	ns	1.14	−1.03, 3.31	−0.37	−0.97, 0.24	ns	−0.09	−2.81, 2.63	−0.27	−0.87, 0.33	ns
During–after—Model 1	0.39	−0.48, 1.25	−0.33	−1.26, 0.59	<0.001	1.10	−1.30, 3.50	−0.08	−0.74, 0.58	ns	−0.90	−3.85, 2.06	0.05	−0.60, 0.71	ns
During–after—Model 2	−0.28	−1.15, 0.59	−1.26	−2.24, −0.28	ns	0.26	−2.28, 2.79	−0.84	−1.53, −0.16	<0.05	−2.04	−5.16, 1.08	−0.70	−1.38, −0.02	ns

Multilevel models, *n* = 22 298–22 688. Model 1 Unadjusted; Model 2 Adjusted for socio-demographic factors, psychosocial work environment factors. ns *P* ≥0.05.

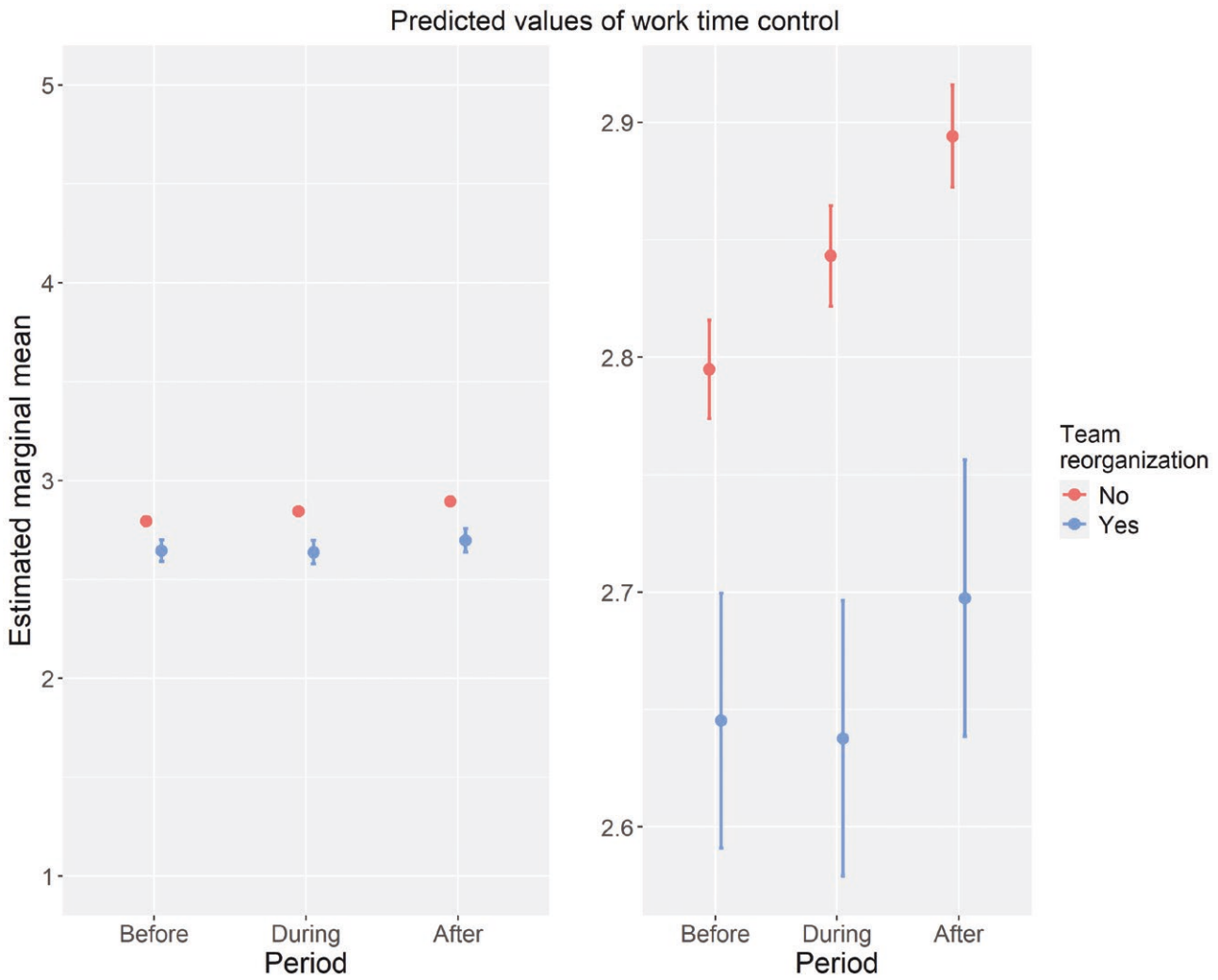

Figure 3. Adjusted means for work time control per survey year by team reorganization in 2020. The left-side figure shows trends with full scale (x-axis); right-side figure shows trends with truncated scale to enable better visualization of 95% confidence intervals.

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COMPETING INTERESTS

None declared.

REFERENCES

1. Kim, TJ, von dem Knesebeck O. Is an insecure job better for health than having no job at all? A systematic review of studies investigating the health-related risks of both job insecurity and unemployment. *BMC Public Health* 2015;**15**:985.
2. De Witte H, Vander Elst T and De Cuyper N. Job insecurity, health and well-being. In: Vuori J, Blonk R, Price RH, eds. *Sustainable Working Lives: Managing Work Transitions and Health Throughout the Life Course*. Dordrecht: Springer Netherlands, 2015; 109–128.
3. Kivimaki M, Pentti J, Ferrie JE *et al.*; IPD-Work Consortium. Work stress and risk of death in men and women with and without cardiometabolic disease: a multicohort study. *Lancet Diabetes Endocrinol* 2018;**6**:705–713.
4. Kivimaki M, Nyberg ST, Pentti J *et al.*; IPD-Work Consortium. Individual and combined effects of job strain components on subsequent morbidity and mortality. *Epidemiology* 2019;**30**:e27–e29.
5. Madsen IEH, Nyberg ST, Magnusson Hanson LL *et al.*; IPD-Work Consortium. Job strain as a risk factor for clinical depression: systematic review and meta-analysis with additional individual participant data. *Psychol Med* 2017;**47**:1342–1356.
6. Ferrie JE, Virtanen M, Jokela M *et al.*; IPD-Work Consortium. Job insecurity and risk of diabetes: a meta-analysis of individual participant data. *CMAJ* 2016;**188**:E447–E455.
7. Ervasti J, Kivimäki M, Dray-Spira R *et al.* Psychosocial factors associated with work disability in men and women with diabetes: a pooled analysis of three occupational cohort studies. *Diabet Med* 2016;**33**:208–217.
8. Vyas L. New normal' at work in a post-COVID world: work-life balance and labor markets. *Policy Soc* 2022;**41**:155–167.

9. 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.
10. Reuschke D, Felstead A. Changing workplace geographies in the COVID-19 crisis. *Dial Human Geogr* 2020;**10**:208–212.
11. Felstead A, Henseke G. Assessing the growth of remote working and its consequences for effort, well-being and work-life balance. *New Technol Work Employ* 2017;**32**:195–212.
12. Eurostat. Labour Market Overview [cited 21 September 2023]. https://ec.europa.eu/eurostat/web/labour-market/overview
13. Arias-Ulloa CA, Gómez-Salgado J, Escobar-Segovia K, García-Iglesias JJ, Fagundo-Rivera J, Ruiz-Frutos C. Psychological distress in healthcare workers during COVID-19 pandemic: a systematic review. *J Safety Res* 2023;**87**:297–312.
14. Chudzicka-Czupala A, Żywiołek-Szeja M, Paliga M, Grabowski D, Krauze N. Remote and on-site work stress severity during the COVID-19 pandemic: comparison and selected conditions. *Int J Occup Med Environ Health* 2023;**36**:96–111.
15. Barone Gibbs B, Kline CE, Huber KA, Paley JL, Perera S. Covid-19 shelter-at-home and work, lifestyle and well-being in desk workers. *Occup Med (Lond)* 2021;**71**:86–94.
16. Ervasti J, Aalto V, Pentti J, Oksanen T, Kivimäki M, Vahtera J. 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. *Occup Environ Med* 2022;**79**:233–241.
17. Vahtera J, Kivimaki M, Pentti J. Effect of organisational downsizing on health of employees. *Lancet* 1997;**350**:1124–1128.
18. Vahtera J, Kivimäki M, Pentti J *et al*. Organisational downsizing, sickness absence, and mortality: 10-town prospective cohort study. *BMJ* 2004;**328**:555.
19. Kivimaki 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**:154–158.
20. Ala-Mursula L, Vahtera J, Pentti J, Kivimäki M. Effect of employee worktime control on health: a prospective cohort study. *Occup Environ Med* 2004;**61**:254–261.
21. Ala-Mursula L, Vahtera J, Kivimäki M, Kevin MV, Pentti J. Employee control over working times: associations with subjective health and sickness absences. *J Epidemiol Community Health* 2002;**56**:272–278.
22. 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**:479–485.
23. Karasek RA. Stress at work: an integrative approach. *New Solut* 1994;**4**:28–35.
24. Karasek RA. Job demands, job decision latitude, and mental strain: implications for job redesign. *Admin Sci Quart* 1979;**24**:285–308.
25. Moorman RH. Relationship between organizational justice and organizational citizenship behaviors: do fairness perceptions influence employee citizenship? *J Appl Psychol* 1991;**76**:845–855.
26. 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.
27. Robine JM, Jagger C, Euro RG. Creating a coherent set of indicators to monitor health across Europe: the Euro-REVES 2 project. *Eur J Public Health* 2003;**13**:6–14.
28. 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**:49–57.
29. Tuomi K, Ilmarinen J, Martikainen R, Aalto L, Klockars M. Aging, work, life-style and work ability among Finnish municipal workers in 1981-1992. *Scand J Work Environ Health* 1997;**23**:58–65.
30. Halonen JI, Kivimäki M, Kouvonen A *et al*. Proximity to a tobacco store and smoking cessation: a cohort study. *Tob Control* 2014;**23**:146–151.
31. 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**:1633–1642.
32. Heikkila K, Nyberg ST, Fransson EI *et al.*; IPD-Work Consortium. Job strain and tobacco smoking: an individual-participant data meta-analysis of 166,130 adults in 15 European studies. *PLoS One* 2012;**7**:e35463.
33. 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**:1078–1089.
34. Bouziri H, Smith DRM, Descatha A, Dab W, Jean K. Working from home in the time of COVID-19: how to best preserve occupational health? *Occup Environ Med* 2020;**77**:509–510.
35. Flovik 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**:134–145.
36. Greubel J, Kecklund G. The impact of organizational changes on work stress, sleep, recovery and health. *Ind Health* 2011;**49**:353–364.
37. Gronstad A, Kjekshus LE, Tjerbo T, Bernstrøm VH. Work-related moderators of the relationship between organizational change and sickness absence: a longitudinal multilevel study. *BMC Public Health* 2020;**20**:1218.
38. Eurofound. *Economic and Social Inequalities in Europe in the Aftermath of the COVID-19 Pandemic*. Luxembourg: Publications Office of the European Union, 2023.
39. Mamelund SE, Shelley-Egan C, Rogeberg O. The association between socioeconomic status and pandemic influenza: systematic review and meta-analysis. *PLoS One* 2021;**16**:e0244346.
40. Eurostat. https://ec.europa.eu/eurostat (13 May 2024, date last accessed).
41. Polvinen A, Laaksonen M. Contribution of age, gender and occupational group to the higher risk of disability retirement among Finnish public sector employees. *Scand J Public Health* 2024;**52**:419–426.
42. Erkkola M, Walsh HM, Saari T, Lehto E, Rahkonen O, Nevalainen J. Private sector service workers' well-being before and during the COVID-19 pandemic. *Soc Sci Human Open* 2023;**8**:100711.
43. Duchek S. Organizational resilience: a capability-based conceptualization. *Bus Res* 2020;**13**:215–246.
44. Labrague LJ. Psychological resilience, coping behaviours and social support among health care workers during the COVID-19 pandemic: a systematic review of quantitative studies. *J Nurs Manag* 2021;**29**:1893–1905.