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Research paper

Organisational changes and depression: The mediating role of psychosocial work exposures in the SUMER study

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ABSTRACT

Background: Studies are lacking on the associations between organisational changes and mental disorders and the underlying mechanisms. The objectives were to explore the associations between organisational changes and depression, measured using a validated instrument, and the mediating role of psychosocial work exposures.

Methods: The study relied on the national representative sample of 25,977 employees of the French SUMER survey. The PHQ-9 instrument was used to measure depression. Weighted robust Poisson regression analyses were performed to explore the associations between organisational changes, psychosocial work exposures, and depression. The method by Karlson, Holm and Breen (KHB) was used to estimate the mediating role (contributions) of psychosocial work exposures in the associations between organisational changes and depression.

Results: The exposure to any organisational change increased the risk of depression (Prevalence Ratio = 1.85, 95 % CI: 1.61–2.13). All types of organisational changes were found to be risk factors for depression. The risk of depression increased with the number of organisational changes. Psychosocial work exposures contributed to mediating the associations between organisational changes and depression. The exposures with the highest contributions were found to be high psychological demands, low esteem, low job promotion, low job security, workplace bullying, and ethical conflict. Taking all the exposures into account mediated the associations by 47–100 %.

Limitations: The study limitations included the cross-sectional design and a potential healthy worker effect.

Conclusions: More prevention oriented towards work organisation and the psychosocial work environment may help to reduce depression among working populations.

1. Introduction

Organisational changes have been more and more common in the workplace in recent decades. Indeed, improving performance, competitiveness and flexibility and reducing costs are among the many reasons that may lead companies to implement organisational changes. Organisational changes may be defined by any change in the structures and processes of the organisation, and consequently include a wide set of changes, and some of them may be major such as downsizing. They have been suspected to affect health outcomes directly because these changes may act as job stressors, and indirectly as they may increase the exposure to psychosocial work factors such as job insecurity or job demands. The literature has been extensive on the associations of various psychosocial work exposures with health outcomes, and especially mental health outcomes, including depression (Niedhammer et al., 2021).

Literature reviews with meta-analysis showed that job strain, low decision latitude, long working hours, effort-reward imbalance, job insecurity, bullying, and violence/threats were associated with depression (Kim and von dem Knesebeck, 2016; Madsen et al., 2017; Ronnblad et al., 2019; Rudkjoebing et al., 2020; Rugulies et al., 2017; Theorell et al., 2015; Virtanen et al., 2018; Wong et al., 2019). The number of studies has been much more limited on the effects of organisational changes on mental health. One main advantage of organisational changes in comparison with psychosocial work exposures is that these changes may be considered as more “tangible”, in the words of Bamberger et al. (Bamberger et al., 2012). Indeed, organisational changes, because they impact a company or an organisation as a whole, may be considered as more collective and objective, in comparison with psychosocial work exposures. Consequently, their assessment may be made at company level and independently of employees. This specific feature

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of organisational changes is particularly useful for their assessment and also from a preventive point of view.

The number of studies exploring the effects of organisational changes on health outcomes has been rather low, particularly on mental health outcomes. The narrative literature review by Bamberger et al. (Bamberger et al., 2012) focused on mental health, and concluded that there was no sufficient evidence for the associations between organisational changes and mental health outcomes. Indeed, among the 17 included studies (11 prospective and 6 cross-sectional studies), an association between organisational changes and mental health outcomes was found in only 11 studies (including 6 prospective studies). Some prospective studies were published after the publication of the review by Bamberger et al. (Bamberger et al., 2012). These studies (Andreeva et al., 2015; Blomqvist et al., 2018; Falkenberg et al., 2013; Flovik et al., 2019b; Jensen et al., 2019; Kaspersen et al., 2017; Magnusson Hanson et al., 2016) were from Denmark, Norway and Sweden, and one from the UK. Among them, four studies examined downsizing collected from administrative sources (Andreeva et al., 2015; Blomqvist et al., 2018; Kaspersen et al., 2017; Magnusson Hanson et al., 2016) and four studies explored purchases/prescriptions of psychotropic medication from medico-administrative sources (Blomqvist et al., 2018; Jensen et al., 2019; Kaspersen et al., 2017; Magnusson Hanson et al., 2016). One shortcoming of the literature was that the studies generally relied on data of purchases/prescriptions of psychotropic medication or mental health symptom scales, and not on mental disorders as assessed using validated instruments. Furthermore, most previous studies focused on one single organisational change, such as downsizing, on specific working populations, such as workers of the public sector, and on some countries, such as Scandinavian countries.

According to the multilevel concept of work organisation by Sauter et al. (2002), external factors (i.e. “economic, legal, political, technological, and demographic forces at the national/international level”) influence organisational factors (i.e. “management structures, supervisory practices, production methods, and human resource policies”), which in turn influence work factors, including psychosocial work exposures. The mediating role of these exposures in the associations between organisational changes and health is thus suspected but rarely studied. We found only one study exploring this mediating role for mental health outcomes (Flovik et al., 2019b).

The main objective of the study was to explore the associations between various organisational changes and depression, measured using a validated instrument, in a nationally representative sample of the French working population of employees. The second objective was to assess the role of psychosocial work exposures as mediating factors in the associations between organisational changes and depression.

2. Methods

2.1. Study sample

The SUMER survey is a national survey performed by the French ministry of labour (DARES) at regular intervals. The data of the last SUMER survey were collected in 2016 among a nationally representative sample of the French working population of employees in the context of occupational medicine. The sampling design had two steps. Firstly, the survey relied on a national network of 1243 volunteer occupational physicians. Secondly, these physicians selected a random sample of the employees they followed up. The occupational physicians played an expert role by their in-depth knowledge of the employees and the companies in which the employees were working. This survey included both a questionnaire filled in by the occupational physicians and a self-administered questionnaire filled in by the employees. Our team already published a large number of studies using the data of the SUMER survey (Supplementary Material). Regarding the data of the 2016 SUMER survey, we previously published a study on the associations between psychosocial work exposures and depression

(Niedhammer et al., 2020) and between psychosocial work exposures and suicidal ideation (Niedhammer et al., 2024).

In 2016, 30,000 employees were asked to participate to the SUMER survey. A total of 26,494 employees participated to the survey and the main questionnaire was filled in by the occupational physicians for these employees, i.e. a participation rate of 88.3 %. Among them, 25,977 employees responded to the self-administered questionnaire, i.e. a response rate of 86.6 %. Consequently, the study sample included 25,977 employees, 14,682 men and 11,295 women.

2.2. Variables

2.2.1. Depression

Depression was assessed in the self-administered questionnaire filled in by the employees using the PHQ-9 instrument, which is considered as a self-administered version of the PRIME-MD diagnostic instrument (Kroenke et al., 2001). The PHQ-9 includes 9 items related to depressive symptoms and their frequency within the last 2 weeks. Depression was defined by values of the PHQ-9 sum score higher than or equal 10 (Manea et al., 2016).

2.2.2. Organisational changes

Seven items were used to measure various types of organisational changes within the last 12 months. These items were collected in the questionnaire filled in by the occupational physicians, who had a good knowledge of the employees and the companies in which the employees were working. The question was the following:

Within the last 12 months, has the work environment strongly changed due to:

- 1) Change of position, function
- 2) Technological change
- 3) Restructuring or relocation of the establishment, company or administration
- 4) Change in work organisation in the establishment
- 5) Redundancy plan in the establishment
- 6) Buyout or change in the management team
- 7) Change in the persons the employee is working with regularly

Each binary item was studied separately as well as the two following variables: any organisational change within the last 12 months (yes/no) and the number of organisational changes within the last 12 months.

2.2.3. Psychosocial work exposures

Various psychosocial work exposures were collected in the self-administered questionnaire filled in by the employees:

- The three dimensions of the job strain model were measured using the validated questionnaire of the Job Content Questionnaire and its French translation (Karasek et al., 1998; Niedhammer, 2002; Niedhammer et al., 2006): decision latitude, psychological demands, and social support at work. The two subdimensions of decision latitude are skill discretion and decision authority and the two subdimensions of social support are colleague support and supervisor support. The recommendations for use were followed to construct the scores and to dichotomise them at the median among the total sample.

- The dimension of reward at work was measured using the validated scale of the effort-reward imbalance model and its French translation (Niedhammer et al., 2000b; Siegrist et al., 2004). Reward has three subdimensions: esteem, job promotion, and job security. We followed recommendations for use to construct the scores and dichotomised them at the median among the total sample.

- Three exposures were related to workplace violence: bullying (9 items), verbal aggression (2 items) and physical/sexual aggression (2 items). These exposures were defined by at least one situation of violence among the proposed items.

- The measure of work-family conflict was based on one item.

- The measure of ethical conflict was also based on one item.
- Temporary work was measured using one item and defined by various temporary work contracts.
- Teleworking was measured using one item and defined by one day a week or more of teleworking.
- Exposure to lean was measured using four items and defined by one exposure or more to just-in-time production, quality improvement, employee involvement, and eliminating wasteful activities.
- Meaning of work was measured using one item.
- Long working hours was measured using the number of hours a week and defined by 48 h or more a week following the European Directive on working time.

Most of these exposures were found to be associated with mental health outcomes in previous literature reviews (Niedhammer et al., 2021).

2.2.4. Covariates

The following covariates, collected in the questionnaire filled in by the occupational physicians, were used: gender, age (in 10-year age groups), marital status (living with a partner or not), occupation (4 main occupational groups), and economic activity of the company (4 main activities). Occupation and economic activity were coded using the national French classifications.

2.3. Statistical methods

All analyses were done using weighted data to allow the results to be representative of the national working population of employees (i.e. 24.5 millions of employees). The calculation of weights performed by the French ministry of labour (DARES) had four objectives: (1) to control for the potential bias related to volunteering of occupational physicians by taking into account their characteristics in comparison with the characteristics of the national population of occupational physicians, (2) to control for the potential bias related to the periodicity of medical examinations (employees exposed to occupational hazards have more frequent medical examinations with their occupational physician than non-exposed employees), (3) to control for the potential bias related to non-participation of the employees to the survey and non-response to the self-administered questionnaire, and (4) to take the characteristics of the national French population of employees into account by a calibration on margins with the following calibration variables: gender, age, nationality, full/part time work, occupation, company size, and economic activity of the company.

A description of the study sample was performed for all studied variables and for each gender separately, and differences between genders were tested using the Rao-Scott Chi-2 test. Tetrachoric correlation coefficients were calculated to study the correlations between the different types of organisational changes and between the different types of psychosocial work exposures.

The associations between organisational changes and depression were studied using weighted Poisson regression models with robust variance estimation (the prevalence of depression defined by the PHQ-9 sum score ≥ 10 was 11.5 %) (Barros and Hirakata, 2003), firstly without adjustment for covariates and secondly with adjustment for covariates. The linear trend of the association between the number of organisational changes and depression was tested. Gender-related interactions in the associations between organisational changes and depression were tested. The following sensitivity analyses were done to assess the robustness of the results: (1) with additional adjustment for private/public sector, company size, and chronic diseases, (2) after excluding the employees working part time, (3) without weights, and (4) using depression as defined by the PHQ-9 algorithm, i.e. the presence of at least 5 symptoms “more than half the days” (except the 9th item that has

to be present “several days”) and one of the two first items has to be present (depressed mood or loss of interest).

The associations between organisational changes and psychosocial work exposures (as outcomes, whose prevalence was $>10\%$ for most of them) were examined using weighted robust Poisson regression models.

The associations between psychosocial work exposures and depression were already presented in our previous publication (Niedhammer et al., 2020).

The mediating role (contributions) of psychosocial work exposures in the associations between organisational changes and depression was estimated by the method by Karlson, Holm and Breen (KHB) that allows comparisons of nested non-linear models (Karlson and Anders, 2011; Karlson et al., 2012; Kohler et al., 2011). Positive contributions (i.e. contributions >0) (%) are interpreted by reductions of the effect of organisational change on depression, and negative contributions (i.e. contributions <0) by increases of the effect. Firstly, to the model (Model 0) including organisational change and covariates as independent variables, and depression as outcome, we added each psychosocial work exposure one by one, as additional independent variable (Models 1). The contribution of each psychosocial work exposure in the association between organisational changes and depression was estimated by the KHB method. Secondly, in a final model (Model 2), we added all psychosocial work exposures, that displayed positive significant contributions, as independent variables, to Model 0. We included in Model 2 the sub-dimensions and not the main dimensions of decision latitude, social support, and reward to present the most detailed results (the results for the main dimensions can be found in Supplementary Material). The overall contribution of all these exposures together (Model 2) in the associations between organisational changes and depression was estimated using the KHB method. Finally, we used the KHB decomposition method to disentangle the respective contribution of each psychosocial work exposure in the overall contribution (Karlson and Anders, 2011).

A summary of the statistical analyses can be found in the Supplementary Fig. S1. The statistical analyses were done using R 4.3.2 and Stata/SE 18 softwares. We used the following R packages: *tidyverse*, *survey*, and *gsummary* for descriptive statistics. The following Stata commands were used: *poisson* with *pweight* and *vce(robust)* options for weighted robust Poisson regression models, and *khb* for the KHB method.

3. Results

The study sample is described in Table 1. The 2-week prevalence of depression defined by the sum score ≥ 10 was higher among women than among men (14 % versus 9 %). There were gender differences in the following covariates: age, occupation, and economic activity. About 60 % of the employees were exposed to at least one organisational change within the last 12 months. There were gender differences in the prevalence of two types of organisational changes. Women were more likely to be exposed to change in work organisation than men, whereas men were more likely to be exposed to redundancy plan than women. Correlations were found to be significant between organisational changes and the strongest correlation was observed between restructuring and change in work organisation (Supplementary Table S1). The internal consistency and the prevalence of psychosocial work exposures are presented in Supplementary Table S2. Internal consistency was found to be satisfactory for all exposures (almost all Cronbach coefficients were higher than 0.7). Some psychosocial work exposures were more prevalent among men than among women (low esteem, low job security, ethical conflict, lean, low meaning, long working hours) or some others were more prevalent among women than among men (low decision latitude and its two subdimensions, high psychological demands, low job promotion, verbal aggression). There were significant

Table 1
Descriptive statistics for depression, organisational changes within the last 12 months, and covariates among the study sample.

	Men N = 14,682 n (%)	Women N = 11,295 n (%)	P-value
Depression			<0.001
No	12,846 (90.8 %)	9067 (86.0 %)	
Yes (PHQ-9 sum score ≥ 10)	1276 (9.2 %)	1566 (14.0 %)	
Any organisational change			0.813
None	5687 (40.5 %)	4004 (40.2 %)	
At least one	8973 (59.5 %)	7279 (59.8 %)	
Change of position/function			0.788
No	11,827 (81.8 %)	9039 (81.6 %)	
Yes	2833 (18.2 %)	2244 (18.4 %)	
Technological change			0.504
No	12,426 (84.9 %)	9366 (84.3 %)	
Yes	2234 (15.1 %)	1917 (15.7 %)	
Restructuring/relocation			0.736
No	12,724 (87.6 %)	9671 (87.4 %)	
Yes	1936 (12.4 %)	1612 (12.6 %)	
Change in work organisation			0.002
No	11,542 (80.2 %)	8488 (77.3 %)	
Yes	3118 (19.8 %)	2795 (22.7 %)	
Redundancy plan			0.046
No	14,236 (96.9 %)	11,003 (97.6 %)	
Yes	424 (3.1 %)	280 (2.4 %)	
Buyout/change in the management team			0.476
No	12,771 (86.5 %)	9553 (86.0 %)	
Yes	1889 (13.5 %)	1730 (14.0 %)	
Change in the persons			0.088
No	8270 (59.2 %)	5959 (57.3 %)	
Yes	6390 (40.8 %)	5324 (42.7 %)	
Number of organisational changes			0.669
0	5687 (40.5 %)	4004 (40.2 %)	
1	3881 (25.7 %)	2923 (25.0 %)	
2	2301 (15.8 %)	1939 (15.7 %)	
3 or more	2791 (18.0 %)	2417 (19.1 %)	
Age (years)			<0.001
<30	1949 (19.0 %)	1357 (16.0 %)	
30–39	3793 (25.0 %)	2714 (23.3 %)	
40–49	4378 (26.1 %)	3427 (27.8 %)	
50 or more	4562 (29.9 %)	3797 (32.8 %)	
Marital status			0.127
With partner	10,785 (70.5 %)	7816 (68.8 %)	
Without partner	3647 (29.5 %)	3319 (31.2 %)	
Occupation			<0.001
Managers/professionals	3693 (19.7 %)	2190 (14.0 %)	
Associate professionals	4136 (18.8 %)	3421 (21.9 %)	
Clerks/service workers	1819 (18.8 %)	4600 (53.5 %)	
Blue collar workers	5034 (42.7 %)	1084 (10.6 %)	
Economic activity of the company			<0.001
Manufacturing	3986 (18.1 %)	1320 (7.5 %)	
Agriculture	370 (1.8 %)	115 (0.8 %)	
Construction	1153 (9.2 %)	213 (1.9 %)	
Services	9173 (71.0 %)	9647 (89.8 %)	

n: unweighted numbers, %: weighted percentages.

P-value for the comparison between genders (Rao-Scott Chi-2 test).

correlations between most of psychosocial work exposures (Supplementary Table S3).

The exposure to at least one organisational change within the last 12 months increased the risk of depression (Table 2). The associations between all types of organisational changes and depression were found to be significant. The risk of depression increased with the number of organisational changes within the last 12 months. All these results were similar before and after adjustment for covariates. The results for the associations between covariates and depression can be found in Supplementary Table S4. No gender-related interaction was observed (Supplementary Table S5), meaning that the associations between organisational changes and depression were likely to be the same for men and women. The results of all the sensitivity analyses provided similar results (Supplementary Tables S6–S7).

The study of the associations between organisational changes and

psychosocial work exposures showed that most of these associations were found to be significant (Table 3). Almost all organisational changes were associated with low decision authority, high psychological demands, low social support, especially low supervisor support, low reward and its three subdimensions (low esteem, low job promotion, and low job security), bullying, verbal aggression, work-family conflict, ethical conflict, teleworking, and lean.

The associations between psychosocial work exposures and depression were presented in one of our earlier publication (Niedhammer et al., 2020). The results showed that low decision latitude, high psychological demands, low social support (especially from supervisors), low reward and its three subdimensions (low esteem, low job promotion and low job security), bullying, work-family and ethical conflicts, low meaning, and long working hours were risk factors for depression among men and/or women.

Table 2

Associations between organisational changes within the last 12 months and depression (PHQ-9 sum score ≥ 10) before and after adjustment for covariates: results from weighted robust Poisson regression analyses (each organisational change was studied separately).

	Before adjustment for covariates		After adjustment for covariates ^a	
	PR (95 % CI)	P-value	PR (95 % CI)	P-value
Any organisational change	1.84 (1.60; 2.11)	<0.001	1.85 (1.61; 2.13)	<0.001
Change of position/function	1.56 (1.36; 1.80)	<0.001	1.57 (1.36; 1.80)	<0.001
Technological change	1.52 (1.32; 1.76)	<0.001	1.51 (1.31; 1.74)	<0.001
Restructuring/relocation	1.24 (1.06; 1.44)	0.006	1.27 (1.09; 1.48)	0.002
Change in work organisation	1.75 (1.53; 1.99)	<0.001	1.72 (1.50; 1.96)	<0.001
Redundancy plan	1.31 (0.99; 1.73)	0.058	1.40 (1.06; 1.85)	0.017
Buyout/change in the management team	1.42 (1.22; 1.66)	<0.001	1.42 (1.21; 1.66)	<0.001
Change in the persons	1.53 (1.36; 1.73)	<0.001	1.53 (1.35; 1.73)	<0.001
Number of organisational changes ^b		<0.001		<0.001
0	1		1	
1	1.59 (1.34; 1.87)	<0.001	1.58 (1.33; 1.87)	<0.001
2	1.74 (1.43; 2.11)	<0.001	1.79 (1.48; 2.16)	<0.001
3 or more	2.27 (1.93; 2.67)	<0.001	2.30 (1.94; 2.72)	<0.001

PR: prevalence ratio.

^a Covariates included: gender, age, marital status, occupation, and economic activity.

^b Tests for linear trend were significant at $p < 0.001$ between the number of organisational changes and depression.

The contributions of psychosocial work exposures in the associations between organisational changes and depression were assessed for all types of organisational changes. The study of any organisational change within the last 12 months (Table 4 and Supplementary Table S8) showed that various psychosocial work exposures reduced the effect of any organisational change on depression. Low decision authority, high psychological demands, low social support and its two subdimensions (low supervisor and colleague support), low reward and its three subdimensions (low esteem, low job promotion and low job security), bullying, verbal aggression, physical/sexual aggression, work-family conflict, ethical conflict, and long working hours had significant positive contributions in the association between any organisational change and depression. As an example (Table 4), the inclusion of low job security led to reduce the prevalence ratio of any organisational change associated with depression from 1.85 (Model 0) to 1.68 (Model 1), corresponding to a reduction of 18.6 % of the effect of any organisational change on depression. This contribution of 18.6 % was found to be significantly different from 0, allowing to conclude that low job security had a significant positive contribution in the association between any organisational change and depression. The highest contributions (>15 %) were found for high psychological demands, low reward and its three subdimensions (low esteem, low job promotion and low job security), bullying, and ethical conflict. All psychosocial work exposures with a significant positive contribution had an overall contribution of 64.3 % in Model 2, meaning that 64.3 % of the association between any organisational change and depression was mediated by all these exposures (Table 4). The KHB decomposition method confirmed the importance of high psychological demands, low esteem, low job promotion, low job security, bullying, and ethical conflict in the overall contribution (footnote to Table 4). The study of the different types of organisational changes (Supplementary Tables S9-S15) showed that the strongest contributions were found for the same exposures. High psychological demands, low esteem, low job security, verbal aggression, and ethical conflict displayed significant positive contributions in the associations between all types of organisational changes and depression. Among the two subdimensions of decision latitude, low decision authority had small contributions for some organisational changes, whereas low skill discretion had none. Regarding social support, supervisor support had higher contributions than colleague support. All three subdimensions of reward (low esteem, low job promotion and low job security) had high contributions. Among the three exposures related to workplace violence, bullying was the exposure that had the highest contribution. The overall

contribution of all psychosocial work exposures with a significant positive contribution ranged from 47 % for change of position/function to 100 % for restructuring and redundancy plan.

4. Discussion

4.1. Main results

About 60 % of the employees were exposed to at least one organisational change within the last 12 months. Some changes were particularly prevalent in this national study such as change in the persons the employee was working with and change in work organisation. The exposure to at least one organisational change increased the risk of depression. All studied types of organisational changes were associated with depression. The risk of depression increased with the number of organisational changes. A large number of associations was found between organisational changes and psychosocial work exposures. Many of these exposures were found to be mediating factors in the associations between organisational changes and depression. The exposures that displayed the strongest mediating role were: high psychological demands, low esteem, low job promotion, low job security, workplace bullying, and ethical conflict. A total of 47–100 % of the associations between organisational changes and depression was mediated by psychosocial work exposures.

4.2. Comparison with the literature

To make our comparison with the literature as relevant as possible, previous studies that explored national samples or at least large samples as heterogeneous as possible were given priority, and we restricted this comparison to studies that examined mental health outcomes.

Gender difference in the prevalence of depression observed in our study were in agreement with previous results in France and Europe (Alonso et al., 2004; Murcia et al., 2013).

We found that all organisational changes were associated with depression in our study. To our knowledge, there was no previous study on the association between organisational changes and depression, as measured using a validated instrument, in the literature. Some previous prospective studies explored various organisational changes in association with mental health outcomes. Falkenberg et al. (Falkenberg et al., 2013) showed that British civil servants who experienced or anticipated major organisational change related to deregulation and privatisation of

Table 3

Associations between organisational changes within the last 12 months and psychosocial work exposures (as outcomes): results from weighted robust Poisson regression analyses with adjustment for covariates (each organisational change was studied separately).

	Any organisational change		Change of position/function		Technological change		Restructuring/relocation	
	PR (95 % CI)	P-value	PR (95 % CI)	P-value	PR (95 % CI)	P-value	PR (95 % CI)	P-value
Low skill discretion	0.95 (0.91; 0.99)	0.019	0.92 (0.87; 0.98)	0.009	0.92 (0.86; 0.98)	0.013	1.00 (0.94; 1.06)	0.969
Low decision authority	1.08 (1.04; 1.12)	<0.001	1.03 (0.98; 1.08)	0.233	1.06 (1.01; 1.11)	0.021	1.08 (1.03; 1.13)	0.002
Low decision latitude	1.03 (0.98; 1.07)	0.255	0.99 (0.93; 1.05)	0.730	1.02 (0.96; 1.09)	0.501	1.07 (1.00; 1.13)	0.038
High psychological demands	1.48 (1.41; 1.57)	<0.001	1.22 (1.15; 1.29)	<0.001	1.29 (1.22; 1.37)	<0.001	1.26 (1.20; 1.33)	<0.001
Low supervisor support	1.24 (1.17; 1.32)	<0.001	1.08 (1.00; 1.16)	0.049	1.07 (0.98; 1.16)	0.127	1.17 (1.09; 1.26)	<0.001
Low colleague support	1.07 (1.03; 1.11)	<0.001	1.04 (0.99; 1.09)	0.110	1.05 (1.00; 1.11)	0.053	1.05 (1.00; 1.10)	0.055
Low social support	1.20 (1.13; 1.27)	<0.001	1.08 (1.00; 1.17)	0.037	1.12 (1.03; 1.22)	0.008	1.12 (1.04; 1.21)	0.003
Low esteem	1.31 (1.25; 1.37)	<0.001	1.11 (1.05; 1.18)	<0.001	1.17 (1.10; 1.23)	<0.001	1.18 (1.12; 1.25)	<0.001
Low job promotion	1.30 (1.24; 1.37)	<0.001	1.00 (0.94; 1.07)	0.926	1.11 (1.04; 1.18)	0.002	1.21 (1.14; 1.28)	<0.001
Low job security	1.43 (1.33; 1.54)	<0.001	1.26 (1.17; 1.35)	<0.001	1.29 (1.19; 1.40)	<0.001	1.43 (1.34; 1.54)	<0.001
Low reward	1.36 (1.29; 1.43)	<0.001	1.07 (1.01; 1.14)	0.022	1.17 (1.09; 1.24)	<0.001	1.27 (1.20; 1.35)	<0.001
Bullying	1.60 (1.42; 1.80)	<0.001	1.23 (1.08; 1.40)	0.002	1.36 (1.19; 1.54)	<0.001	1.36 (1.20; 1.54)	<0.001
Verbal aggression	1.68 (1.51; 1.87)	<0.001	1.30 (1.17; 1.46)	<0.001	1.50 (1.35; 1.68)	<0.001	1.26 (1.12; 1.42)	<0.001
Physical/sexual aggression	2.02 (1.36; 3.00)	<0.001	1.08 (0.71; 1.64)	0.723	1.34 (0.91; 1.97)	0.134	1.16 (0.78; 1.75)	0.463
Work-family conflict	1.20 (1.13; 1.28)	<0.001	1.13 (1.06; 1.21)	<0.001	1.11 (1.03; 1.20)	0.008	1.12 (1.04; 1.20)	0.002
Ethical conflict	1.46 (1.36; 1.58)	<0.001	1.22 (1.13; 1.32)	<0.001	1.24 (1.14; 1.35)	<0.001	1.29 (1.19; 1.39)	<0.001
Temporary work	1.00 (0.85; 1.17)	0.991	1.36 (1.13; 1.64)	0.001	0.93 (0.72; 1.19)	0.554	0.75 (0.57; 0.97)	0.030
Teleworking	1.36 (1.08; 1.73)	0.010	1.39 (1.08; 1.79)	0.012	1.43 (1.11; 1.84)	0.005	1.31 (1.03; 1.66)	0.026
Lean	1.44 (1.35; 1.53)	<0.001	1.28 (1.20; 1.36)	<0.001	1.42 (1.32; 1.52)	<0.001	1.32 (1.24; 1.41)	<0.001
Low meaning	0.98 (0.94; 1.01)	0.218	1.01 (0.96; 1.05)	0.807	1.00 (0.95; 1.05)	0.887	1.02 (0.97; 1.07)	0.525
Long working hours	1.45 (1.24; 1.69)	<0.001	1.26 (1.07; 1.49)	0.005	1.06 (0.86; 1.30)	0.596	1.16 (0.98; 1.37)	0.085

	Change in work organisation		Redundancy plan		Buyout/change in the management team		Change in the persons	
	PR (95 % CI)	P-value	PR (95 % CI)	P-value	PR (95 % CI)	P-value	PR (95 % CI)	P-value
Low skill discretion	0.95 (0.90; 1.01)	0.078	0.98 (0.87; 1.11)	0.755	1.03 (0.98; 1.10)	0.250	0.97 (0.93; 1.01)	0.113
Low decision authority	1.10 (1.06; 1.15)	<0.001	1.05 (0.95; 1.15)	0.345	1.13 (1.08; 1.18)	<0.001	1.04 (1.00; 1.08)	0.037
Low decision latitude	1.05 (1.00; 1.11)	0.055	0.97 (0.84; 1.12)	0.721	1.08 (1.01; 1.14)	0.017	1.00 (0.96; 1.05)	0.981
High psychological demands	1.38 (1.31; 1.45)	<0.001	1.30 (1.17; 1.45)	<0.001	1.24 (1.18; 1.32)	<0.001	1.39 (1.33; 1.46)	<0.001
Low supervisor support	1.31 (1.23; 1.40)	<0.001	1.05 (0.89; 1.24)	0.543	1.21 (1.13; 1.31)	<0.001	1.22 (1.15; 1.29)	<0.001
Low colleague support	1.09 (1.04; 1.13)	<0.001	1.02 (0.92; 1.14)	0.645	1.10 (1.05; 1.15)	<0.001	1.05 (1.01; 1.08)	0.020
Low social support	1.25 (1.16; 1.33)	<0.001	1.02 (0.87; 1.21)	0.771	1.14 (1.06; 1.23)	<0.001	1.16 (1.10; 1.23)	<0.001
Low esteem	1.30 (1.24; 1.36)	<0.001	1.22 (1.09; 1.36)	<0.001	1.25 (1.18; 1.31)	<0.001	1.25 (1.20; 1.31)	<0.001
Low job promotion	1.26 (1.20; 1.33)	<0.001	1.26 (1.13; 1.40)	<0.001	1.27 (1.20; 1.34)	<0.001	1.25 (1.20; 1.31)	<0.001
Low job security	1.56 (1.46; 1.66)	<0.001	1.82 (1.63; 2.03)	<0.001	1.41 (1.31; 1.51)	<0.001	1.24 (1.16; 1.32)	<0.001
Low reward	1.36 (1.29; 1.43)	<0.001	1.35 (1.21; 1.50)	<0.001	1.34 (1.27; 1.41)	<0.001	1.29 (1.23; 1.35)	<0.001
Bullying	1.63 (1.46; 1.82)	<0.001	1.32 (1.00; 1.74)	0.053	1.43 (1.26; 1.62)	<0.001	1.58 (1.42; 1.76)	<0.001
Verbal aggression	1.56 (1.42; 1.72)	<0.001	1.47 (1.16; 1.86)	0.001	1.37 (1.23; 1.53)	<0.001	1.60 (1.46; 1.75)	<0.001
Physical/sexual aggression	1.50 (1.06; 2.13)	0.021	1.20 (0.57; 2.55)	0.633	1.34 (0.91; 1.98)	0.142	1.69 (1.21; 2.36)	0.002
Work-family conflict	1.16 (1.08; 1.23)	<0.001	1.11 (0.96; 1.29)	0.143	1.13 (1.05; 1.21)	0.001	1.19 (1.12; 1.26)	<0.001
Ethical conflict	1.44 (1.34; 1.55)	<0.001	1.37 (1.18; 1.60)	<0.001	1.34 (1.24; 1.45)	<0.001	1.35 (1.26; 1.44)	<0.001
Temporary work	0.75 (0.59; 0.96)	0.022	2.97 (2.22; 3.98)	<0.001	0.54 (0.40; 0.73)	<0.001	0.97 (0.83; 1.13)	0.675
Teleworking	1.48 (1.13; 1.94)	0.005	1.37 (1.22; 1.52)	<0.001	1.42 (1.13; 1.80)	0.003	1.20 (0.97; 1.49)	0.097
Lean	1.38 (1.30; 1.46)	<0.001	1.37 (1.22; 1.52)	<0.001	1.27 (1.18; 1.35)	<0.001	1.27 (1.20; 1.34)	<0.001
Low meaning	1.00 (0.95; 1.04)	0.921	1.02 (0.91; 1.13)	0.790	0.99 (0.93; 1.04)	0.640	0.96 (0.92; 0.99)	0.025
Long working hours	1.25 (1.08; 1.46)	0.003	1.28 (0.94; 1.75)	0.118	1.06 (0.89; 1.27)	0.490	1.36 (1.19; 1.57)	<0.001

Covariates included: gender, age, marital status, occupation, and economic activity.

PR: prevalence ratio.

the public service were at higher risk of minor psychiatric disorder (GHQ-30 ≥ 5). Flovik et al. (Flovik et al., 2019b) found that among the six studied organisational changes, two or three changes, especially company reorganization, were associated with mental distress (HSCL-10 ≥ 1.85), using various statistical models, in a Norwegian sample including 66 organisations. Jensen et al. (Jensen et al., 2019) showed that among the seven studied organisational changes, one to four changes, especially change in management, were associated with prescriptions of psychotropic medication, according to various models, in a sample of Danish public healthcare employees. Four studies showed significant associations between downsizing, often assessed using administrative sources but defined differently in the studies, and various mental health outcomes, purchases/prescriptions of psychotropic medication (Blomqvist et al., 2018; Kaspersen et al., 2017; Magnusson Hanson et al., 2016), depressive symptoms (SCL-CD6 ≥ 17) (Andreeva et al., 2015), and mental distress (Flovik et al., 2019b) in national Swedish and Norwegian samples. A strong dose-effect association was

observed between the number of organisational changes and depression in our study, which was in line with prior results for mental distress (Flovik et al., 2019b). One previous study however did not observe such cumulative effect of multiple exposures with psychotropic medication (Jensen et al., 2019). No gender difference in the associations between organisational changes and depression was observed in our study, echoing the findings by Jensen et al. (Jensen et al., 2019) showing that the associations between organisational changes and psychotropic medication did not vary according to gender.

The contribution of psychosocial work exposures in the associations between organisational changes and depression was found to be substantial in our study. The literature is very scarce in this topic. Few studies examined the associations between organisational changes and psychosocial work exposures. Ferrie et al. (Ferrie et al., 2007) underlined that the effects of organisational changes on psychological demands, decision authority, skill discretion, and social support may differ according to the moderate/major level of downsizing or expansion and

Table 4

Contribution of psychosocial work exposures in the association between any organisational change and depression (PHQ-9 sum score ≥ 10): results from weighted robust Poisson regression analyses and the KHB method.

	PR of depression associated with any organisational change PR (95 % CI)	P-value of PR	Contribution of psychosocial work exposure (s) % ^a	P-value of contribution
Model 0	1.85 (1.61; 2.13)	<0.001		
Models 1 (with each exposure)				
Low skill discretion	1.86 (1.62; 2.14)	<0.001	-1.2	0.041
Low decision authority	1.81 (1.57; 2.08)	<0.001	3.3	0.001
High psychological demands	1.54 (1.34; 1.78)	<0.001	29.9	<0.001
Low supervisor support	1.68 (1.46; 1.94)	<0.001	13.6	<0.001
Low colleague support	1.81 (1.57; 2.09)	<0.001	2.9	0.008
Low esteem	1.58 (1.37; 1.82)	<0.001	28.8	<0.001
Low job promotion	1.63 (1.41; 1.88)	<0.001	21.6	<0.001
Low job security	1.68 (1.45; 1.94)	<0.001	18.6	<0.001
Bullying	1.63 (1.41; 1.87)	<0.001	15.4	<0.001
Verbal aggression	1.70 (1.48; 1.96)	<0.001	10.9	<0.001
Physical/sexual aggression	1.83 (1.59; 2.11)	<0.001	1.0	0.006
Work-family conflict	1.76 (1.53; 2.03)	<0.001	8.3	<0.001
Ethical conflict	1.62 (1.41; 1.86)	<0.001	19.0	<0.001
Temporary work	1.85 (1.61; 2.13)	<0.001	0.2	0.737
Teleworking	1.85 (1.61; 2.14)	<0.001	0.3	0.208
Lean	1.82 (1.58; 2.10)	<0.001	2.3	0.089
Low meaning	1.87 (1.62; 2.15)	<0.001	-0.7	0.185
Long working hours	1.84 (1.59; 2.12)	<0.001	0.8	0.032
Model 2 (with all exposures)	1.22 (1.05; 1.42)	0.008	64.3 ^b	<0.001

Model 0 included organisational change and covariates (gender, age, marital status, occupation, economic activity).

Models 1: each psychosocial work exposure was added separately to Model 0.

Model 2: all psychosocial work exposures that displayed a significant positive contribution were added to Model 0.

PR: prevalence ratio.

^a Contribution (%) of psychosocial work exposure(s) in the association between organisational change and depression.

^b The decomposition of the overall contribution (64.3 %) of all psychosocial work exposures (Model 2) was the following: Low decision authority (1.4 %), High psychological demands (10.5 %), Low supervisor support (2.5 %), Low colleague support (1.0 %), Low esteem (11.8 %), Low job promotion (8.2 %), Low job security (8.2 %), Bullying (7.2 %), Verbal aggression (1.1 %), Physical/sexual aggression (0.1 %), Work-family conflict (5.8 %), Ethical conflict (6.5 %), Long working hours (0.0 %).

according to the public/private sector. The study by Flovik et al. (Flovik et al., 2019a) showed that five types of organisational changes (restructuring, downsizing, layoffs, partial closure, and partial outsourcing) were associated with a large set of psychosocial work exposures. Westerlund et al. (Westerlund et al., 2004) reported that organisational changes were associated with higher job strain, lower decision authority, and lower skill discretion in a sample of white-collar employees in Sweden. In the prospective study by Conway et al. (Conway et al., 2021), an association was found between restructuring and workplace bullying in a representative sample of German employees. The number of studies that assessed the contribution of psychosocial work exposures in the associations between organisational changes and mental health outcomes were still more seldom. Flovik et al. (Flovik et al., 2019b) reported that the association between organisational change and mental distress could be mediated by job demands, job control and social support, but the magnitude and significance of the mediating role were not assessed.

4.3. Strengths and limitations

The study included the following strengths. The study was based on a nationally representative sample and we used weights in all analyses, making the results generalisable to the whole national French working population of employees. The rates of participation to the survey and response to the self-administered questionnaire were both very high. We explored gender differences in the studied variables and also in the studied associations (Niedhammer et al., 2000a). Differences between genders were found in the studied variables but there was no gender differences in the associations between organisational changes and depression. The study explored various organisational changes and the number of changes, which displayed particularly strong associations

with depression. The study of at least one organisational change and the number of changes was also useful to take the correlations between organisational changes into account and to study the association of multiple organisational changes with depression. Depression was assessed using a validated instrument (PHQ-9). In addition, the PHQ-9 was included in the self-administered questionnaire filled in by employees which may have increased the validity of the assessment. Psychosocial work exposures were based on validated questionnaires and a large set of exposures was studied. The step-by-step study of the mediating role of psychosocial work exposures allowed to assess the overall contribution of all exposures and the respective contribution of each one. The results were based on both data collected by occupational physicians for organisational changes and covariates, and self-reported data for depression and psychosocial work exposures, which may have reduced reporting bias. We adjusted for covariates, although there was no major confounding effects of these covariates. We performed various sensitivity analyses that underlined the robustness of the results. Our study may be one of the first to study the associations between organisational changes and depression, using a validated instrument, as well as the mediating role of psychosocial work exposures in these associations, in a population-based sample.

The following limitations deserve to be mentioned. The study had a cross-sectional design, and no causal conclusion could be drawn, as all data were collected at the same point in time. Indeed, no clear temporal sequence between exposure and outcome could be determined and reverse causality remained possible. Nevertheless, organisational changes were assessed within the last 12 months in the questionnaire filled in by occupational physicians, whereas depression was assessed within the last 2 weeks in the self-administered questionnaire filled in by the employees using the PHQ-9. Authors (Theorell and Hasselhorn, 2005) underlined the interest of cross-sectional studies that included

objective assessment of exposure, as it was the case in our study (organisational changes were assessed by occupational physicians). These authors concluded that exposure-outcome associations need to be confirmed repeatedly whatever the study design and the method of exposure assessment. As the topic of organisational changes has been understudied until now, our study was definitively a contribution to the literature, although its results need to be confirmed. Given the cross-sectional design, a mediation analysis may have a limited significance. Furthermore, various methods of mediation analysis have been developed (VanderWeele, 2016). However, the KHB method, we used, allowed to study the mediating role of more than one mediator (psychosocial work exposures) and to assess the overall contribution of all mediators and the respective contribution of each one. A healthy worker effect, which is a specific selection bias, may have operated as employees with depression because of organisational changes may have left the most exposed jobs or the labour market, or may have lost their jobs. This effect is likely to bias the results towards the null hypothesis. There was no available information about the timing, implementation, design, and management of organisational changes, which may be of importance for the study of the health effects. Indeed, as shown by others (Andreeva et al., 2017; Brenner et al., 2014), the process and the way organisational changes are implemented may have a differential impact on mental health outcomes. Furthermore, organisational changes were not defined formally in the questionnaire which may have led to a lack of precision and misclassification. Redundancy plan is defined in France by any redundancy for economic reasons and is related to job cut/loss, or job change not accepted by the employee. The lack of precise definition in organisational changes, frequent in the literature, is likely to make comparison between studies difficult. Furthermore, organisational changes may have been interpreted differently according to the occupational physicians, especially because they were expected to collect organisational changes that may have changed the work environment strongly.

5. Conclusions

Our study showed that organisational changes were associated with depression, and that the higher the number of changes, the higher the risk of depression. Psychosocial work exposures were found to be mediators in the associations between organisational changes and depression. Their mediating role was estimated to be from 47 to 100 %. The exposures that displayed the strongest contributions were high psychological demands, low esteem, low job promotion, low job security, workplace bullying, and ethical conflict. This suggests that organisational changes of all types and specific psychosocial work exposures, such as those mentioned above, may warrant more attention.

More research is needed to improve our knowledge of the effects of organisational changes on mental health outcomes, especially mental disorders. As various organisational changes may occur at the same time and/or may be causes or consequences of other changes, more understanding of the synergetic effects of these changes would be an asset. Prevention oriented towards organisational changes and the psychosocial work environment may be useful to improve mental health at work.

CRedit authorship contribution statement

Isabelle Niedhammer: Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Maël Quatrevaux:** Writing – review & editing, Methodology, Formal analysis. **Sandrine Bertrais:** Writing – review & editing, Methodology, Formal analysis.

Declaration of competing interest

None.

Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Contributors

IN wrote the study protocol, performed the literature review, made contributions to statistical analysis, and wrote and revised the manuscript. MQ and SB performed the statistical analysis. All authors made contributions to interpretations of results and manuscript revisions.

Ethics approval

Ethical permissions were granted by French ethics committees: Commission Nationale de l'Informatique et des Libertés (no 762430) and Conseil National de l'Information Statistique (no 2016X711TV).

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jad.2024.09.157>.

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