Chronic exposure to adverse psychosocial work factors and high psychological distress among white-collar workers: A 5-year prospective study

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ABSTRACT

Objectives: Prospective studies which evaluated whether the effects of chronic exposure to psychosocial work factors on mental health persisted over time are scarce. For the first time, this study evaluated: 1) the effect of chronic exposure to effort-reward imbalance over 5 years on the prevalence of high psychological distress among men and women, and 2) the persistence of this effect over time.

Methods: Overall, 1747 white-collar workers from three public organizations participated in a prospective study. Psychological distress and effort-reward imbalance were measured using validated questionnaires at baseline, and at 3- and 5-year follow-ups. Prevalence ratios (PRs) of high psychological distress were estimated using log-binomial regression according to baseline and repeated exposure.

Results: Compared to unexposed workers, those with repeated exposure to effort-reward imbalance had a higher prevalence of high psychological distress. Workers exposed only at some time-points also had a higher prevalence. The deleterious effect of repeated exposure observed at the 3-year follow-up persisted at the 5-year follow-up among women (PR = 2.48 95% confidence interval (CI) 1.97–3.11) and men (PR = 1.91 95% CI 1.20–3.04). These effects were greater than those found using a single baseline measurement.

Conclusion: The current study supported a deleterious effect of repeated exposure to effort-reward imbalance on psychological distress, and a lack of adaptation to these effects over time among men and women. Since psychological distress may later lead to severe mental problems, current results highlight the need to consider exposure to these adverse work factors in primary and secondary preventions aimed at reducing mental health problems at work.

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Mental health problems account for close to a third of the disease burden associated with non-communicable diseases in high income countries [1,2]. In Canada, these problems represent the second leading reason for visiting a general practitioner [3,4]. Psychological distress, a major risk factor for severe mental health problems [5,6], is highly prevalent among workers of industrialized countries. In the United States and Canada, about 25% of workers reported high psychological distress in the last decade [5–7]. Also, 19% of Canadian adults reported recurrent episodes of psychological distress within a 12-month period [8].

A growing body of research reported prospective associations between adverse psychosocial work factors and mental health problems [9–12]. Psychosocial factors from the validated effort-reward imbalance (ERI) model [13] was shown to play an important role in current job content, which is characterized by increasing work flexibility and changing work environment [14,15]. The ERI model posits that workers are in a state of detrimental imbalance when high efforts at work are accompanied by low reward, and are thus more likely to have health problems [13].

Previous prospective studies on mental health problems mostly assessed the effect of ERI using only baseline measurement of exposure [16-20]. Using repeated measures of exposure to adverse work factors over time (or chronic exposure) was shown to be highly relevant. Firstly, repeated measures of exposure provide the opportunity to take into account changes in exposure occurring over time [10,19], and to identify chronically exposed workers who may have a higher risk than workers exposed only once [21]. Secondly, repeated measurements of the outcome during follow-up give the opportunity to evaluate whether the effects of exposure persist (or not) over time [25]. Persistence refers to the fact that the effects observed at one specific time remains of similar amplitude over a longer follow-up duration (whether or not exposure ceases) [21]. Therefore, persistence of the effects can be opposed to the habituation hypothesis, which suggests that the effect of exposure attenuates over time [26].

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Although such attenuation have been reported for psychosocial factors from the demand-control (DC) model [25,27,28], no previous studies evaluated the persistence of the effects of chronic ERI on mental health. Moreover, all three studies on chronic exposure to ERI and mental health problems [22–24] were limited by i) low participation rates (from 40% to 62% [22–24]), which can lead to a potential selection bias; ii) a short follow-up time (one year [22] or two years [23,24]) which does not allow an exploration of long-term effects, and iii) a single measurement of mental health during follow-up [22,23]. Empirical data on this issue could have important implications for promotion and implementation of workplace interventions.

The current study addresses this gap in knowledge by simultaneously using, for the first time, repeated measurements of exposure and outcome over five years. The objectives of the present study were to evaluate: 1) the effect of chronic exposure to ERI on the prevalence of high psychological distress among white-collar workers and 2) to evaluate the persistence of this effect over five years.

1. Methods

1.1. Study design and population

The current study used data from a large prospective cohort of 2335 white-collar workers from three public organizations in Quebec City, Canada. Their jobs encompassed the full range of white-collar positions (senior and middle managers, professionals, technicians and office workers). Participants completed a self-administered questionnaire on their work characteristics and psychological distress at their workplace. Data were collected three times: at baseline in 2000–2003, and then at 3- and 5-year follow-ups. The participation rate at baseline among the eligible population was high (80.8%) and relatively few losses at

follow-up occurred (14% at three years and 26.9% at five years). The current study was restricted to workers who participated at all three data collections and met the following criteria at baseline: i) had <2 missing items on the effort, reward and Psychiatric Symptom Index (PSI) scales; ii) working for the organization for ≥3 months; iii) working ≥21 h per week and iv) not pregnant. The selected participants at baseline were then followed longitudinally, retaining retirees. Applying similar selection criteria at time 2 and 3 (Fig. 1), the current study population included 1747 participants. This study was approved by the ethical review board of the *Centre Hospitalier Affilié* of Quebec City.

1.2. Effort-reward imbalance

The French version of the ERI scale was used to assess adverse psychosocial work factors [13,29]. Its psychometric qualities and 1-year stability have been demonstrated previously [29]. Efforts at work refer to aspects of the work task including overtime, frequent interruptions, and time pressure. This scale was measured using three items from the ERI scale ("having to do overtime", "in recent years, my job became more demanding" and "my task is often interrupted before I finish it, so I must come back to it later") [13], and one rephrased item ("I have enough time to do my job") from the Demand scale of the Job Content Questionnaire [30] (Cronbach $\alpha = 0.69$ [13]). Reward was assessed using the 11 original items recommended by Siegrist [13] divided into three scales: esteem (five items), promotions and salary (four items), and job security (two items). All items used a 4-point Likert-type response format, ranging from 1 (strongly disagree) to 4 (strongly agree) [29]. The separate scores were each calculated as the sum of their respective item scores, divided by their number of items. The ERI score is the ratio of effort to reward. Workers with a ratio above 1.0
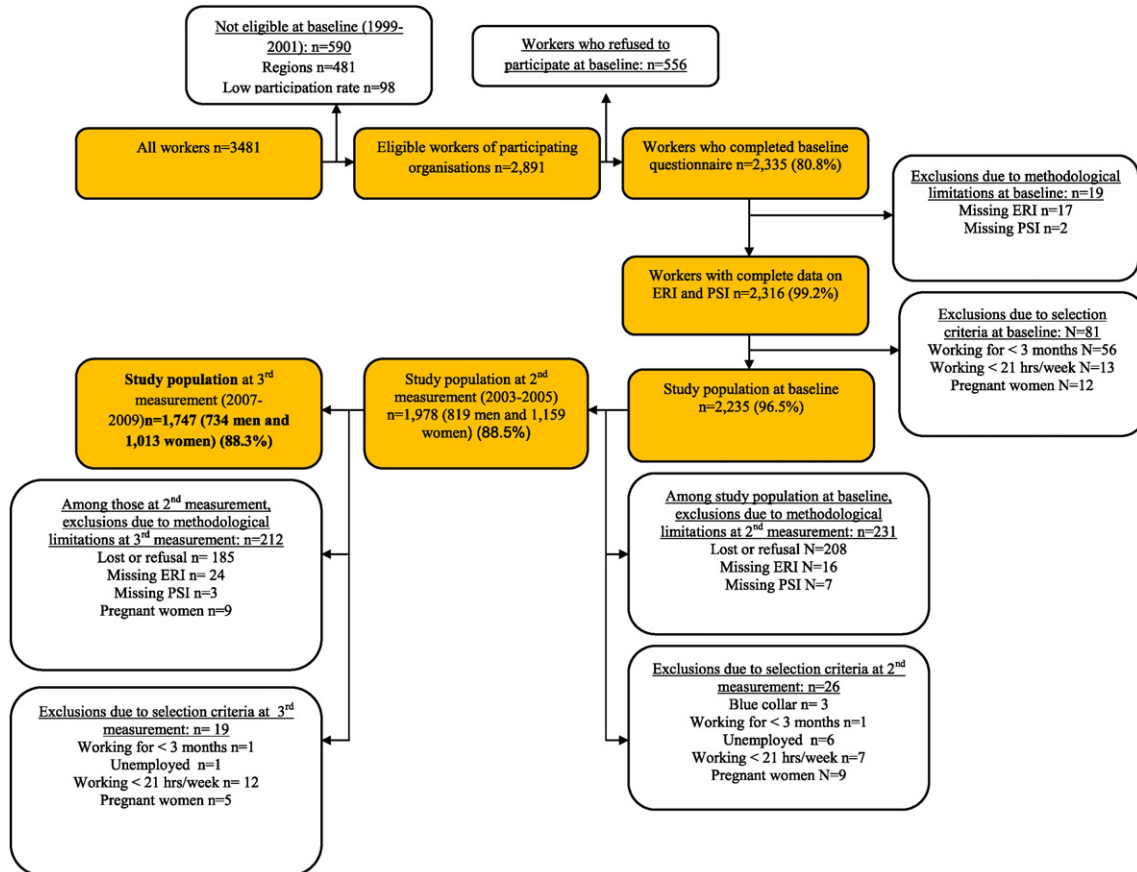

Fig. 1. Selection process of the population.

were defined as exposed [13]. Effort and reward scores were categorized in tertiles when considered separately.

To assess chronic exposure to ERI, workers were classified using the binary (1/0) exposure variables at each time point. For the 5-year follow-up, workers were classified as either being never exposed (0, 0, 0) (reference group); having cessation of exposure (1, 0, 0 or 1, 1, 0), having intermittent exposure (0, 1, 0 or 1, 0, 1); having onset of exposure (0, 1, 1 or 0, 0, 1) or being always exposed (1, 1, 1: called repeated exposure). The same strategy was used to define chronic exposure over three years. Workers who retired during follow-up (n = 219) were classified as unexposed at follow-ups as discussed below.

1.3. Psychological distress

Psychological distress was measured using the French version of the validated 14-item version of the Psychiatric Symptom Index (PSI) [31–33]. The PSI assesses the presence and intensity of four groups of symptoms (anxiety, depression, aggressiveness, minor cognitive impairment) during the previous week. The factor validity and the reliability of the French version of the PSI has been demonstrated (65% of variance of the items and Cronbach $\alpha = 0.91$, respectively) [32]. Using the quintiles of the general Quebec population [34], high psychological distress was defined as a score ≥ 80th percentile in 1987. This cut-off corresponded to the upper tertile of the current sample. Scores above this cut-off have good concurrent validity with other mental health indicators such as hospitalization and psychotropic medication [32,33,35].

1.4. Covariates

Several characteristics at baseline were considered as potential confounders including socio-demographic characteristics (gender, age, education (secondary school or less, community college or university)), job type (clerical, technician, professional, executive) and living situation (living with a partner or not). Psychosocial factors outside work included the number of children, the share of domestic work and stressful events over the past 12 months (including illness, divorce, death, financial difficulties) [36]. Home load was defined by an index based on the individual's living situation, number of children and share of domestic work (in tertiles) [36]. Lifestyle characteristics considered were cigarette smoking (≥1 cigarette/day), alcohol drinking (number of times per week), sedentary behavior (leisure time physical activity ≤1 time/week) and body mass index (BMI) in kg/m^2 (<25, 25–27, ≥27). Job strain (high psychological demands combined with low decision latitude) was measured using a validated questionnaire [28,30].

1.5. Statistical analysis

Baseline characteristics of men and women were compared using Chi-square. Given that women are more exposed to adverse psychosocial work factors [5,37] and also reported more mental health problems than men [5,38] in industrialized countries, all analyses were performed by gender. Log-binomial regression was used to measure the association between ERI and psychological distress. Prevalence ratios (PRs) were computed with 95% confidence intervals (CIs). Model 1 was crude. Model 2 included all covariates (except job strain as discussed below). Complementary analyses evaluating the prospective effects of single baseline exposure were performed in order to explore whether the effects of repeated ERI were stronger than the effect of baseline ERI exposure. Moreover, cross-lagged analyses of the association between chronic ERI and psychological distress contributed to estimate the impact of a potential common method bias and reinforce the longitudinal design of the current study [19,39,40].

Five sensitivity analyses were also performed. First, cigarette smoking, alcohol drinking, sedentary behavior and BMI were excluded from the model to evaluate an eventual over-adjustment [21]. Second, analyses excluding retirees during follow-up (n = 219) were

performed to check for a potential selection bias. Indeed, although we hypothesized that retirees were unexposed to ERI, it cannot be ruled out that retirement might be associated with the outcome (Appendix B) [41–43]. Third, it has been mentioned that the current definition of chronic exposure might lead to misclassification error by depending on crossing a normative score [44]. We thus hypothesized that a potential misclassification could be handled by excluding workers with an ERI ratio around the cut-off. Fourth, an adjustment for job strain of the DC model was also explored given that i) the ERI [13] and the DC [28] models overlap to some extent [45], and ii) both have been associated with mental health [9,10]. Fifth, given that prevalent cases at baseline were not excluded, we further adjusted for baseline psychological distress to minimize the possibility of a reverse causality. However, it is possible that baseline differences in the outcome might be related to previous work exposure in occupational observational studies [21]. Also, using self-reported outcome in the current study (compared to objective measure) might have led to measurement error. In such context, excluding prevalent cases or adjusting for the initial value of the outcome may introduce a bias related to a horse-racing effect [46,47]. All analyses were performed using SAS V.9.2 software.

2. Results

Overall 25.8% of men and 37.8% of women had high psychological distress in the current sample of white-collar workers. Men were more likely to hold professional and executive jobs, smoke, and have sedentary behavior. Women were less educated, had lower BMI, drank less alcohol, and reported more stressful events and greater home

Table 1
Baseline characteristics of participants by gender.

	Men	Women
	916 (41.0)	1319 (59.0)
Age (years)		
21–39	200 (21.8)	352 (26.7)
40–49	402 (43.9)	706 (53.5)
50–65	314 (34.3)	261 (19.8)
Education level		
Secondary degree or less	151 (16.5)	443 (33.6)
College degree	262 (28.6)	403 (30.5)
University degree	503 (54.9)	473 (35.9)
Occupation type		
Clerical	142 (15.5)	514 (39.0)
Technician	202 (22.0)	390 (29.7)
Professional	496 (54.2)	369 (28.0)
Executive	76 (8.3)	44 (3.3)
Frequency of stressful events in the past year		
0	500 (54.9)	582 (45.5)
1	292 (32.1)	443 (34.7)
2–5	118 (13.0)	253 (19.8)
Marital status		
Married/common law	675 (74.1)	897 (68.1)
Divorced/single	224 (24.6)	385 (29.2)
Other	12 (1.3)	35 (2.7)
Home load		
Low	311 (34.1)	321 (24.5)
Intermediate	386 (42.3)	458 (34.9)
High	215 (23.6)	532 (40.6)
Alcohol intake (times/week)		
0–1	269 (29.4)	505 (38.3)
1–10	507 (55.5)	727 (55.2)
11–26	138 (15.1)	86 (6.5)
Smoker (yes)	112 (12.2)	198 (15.0)
Body mass index (kg/m^2)		
15.60–24.99	297 (32.5)	707 (54.4)
25.00–26.99	205 (22.5)	185 (14.2)
27.00–46.87	411 (45.0)	409 (31.4)
Physical activity ≤1 time/week	487 (53.3)	588 (44.8)
Effort-reward imbalance	251 (27.4)	358 (27.1)
High psychological distress (%)	238 (26.0)	499 (37.9)

Values are n (%).

Table 2
Prevalence ratios (95% confidence intervals) of high psychological distress at 3-year and 5-year follow-ups according to chronic ERI, by gender.

	At 3-year follow-up			At 5-year follow-up		
	N	Model 1	Model 2	N	Model 1	Model 2
Men						
No exposure	484	1.00	1.00	403	1.00	1.00
Cessation of exposure	112	1.09 (0.71–1.68)	1.09 (0.72–1.66)	122	1.88 (1.29–2.74)	1.89 (1.30–2.74)
Intermittent exposure[a]	–	–	–	81	2.14 (1.43–3.21)	2.18 (1.46–3.27)
Onset of exposure	115	2.38 (1.78–3.20)	2.35 (1.75–3.15)	68	2.25 (1.48–3.41)	2.19 (1.44–3.32)
Repeated exposure	108	2.00 (1.44–2.77)	1.97 (1.44–2.69)	60	2.08 (1.32–3.28)	1.91 (1.20–3.04)
P for trend[b]		0.045	0.032		0.069	0.022
Women						
No exposure	694	1.00	1.00	541	1.00	1.00
Cessation of exposure	164	1.81 (1.48–2.21)	1.80 (1.47–1.89)	172	1.35 (1.03–1.76)	1.28 (0.98–1.68)
Intermittent exposure[a]	–	–	–	106	1.46 (1.07–1.98)	1.40 (1.03–1.90)
Onset of exposure	143	1.78 (1.44–2.20)	1.76 (1.42–2.19)	112	1.80 (1.30–2.35)	1.68 (1.29–2.17)
Repeated exposure	158	2.16 (1.80–2.59)	2.02 (1.68–2.44)	82	2.78 (2.22–3.46)	2.48 (1.97–3.11)
P for trend[b]		<0.01	<0.01		<0.01	<0.01

Model 1: crude association; Model 2: adjusted for age, education, marital status, stressful events, home load, smoking, BMI, sedentary behavior and alcohol intake.
[a] This category was not defined for 3-year follow-up.
[b] P for trend was estimated using three main categories (no exposure, repeated exposure, and transition exposure (which included exposure cessation, exposure onset, and intermittent exposure).

load than men. No meaningful gender difference was observed for ERI exposure (Table 1).

Table 2 presents PRs of high psychological distress at 3- and 5-year follow-ups according to chronic exposure to ERI over three and five years, respectively. For each exposure category, the prevalence of high psychological distress at follow-up was compared to the prevalence among never exposed workers.

Compared to never exposed workers, those with repeated exposure had a two times higher prevalence of psychological distress at 3-year follow-up; PR = 1.97 95% CI 1.44–2.69 for men and 2.02 95% CI 1.68–2.44 for women. Regardless of gender, exposure onset at 3-year follow-up was also associated with a higher PR of psychological distress. A high prevalence of psychological distress at 3-year follow-up was found among women (PR = 1.80 95% CI 1.4–1.89) but not men (PR = 1.09 95% CI 0.72–1.66) having exposure cessation.

Most effects observed at the 3-year follow-up persisted at the 5-year follow-up. More specifically, repeated exposure over 5 years was associated with a higher prevalence of psychological distress among men (PR = 1.91 95% CI 1.20–3.04) and women (PR = 2.48 95% CI 1.97–3.11), compared to unexposed men and women at 5-year follow-up respectively. The associations between exposure onset and psychological distress at 5-year follow-up also remained of similar amplitude than at 3-year follow-up for men and women. However, the association between exposure cessation to ERI and psychological distress at 5-year follow-up notably increased among men (+0.80) and lowered among women (−0.52), compared to the 3-year follow-up. Furthermore, intermittent exposure was associated with psychological distress in men

(PR = 2.18 95% CI 1.46–3.27) and women (PR = 1.40 95% CI 1.03–1.90) at 5-year follow-up.

A trend test was used to evaluate the relationship between chronic exposure and high psychological distress. For theses analyses, intermediary exposures (onset, cessation and intermittent exposure) were merged into a single category. Results suggest a dose-response trend between chronic exposure over five years and high psychological distress among men (p = 0.02) and women (p ≤ 0.01).

Table 3 presents the prevalence of high psychological distress at 3- and 5-year follow-ups according to single baseline exposure to ERI. Among men, the association between baseline ERI and psychological distress was 1.26 (95% CI 0.96–1.66) at 3-year and 1.61 (95% CI 1.22–2.12) at 5-year follow-up. Among women, these associations were respectively 1.69 (95% CI 1.45–1.98) and 1.54 (95% CI 1.28–1.84). These latter associations were mostly of smaller sizes than what was observed with chronic exposure to ERI, regardless gender. More specifically, repeated exposure was associated with a greater prevalence of high psychological distress than single baseline exposure, for men (respectively +0.71 and +0.30 at 3- and 5-year) and women (respectively +0.33 and +0.94 at 3- and 5-year).

Finally, sensitivity analyses excluding lifestyle characteristics (data not shown), and adjusting for job strain (Table 4) and baseline psychological distress (Table 4) provided no meaningful change (≤8%) in the PRs of the association between chronic ERI exposure and psychological distress. Moreover, most associations observed in Table 3 strengthened in sensitivity analyses excluding i) 10% of participants around the ERI cut-off (ratio ranging from 0.948 to 1.052) (data not shown) and ii)

Table 3
Prevalence ratios (95% confidence intervals) of high psychological distress at 3-year and 5-year follow-ups according to single baseline exposure to ERI, by gender.

	N[a]	At 3-year follow-up		At 5-year follow-up	
		Model 1	Model 2	Model 1	Model 2
Men					
No imbalance	533	1.00	1.00	1.00	1.00
Imbalance	201	1.29 (0.97–1.72)	1.26 (0.96–1.66)	1.66 (1.25–2.19)	1.61 (1.22–2.12)
Women					
No imbalance	729	1.00	1.00	1.00	1.00
Imbalance	284	1.77 (1.52–2.07)	1.69 (1.45–1.98)	1.61 (1.35–1.93)	1.54 (1.28–1.84)

Model 1: crude association; Model 2: adjusted for age, education, marital status, stressful events, home load, smoking, BMI, sedentary behavior and alcohol intake.
[a] The sample size was the same at each time.

Table 4
Sensitive analyses for prevalence ratios (95% confidence intervals) of high psychological distress at 3-year and 5-year follow-ups according to chronic ERI, by gender (adjusting for job strain and baseline psychological distress).

	At 3-year follow-up			At 5-year follow-up		
	N	Model A	Model B	N	Model A	Model B
Men						
No exposure	484	1.00	1.00	403	1.00	1.00
Cessation of exposure	112	1.04 (0.68–1.61)	0.88 (0.59–1.33)	122	**1.79 (1.22–2.63)**	**1.60 (1.12–2.28)**
Intermittent exposure[a]				81	**2.15 (1.43–3.22)**	**1.62 (1.12–2.35)**
Onset of exposure	115	**2.33 (1.73–3.13)**	**1.81 (1.38–2.38)**	68	**2.21 (1.45–3.35)**	**2.02 (1.34–3.05)**
Repeated exposure	108	**1.93 (1.39–2.68)**	**1.60 (1.19–2.16)**	60	**1.77 (1.10–2.85)**	**1.61 (1.05–2.47)**
P for trend[b]		0.029	0.022		0.024	0.041
Women						
No exposure	694	1.00	1.00	541	1.00	1.00
Cessation of exposure	164	**1.82 (1.48–2.24)**	**1.43 (1.19–1.71)**	172	1.20 (0.90–1.60)	1.03 (0.79–1.33)
Intermittent exposure[a]				106	1.34 (0.99–1.83)	1.17 (0.86–1.57)
Onset of exposure	143	**1.79 (1.43–2.23)**	**1.67 (1.36–2.06)**	112	**1.64 (1.26–2.13)**	**1.50 (1.16–1.94)**
Repeated exposure	158	**2.05 (1.66–2.53)**	**1.56 (1.32–1.85)**	82	**2.28 (1.77–2.95)**	**1.89 (1.51–2.37)**
P for trend[b]		<0.01	0.009		<0.01	<0.01

Model A: adjusted for age, education, marital status, stressful events, home load, smoking, BMI, sedentary behavior and alcohol intake and job strain. Model B: adjusted for age, education, marital status, stressful events, home load, smoking, BMI, sedentary behavior and alcohol intake and psychological distress at baseline.

[a] This category was not defined for 3-year follow-up; bold: p < 0.05.

[b] P for trend was estimated using 3 main categories (no exposure, repeated exposure, and transition exposure (which included exposure cessation, exposure onset, and intermittent exposure)).

retirees (Appendix C). However, analyses without retirees led to larger CIs, thus suggesting a decrease of the statistical power.

3. Discussion

In the present prospective study conducted among Canadian workers employed in white collar occupations, men and women having repeated exposure to ERI had a high prevalence of high psychological distress at follow-up. Compared to never exposed workers, those with exposure onset and exposure cessation also had a higher prevalence of high psychological distress at follow-up. The deleterious effects observed at 3-year persisted at 5-year follow-up, regardless of gender. Moreover, the effect of repeated exposure to ERI was stronger than those observed with single baseline ERI exposure among these white-collar workers, regardless of gender.

3.1. Chronic exposure to adverse work factors and mental health

The deleterious effects of repeated ERI on high psychological distress found in the current study are consistent with previous studies measuring repeated exposure to adverse psychosocial factors, either ERI [22,24] or job strain [25,27]. Moreover, these results also confirm previous findings on other categories of ERI exposure over time. Indeed, exposure onset – that is, changing from no exposure to exposure – led to a higher prevalence of high psychological distress than did the reverse change, from exposure to no exposure [22,24]. Similar pattern has also been previously for job strain exposure [25,27]. Exposure cessation (and intermittent exposure) to ERI nonetheless led to a higher prevalence of mental health problems than no exposure, as already found in previous studies [22–24]. This latter finding suggests that the adverse effect of ERI might be such that mental health symptoms are not resolved immediately after a beneficial change in working conditions occurred. In line with our results, the prevalence of major depressive disorder associated with job strain did lowered immediately after a beneficial change in psychosocial work factors occurred [25].

It has been argued that people chronically exposed to a stressor might become adapted to that stressor over time, including adverse psychosocial work factors [25,27,48]. Adaptation to a stressor refers to the habituation hypothesis, suggesting that an individual can get used to repeated stress. In this context, the magnitude of the hypothalamic-pituitary-adrenal (HPA) activation occurring in response to a stressor

would decline with repeated exposure to that same stressor [26]. In other words, the hypothesis of habituation suggests that the effect of ERI might attenuate over time among chronically exposed workers. Three main observations from the current results suggest a lack of adaptation to ERI exposure: i) the strong association of ERI with high psychological distress found among workers with repeated exposure, ii) the persistence of the effect at five years and iii) the dose-response trend for chronic exposure. Furthermore, our results are not consistent with those of two previous studies reporting an attenuation of adverse effects of single baseline exposure to job strain [25,27]. Concerning the persistence of the effect, our results are consistent with one study on job strain, another psychosocial work factor, reporting that the risk of depression remained stable or tended to increase over time among workers with repeated exposure, compared to never exposed workers [27]. Since no previous studies on chronic exposure to ERI [22–24] have assessed ≥2 follow-ups using the same outcome within the same population, the possibility of comparing their results with the current ones is limited. Future studies with several measurement of exposure and outcomes are needed to evaluate these time related etiological processes.

The present study also provides useful information on possible gender differences among white-collar workers concerning the risk associated with exposure status over time. As reported in one previous study, exposure onset was associated with the highest prevalence of mental health problems among men, whereas the highest prevalence was observed for repeated exposure among women [22]. One explanation might be that women were more responsive to repeated exposure than men [22]. Also, women of the current study experienced significantly more stressful events and more home load which might have increased their vulnerability to psychological distress in the presence of ERI exposure. Furthermore, the association of exposure cessation and psychological distress was moderate at 3-year and strengthened at 5-year among men. This pattern was different among women who had a moderate but not statistically significant association between exposure cessation and psychological distress at 5-year whereas a significant association was found at 3-year. These latter observations suggest that removing or decreasing exposure might not reverse symptoms in the same way for men and women [22]. For women, it have been suggested that they tend to choose jobs which allow spending enough time with their family [49]. Therefore, it is plausible that women with exposure cessation may spend more time with their family and better enjoy it

than when they were exposed. In such context, social support outside work may attenuate the deleterious effect of previous exposure to ERI [50]. This might not be relevant for men of our cohort. Since more men than women hold professional and executive jobs in the current cohort, it is possible that male managers might have more control to temporally manage their time with family but less opportunity to do it in a long term course. These potential gender differences need further investigation.

3.2. Baseline versus chronic exposure to ERI

Given that baseline exposure to ERI has an effect on high psychological distress at follow-ups among white-collar male and female workers, current findings support previous empirical studies evaluating such effect [9,10,51,52]. However, it was argued that a single measurement of psychosocial work factors [25] might underestimate the deleterious effect of a stressful work environment [19,20, 24,25]. This makes sense in the current context of changing work environments and job flexibility, where reward at work was shown to play an important role in job content [14,15]. For the first time, the current study explored the effect of single and repeated exposure to ERI within the same population of white-collar workers. Given that the effect of repeated exposure in main analyses seemed to be stronger than the effect of single baseline exposure, cross-lagged analyses were performed to evaluate the amplitude of a potential inflation of our estimates due to common method biases. Indeed, this measurement error mostly occurs when exposure and outcome are both self-reported and closer in time [19,21,53]. Current cross-lagged analyses estimated the outcome at 5-year follow-up (time 2) according to chronic exposure at 3-year follow-up (baseline and time 1) (see appendix A). Unsurprisingly, there was a decrease of PRs for repeated exposure at 3-year follow-up in the cross-lagged design compared to main analyses (up to −0.35 for men and −0.23 for women). However, these latter effects of repeated exposure were still greater than effects observed using single baseline exposure (+0.32 among men and +0.10 among women). Therefore, current findings do not directly suggest that single baseline ERI might underestimate the effect of ERI. Rather, they showed that repeated exposure over time provide more precise estimates of the risk chronically exposed workers, who may have a higher risk of mental health problems than workers exposed only once [19,24,25].

3.3. Other considerations

Sensitivity analyses adjusting for job strain and baseline psychological distress mostly provided similar PRs as main results, thus supporting respectively an independent effect of chronic ERI (from job strain) on the outcome [45] and the causal interpretation of our main results [54]. Given that no previous studies on this topic controlled for other adverse psychosocial [22–24], future studies are needed to confirm current findings. Furthermore, since most PRs increased in analyses excluding participants with ERI ratio around the cut-off, it is plausible that workers with borderline scores that crossed the threshold were mainly unexposed people who became exposed rather than the reverse (exposed becoming unexposed). Potential misclassification error might thus have underestimated the effect of chronic ERI in the current study [44]. Finally, results from analyses excluding retirees during follow-up also suggest an underestimation of our main estimates. These latter results provide support to the internal validity of the current study.

3.4. Limitations and strengths

The current study has some limitations. First, not all the original items of the effort scale were available. Although, the internal validity of the current version was acceptable, the effect of effort at work might have been underestimated [51]. Future studies should consider using a more comprehensive set of items to assess efforts at work. Second, chronic exposure was based on the dichotomization of the original scores which could have led to an underestimation of estimates as previously mentioned. Third, the introduction of a common method bias in our data is plausible. Cross-lagged sensitive analyses suggested that an overestimation of small amplitude cannot be ruled out. Fourth, a potential selection bias might have been introduced by restricting the current analyses to white-collar workers involved at baseline and both follow-ups. Comparisons of participants at all three time-points to other participants according to their baseline characteristics showed similar proportions for age, job strain and high psychological distress. However, those who did not participate at all time-points were mostly women, clerical employees, divorced or single, and less exposed to ERI (data not shown). Finally, the generalization from this study is limited to the white-collar working population.

The current study also has important methodological strengths. First, this study had a three-wave prospective design, high participation rates at each time, and a large sample of white-workers with various job types. Second, the causal interpretation of current results is reinforced by the long follow-up period, the adjustment for multiple covariates and the consistency of our results with sensitivity analyses. Third, the current definition of exposure took into account both the intensity and the duration of exposure [12,21,44]. Indeed, our definition assumed that i) repeated exposure is a proxy measure of increased duration of exposure, although it cannot be completely ruled out that exposure status may have changed between measurements [25], and also that ii) that the dose-response trend is a proxy of exposure intensity [21]. Sensitivity analyses using other chronic exposure definitions [23,24,44] provided similar results (data not shown). Finally, this is the first study evaluating the persistence of the effects of chronic exposure to ERI on mental health problems over time.

3.5. Implications

Since psychological distress is an early stage of severe mental problems [5,6,34], primary prevention aimed at reducing exposure to these adverse work factors may greatly contribute to reducing mental health problems. By suggesting that workers might not get used to these factors over time, current findings provide insights of the relevance to also consider secondary prevention. The aforementioned secondary interventions might contribute to i) reducing mental health problems among chronically exposed workers, and ii) reducing repeated exposure among workers with mental outcomes or returning to work after a medical absence for mental health problems (as it has been shown for CVD [55,56]). Indeed, in the current context of increasing work flexibility, intensity and changing work organization, minimizing repeated exposure to these adverse work factors among vulnerable workers can be a first step when it is impossible to quickly avoid such exposure.

4. Conclusion

The current study showed a deleterious effect of repeated exposure to ERI on high psychological distress, regardless gender. Moreover, there was a lack of adaptation to repeated exposure as the deleterious effects of ERI persisted over time. Finally, the effect of chronic exposure tends to be greater than the effect of single exposure. Future studies should evaluate the persistence of the effect of chronic exposure on psychological distress and other more severe and certified mental health outcomes.

List of the author's contributions to the study

R. Ndjaboue supervised and synthesized the data analyses and led the writing. C. Brisson originated and supervised all aspects of the study. M. Vezina supervised the aspects of the study related to mental

health measurement and supervised the public health issues of the study. D. Talbot participated to data analyses. All authors participated in reviewing and drafting the article.

Competing interests

The authors have no competing interests to report.

Acknowledgments

Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.jpsychores.2017.01.001.

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