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Combined exposure to adverse psychosocial work factors and medically certified absence for mental health problems: A 5-year prospective study

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1. Introduction

Mental health problems (MHP) represent one of the leading reasons (15.1 to 18.7%) for visiting a general practitioner in the United States and Canada [1,2]. In industrialized countries, these problems are the second leading cause of medically certified absences from work [3–5]. Depression, a major cause of absence [6] and disability [7], is estimated to cause 200 million lost workdays each year in the United States [8].

Adverse psychosocial work factors have been identified as important risk factors self-reported MHP [9–11]. These factors are mostly measured using two validated theoretical models: the Demand-Control (DC) [12] and the Effort-Reward Imbalance (ERI) models [13]. The DC model suggests that workers simultaneously experiencing high psychological demands and low job control, i.e. high strain, are more likely to develop stress-related health problems [12]. The ERI model posits that workers are in a state of detrimental imbalance when high efforts at work are accompanied by low reward, and thus have a higher risk of deteriorating health [13]. It has been pointed out that both models are complementary for explaining health problems because they identify specific aspects of the work environment [12–16]. Using both models simultaneously is highly relevant for two main reasons. First, it offers the opportunity to evaluate the contribution of each model – while taking into account the other model – for explaining the same issue (independent effect) [14,15]. Second, it allows the identification of workers exposed simultaneously to factors from the DC and ERI models (combined exposure) who may have a higher risk of MHP than subjects exposed to a single exposure [15].

Previous studies that evaluated these two models and mental health mainly used self-reported measures [10,11]. Using self-reported measures for both the exposure and the outcome may induce a measurement error called common method bias [17,18]. This bias usually leads to an overestimation of effects [19], which can be avoided by employing objective measures, such as medically certified absence for MHP [18,19].

Although some studies assessed the effect of the DC and ERI models on medically certified absence for MHP [3,20–25], their independent effect have rarely been evaluated [23,24] and only one previous study evaluated their combined effect [24]. This previous study was limited by a retrospective design, a small sample size ($n = 385$) and a restriction to workers with disabling diseases.

The present study addresses this gap in knowledge while simultaneously using an objective measure of MHP, a prospective design and a large sample of workers. The objectives are to examine: 1) the independent and 2) the combined effect of adverse psychosocial work factors from the DC and ERI models on medically certified absence for MHP among white-collar workers.

2. Methods

2.1. Study design and population

White-collar workers from three public organizations in Quebec City, Canada, were invited to participate to the current study. The participants completed a self-administered questionnaire on work characteristics at baseline, and again three and five years later. New workers in the organizations at the 2nd and 3rd measurements were invited to participate. Participation rate were 80.9% at baseline, and 86%, and 85% at 3- and 5-year follow-up, respectively. The current study sample was composed of 2273 workers who participated in at least one of the three measurements. Participants had different occupations, including senior management, professional positions, technical jobs and office jobs. Workers who did not provide informed consent for collection of their absence data ($n = 12$), left the organization soon after baseline data collection (no follow-up for them) ($n = 24$), did not have matched data for work factors and sickness absence ($n = 5$) and had ≥2 missing data on any of the psychosocial factors scales ($n = 13$) were excluded. Analyses were further restricted to workers who met the following criteria: 1) being <60 years old; 2) not having a medically certified absence of ≥ 5 workdays for MHP during the 12 months before baseline assessment (in order to exclude prevalent cases); 3) working at least 21 h per

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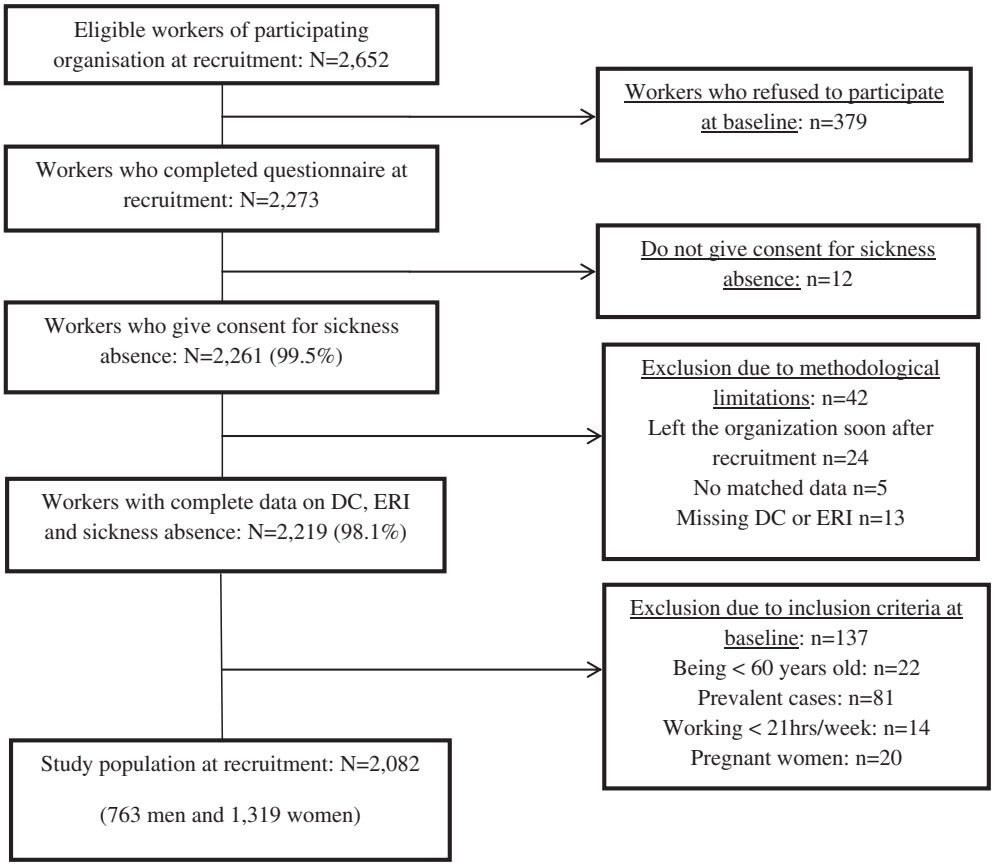

Fig. 1. Selection of the study population

week and 4) not pregnant (Fig. 1). A total of 2082 workers were considered for analyses.

2.2. Medically certified absence for MHP

Medically certified absences collected from the employers' files included the diagnosis, the exact date of onset and duration of each episode. For each episode ≥5 workdays, workers had to provide a medical certificate from a physician to their employer. When the diagnosis was unavailable (15.07% of episodes), the related health problem(s) was collected from the workers by telephone interviews. Overall, 9.7% of all absences remained without any diagnoses, either because participants could not be reached or did not remember the reason for the absence, and were excluded. Diagnoses on medical certificates were coded by a medical archivist using these ICD-10 codes: F10-F19; F30-F39; F40-F48; F50-F59; F60-F69; F99. In addition, occupation-related health problems (code Z56.7), non-specific sleep problems (code G47.9), professional harassment (Z65.8), fatigue, asthenia, burnout and professional exhaustion (code R53) were classified as MHP (see Appendix A). Medically certified absence for MHP lasting ≥5 workdays was the main outcome of the present study. Each subject could contribute more than one event to the analyses. Overlapping and consecutive spells of absence for MHP (<30 working days between two episodes) were merged into a single spell.

2.3. Demand-Control

Psychological demands and job control were measured using the 18 items of the validated French version of the Job Content Questionnaire [26,27] whose psychometric qualities have been demonstrated [28–30]. Response scales ranged from 1 (strongly disagree) to 4 (strongly agree). For participants having ≤2 missing items on one scale, an imputation score based on the mean of their answered items was applied. Psychological demands and job control scales were dichotomized using the median for the general population of Quebec as the cut-off point [31]. The proposed quadrants method was used to classify subjects in four groups [26,27]. Exposure to high strain was thus defined as a combination of high psychological demands and low job control. Other workers were classified as unexposed for analyses using the binary job strain. Psychological demands and job control were categorized in tertiles when considered separately.

2.4. Effort-reward imbalance

Efforts were measured using two original items of the French version of the Siegrist questionnaire ("over the past few years, my job has become more and more demanding" and "I am regularly forced to work overtime") [13] and two proxies ("my tasks are often interrupted before they can be completed, requiring attention at a later time" and "I have enough time to do my work") [26]. Reward was evaluated using the original 11 items of the Siegrist questionnaire. Reward was divided into three scales: esteem (five items), promotions and salary (four items), and job security (two items) [13]. Psychometric qualities and 1-year stability of this French version have been demonstrated [32]. Response scales ranged from 1 (strongly disagree) to 4 (strongly agree) [32]. For participants having ≥2 missing items on one scale, an imputation score based on the mean of their answered items was applied. The separate efforts and reward scores were each calculated as the sum of item scores, divided by their number of items. The ERI score is the ratio of efforts to reward. Workers with ratio > 1 were considered as having an imbalance [13]. Efforts and reward scores were also categorized in tertiles when considered separately.

2.5. Combined exposure

To assess combined exposure to high strain and ERI, workers were classified using binary (1/0) exposure variables for both job strain and ERI. Then, the respondents were divided into four categories: i) those exposed to neither DC nor ERI (reference group), ii) those exposed to high strain only, iii) those exposed to ERI only, and iv), those exposed to both factors (combined exposure). For analyses using low reward and low job control, the lowest tertile was considered as the exposed category.

2.6. Covariates

Several covariates were considered: gender, age, education, job category, living situation, home load and stressful events over the past 12 months (e.g., divorce, death, financial difficulties) [33], cigarette smoking, alcohol drinking, sedentary behavior and body mass index (BMI) in kg/m^2.

2.7. Statistical analyses

The Andersen-Gill Cox regression model was used for multivariate analyses because it allows modeling time-dependent exposures and multiple events for one subject [34]. To compute hazard ratios (HR) and their 95% confidence intervals (CI), person-years were calculated from the date of each questionnaire until the first of the following events, whichever came first: i) the first medically certified absence of ≥5 workdays for MHP, ii) the participant definitively left the organization (e.g., retirement or quitting the organization), iii) the end of the follow-up, or iv) the date of the next questionnaire. When a participant experienced an absence for MHP, its person-years were no more computed from the end of this absence until the next questionnaire administration. Absences for other health problems were not considered as an endpoint. The period during which workers were absent for other medical reasons or were temporarily outside the pay management system were excluded from the person-years at risk. The proportionality assumption was assessed and confirmed. Analyses were done in three steps. First, the effect of high strain and ERI were analysed separately. Second, the independent effect of each factor was evaluated while adjusting for the other. Third, their combined effect was evaluated as main analyses while comparing workers exposed simultaneously to both factors to those unexposed.

Given that both models overlap to some extent but also identify specific adverse work factors [15], complementary analyses were performed while using the specific dimension of each model. Three complementary definitions of combined exposure were thus considered: i) high strain and low reward, ii) ERI and low decision latitude and iii) low decision latitude and low reward [3,35,36]. Model 1 was crude and Model 2 was fully adjusted for covariates. Given that women are more exposed to adverse psychosocial work factors [37] and report twice more MHP than men [38], analyses were conducted separately by gender. Analyses were performed using SAS V.9.4 software.

3. Results

Table 1 presents baseline characteristics of participants. The incidence density of medically certified absences for mental health problems was lower among men than women (respectively 2.03 and 4.50 per100 person-years). Depression represents the most frequent diagnosis of mental health problems in our study population (see Appendix A). Men had a higher prevalence of professional and executive jobs, and university degree. Women were more likely to maintain a sedentary lifestyle, had lower BMI, drank less alcohol and smoked less. Women also reported more stressful events and had greater home load than men. No meaningful gender difference was observed for ERI. High strain was less prevalent among men than women. Overall, 12.3% of participants had combined exposure to high strain and ERI (10.2% among men and13.6% among women).

Table 1
Baseline characteristics of participants, by gender.

	Men 763 (36.65)	Women 1319 (63.35)	*P* value
Age (years)			
21–40	222 (29.10)	473 (35.86)	<0.0001
40–49	329 (43.12)	629 (47.69)	
50–65	212 (27.79)	217 (16.45)	
Education level			
Secondary degree or less	93 (12.19)	398 (30.20)	<0.0001
College degree	246 (32.24)	446 (33.84)	
University degree	424 (55.57)	474 (35.96)	
Occupation type			
Clerical	110 (14.42)	511 (38.74)	<0.0001
Technician	181 (23.72)	396 (30.02)	
Professional	410 (53.74)	360 (27.29)	
Executive	62 (8.13)	52 (3.94)	
Frequency of stressful events in the past year			
0	413 (54.13)	588 (45.58)	<0.0001
1	248 (32.50)	455 (34.50)	
2–5	97 (12.71)	240 (18.20)	
Missing	5 (0.66)	36 (2.73)	
Marital status			
Married/common law	552 (72.54)	878 (66.82)	0.0013
Divorced/single	203 (26.68)	403 (30.67)	
Other	6 (0.79)	33 (2.51)	
Homeload			
Low	253 (33.20)	342 (26.09)	<0.0001
Intermediate	323 (42.39)	450 (34.32)	
High	186 (24.41)	519 (49.59)	
Alcohol intake (times/week)			
0–1	229 (30.01)	518 (39.30)	<0.0001
1–10	423 (55.44)	722 (54.78)	
11–26	111 (14.55)	78 (5.92)	
Smoker	89 (11.66)	212 (16.07)	0.0065
Body Mass Index (Kg/m^2)			
15.60–24.99	249 (32.72)	735 (56.32)	<0.0001
25.00–26.99	169 (22.21)	171 (13.10)	
27.00–46.87	343 (45.07)	399 (30.57)	
Physical activity ≤ 1 time/week	321 (42.07)	635 (48.22)	0.0071
Effort-reward imbalance	208 (27.26)	374 (28.35)	0.6125
Demand-Control			
Low strain	138 (18.09)	160 (12.13)	0.0150
Passive job	242 (31.72)	521 (39.50)	
Active job	239 (31.32)	298 (22.59)	
High strain	144 (18.87)	340 (25.78)	
Combined exposure			
Unexposed	489 (64.09)	784 (59.44)	0.0701
High strain only	66 (8.65)	161 (12.21)	
ERI only	130 (17.04)	195 (14.78)	
High strain and ERI	78 (10.22)	179 (13.57)	
Incidence density of absence (/100 person-years)	2.03	4.50	<0.0001

Values are n (%).

Table 2 presents the risks of medically certified absence for MHP according to job strain (dichotomous and in quadrants) and ERI taken separately. No deleterious effect of high strain was found among men (HR = 0.68, 95% CI 0.31 to 1.49). A moderate risk was found among women having high strain (HR = 1.50, 95% CI 1.12 to 2.01) compared to the reference group. Further adjustment for ERI in the fully adjusted model slightly lowered the effect of high job strain among women. Among men, the effect of ERI on medically certified absence for MHP was weak (HR = 1.33, 95% CI 0.79 to 2.26). Further adjustment for job strain led to an increase (+23%) of the estimate among men with ERI but it still did not reach statistical significance (HR = 1.64, 95% CI 0.90 to 2.98). A higher risk was found among women having ERI (HR = 1.58, 95% CI 1.20 to 2.08), compared to unexposed women. After

Table 2
Hazards Ratios (95% Confidence intervals) of medically certified absence for mental health problems according to job strain and ERI.

	Model 1[a]	Model 2[b]	Model 3[c]
Men ($n = 1981$)			
High job strain			
No	1.00	1.00	1.00
Yes	0.89 (0.46 to 1.71)	0.71 (0.38 to 1.30)	0.60 (0.33 to 1.11)
Job strain quadrants			
Low strain	1.00	1.00	1.00
Passive	1.18 (0.58 to 2.40)	0.93 (0.47 to 1.85)	0.89 (0.45 to 1.73)
Active	0.95 (0.45 to 2.04)	0.96 (0.47 to 1.95)	0.76 (0.35 to 1.66)
High strain	0.93 (0.38 to 2.26)	0.68 (0.31 to 1.49)	0.50 (0.23 to 1.12)
ERI			
No	1.00	1.00	1.00
Yes	1.53 (0.85 to 2.73)	1.33 (0.79 to 2.26)	*1.64 (0.91 to 2.98)*
Women ($n = 3632$)			
High job strain			
No	1.00	1.00	1.00
Yes	**1.86 (1.44 to 2.41)**	**1.69 (1.29 to 2.21)**	**1.50 (1.12 to 2.01)**
Job strain quadrants			
Low strain	1.00	1.00	1.00
Passive	**1.67 (1.02 to 2.73)**	*1.59 (0.97 to 2.60)*	*1.57 (0.96 to 2.57)*
Active	*1.67 (0.99 to 2.82)*	*1.65 (0.98 to 2.79)*	1.45 (0.85 to 2.48)
High strain	**2.89 (1.77 to 4.72)**	**2.55 (1.55 to 4.20)**	**2.17 (1.28 to 3.69)**
ERI			
No	1.00	1.00	1.00
Yes	**1.66 (1.27 to 2.16)**	**1.58 (1.20 to 2.08)**	*1.34 (0.98 to 1.84)*

Results in bold: $p < 0.05$; Results in italic: $0.05 \leq p < 0.10$.
[a] Model 1: Crude association.
[b] Model 2: Adjusted for age, education, marital status, stressful events, home load, smoking, BMI, sedentary behavior and alcohol intake (categorizations as in Table 1).
[c] Model 3: Model 2 additionally adjusted for job strain or ERI.

adjustment for job strain, the risk slightly lowered among women with ERI (−15%) (HR = 1.34, 95% CI 0.98 to 1.84).

Table 3 presents the risk of medically certified absence for MHP according to job strain only, ERI only and combined exposure. Among men, there was no evidence of a deleterious effect of high strain only, ERI only and the combined exposure to both factors. Among women, a two-fold risk of medically certified absence for MHP was found for combined exposure to high strain and ERI (HR = 1.97, 95% CI 1.40 to 2.78) compared to no exposure. This combined effect was 16% higher than the effect of high strain only (HR = 1.70, 95% CI 1.14 to 2.52) and 30% higher than the effect of ERI only (HR = 1.52, 95% CI 1.03 to 2.22) among women.

4. Discussion

In the present study, there was no evidence of the independent and combined effects of job strain and ERI among men. In women, an independent effect of high strain and ERI on medically certified absence for MHP was found. Moreover, combined exposure to high strain and ERI led to a higher risk than independent effect.

4.1. Independent effect

In the current study, the effects observed for the DC model among women are in line with the theoretical background. The DC model posits that workers who simultaneously experienced high psychological demand and low job control (or high strain) have a higher risk of deteriorating health. Moreover, the fact that high strain remained strongly associated with the issue after further adjustment for ERI provides support for an independent effect of high strain on medically certified absence for MHP among women. Adjustment for low reward – the main ERI dimension not overlapping with the DC model [15] – instead of ERI did not meaningfully change the risk associated with high strain, also supporting this independent effect (Appendix B, model 4). This independent effect of high strain is consistent with previous findings examining self-reported [39] and medically certified absence for MHP [24].

The effect of ERI on women's mental health was also coherent with the conceptual framework [13]. However, this effect was marginally statistically significant after adjustment for job strain. One explanation might be the lack of statistical power. Furthermore, it has been argued that the ERI model might be more sensitive than the DC model for capturing a stressful work environment [14,39,40]. The main hypothesis being that occupational rewards, rather than job control, are now more meaningful because of increased job insecurity and flexibility [14,40]. Although this hypothesis is plausible, our results do not support it. Given that job control is a specific dimension of the DC model not assessed by the ERI model [12–16], the independent effect of ERI from job control was verified. Results showed that the effect of ERI didn't change after adjustment for job control (Appendix B, model 4). The current findings provide support for an independent effect of ERI from work factors from the DC model, as previously reported for physical health [41], self-reported MHP [42,43] and absence for MHP [24].

Table 3
Hazards Ratios (95% Confidence intervals) of medically certified absence for mental health problems according to combined exposure to job strain and ERI.

	Model 1[a]	Model 2[b]
Men		
No exposure	1.00	1.00
High strain only	0.76 (0.26–2.20)	0.67 (0.28–1.59)
ERI only	*1.64 (0.92–2.94)*	1.56 (0.90–2.70)
Combined exposure	1.22 (0.50–3.00)	0.88 (0.38–2.06)
Women		
No exposure	1.00	1.00
High strain only	**1.87 (1.29–2.73)**	**1.70 (1.14–2.51)**
ERI only	**1.56 (1.08–2.26)**	**1.52 (1.03–2.22)**
Combined exposure	**2.20 (1.58–3.07)**	**1.97 (1.40–2.78)**

Results in bold: $p < 0.05$. Results in italic: $0.05 \leq p < 0.10$.
[a] Model 1: Crude association;
[b] Model 2: Adjusted for age, education, marital status, stressful events, home load, smoking, BMI, sedentary behavior and alcohol intake (categorizations as in Table 1).

Finally, our findings concerning women's mental health might be partly explained by the fact that, women experienced significantly more stressful events and more home load which might have increased their vulnerability to mental health problems compared to men.

Among men, the estimation of ERI risk provided large confidence intervals around the null value. This suggests a lack of statistical power. Indeed, the number of incident absence was smaller among men ($n = 43$) than women ($n = 198$) having combined exposure. It thus remains unclear whether factors from the DC and ERI models are independent with regards to medically certified absence for MHP among men.

Considering that reward at work is a specific dimension of the ERI model not assessed by the DC model [15], the effect of low reward only was further examined. Results showed that men exposed to low reward had a two-fold risk of absence (Appendix C). Therefore, one might question the sensitivity of the DC model to capture adverse factors in men of our population. An interpretation could be that, since more men than women hold professional and executive jobs [37,44], male managers of this cohort might either: i) have more control to withdraw temporally from a stressful work environment, or ii) do presenteeism [45] due to fear of stigmatization if they report mental health conditions [46]. The stigmatization hypothesis being more plausible for MHP than physical problems in men [47]. Moreover, there seems to be a difference in job tasks by gender (even for jobs with the same title) [44] and therefore, it is likely that men held more challenging jobs with a lack of recognition [44,48]. Women may also have different values concerning work; they might attribute more importance, for example, to the social utility of their work instead of the remuneration [44]. Finally, it has been suggested that men may be more sensitive to low work-related reward than women because of the socio-cultural context. Given that women might be used to receiving less recognition than men for housework or caring for family members, low reward at work might have a less adverse effect on their mental wellbeing whether it might have a stronger adverse effect on men's mental wellbeing [23,44].

4.2. Combined effect of job strain and ERI

A central issue in occupational health research is whether two theoretical models can be considered advantageous to combine when measuring stressful work environment. Given that the DC and ERI models capture different aspects, their combined effect could provide additional insights about the effect of the psychosocial environment on health [14].

In the present study, the fact that the risk of medically certified absence for MHP was strong among women with combined exposure suggests that combined exposure might lead to higher risk of MHP compared to single exposure. Complementary analyses using alternative definitions of combined exposure to i) job strain and low reward, ii) ERI and low job control, iii) low reward and low job control, led to similar results (Appendix D). Given that job control and reward at work have been identify as specific dimensions of the DC and ERI models which do not overlap [3,15,35,36], these findings provide additional support to the usefulness of considering combined exposure to adverse psychosocial work factors when examining risk factors of MHP.

Furthermore, our results suggest a potential interaction between factors from the DC and ERI models. Therefore, an interaction term between job strain and ERI was entered in the final model in order to test for a multiplicative interaction. The results showed no interaction in a multiplicative scale. However, a negative interaction was found in the additive scale using the Relative risk estimate due to interaction (RERI) method [49]. In such context - when two factors have independent effects on the outcome but there is no positive interaction- it was suggested to always take into account the importance of one factor when evaluating the other factor [49].

Only one retrospective study assessed the effect of combined exposure to psychosocial work factors from both models on medically certified absence for MHP [24]. This previous study reported a higher risk among workers with combined exposure, compared to unexposed workers. However, it was limited by a possible memory bias of exposure, a small sample size, a restriction of the population to workers with disability diseases and it did not perform analyses by gender. Thus, these previous findings can't easily be compared with ours.

4.3. Strengths and limitations

Our study has important strengths, including: a large sample size, high participation rates, objective measures of MHP (which avoids the common method bias) and validated scales of reward, psychological demands and job control to assess psychosocial work factors. Moreover, the male and female proportions allowed us to investigate gender-specific associations. Finally, this is the first prospective study to examine the effect of combined exposure to adverse psychosocial work factors of two validated models on medically certified MHP.

The current study have been limited by the fact that not all original items of the effort scale from the ERI model were available. This might have led to an underestimation of the effect of effort [50]. However, the Cronbach's alpha was acceptable while adding proxy items. Also, the cohort was restricted to white-collar workers. Therefore, current results may not be generalizable to other populations.

5. Conclusion

In the present study, high strain and ERI in women had independent and combined effect on the risk of medically certified absence for MHP. The effect of combined exposure to both factors was higher than the effect of single factor. The current results highlight the need to develop a comprehensive set of preventive interventions for workers exposed to adverse factors of these two models, especially women.

Competiting interests

The authors have no competing interests to report.

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Contributors

R. Ndjaboue supervised and synthesized the data analyses and led the writing. C. Brisson originated and supervised all aspects of the study. D. Talbot participated to data analyses. All authors participated in reviewing and drafting the article. M. Vezina supervised the aspects of the study related to mental health measurement and supervised the public health issues of the study.

Ethics approval

This study has been approved by the thic comitee of the *Centre de Recherche du Centre Hospitalier Universitaire de Québec.*

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Appendix A. Incidence of absence for specific diagnosis, among participants with medically certified absence for mental health problems

Diagnosis	N* (%)
Adjustment disorders	
Yes	211 (54.7)
No	175 (45.3)
Depression	
Yes	122 (31.6)
No	264 (68.4)
Anxiety	
Yes	83 (21.5)
No	303 (78.5)
Fatigue and asthenia	
Yes	46 (11.9)
No	340 (88.1)
Alcoholism and drug abuse	
Yes	21 (5.4)
No	365 (94.6)
Personality disorder	
Yes	21 (5.4)
No	365 (95.6)
Occupational related health problems	
Yes	4 (1.0)
No	382 (99.0)

* Number and percentages of these diagnoses are not mutually exclusive.

Appendix B. Hazards Ratios (95% Confidence intervals) of medically certified absence for mental health problems according to job strain and ERI

	Model 1[a]	Model 2[b]	Model 3[c]	Model 4[d]
Men				
High job strain				
No	1.00	1.00	1.00	1.00
Yes	0.89 (0.46 to 1.71)	0.71 (0.38 to 1.30)	0.60 (0.33 to 1.11)	0.53 (2.29 to 0.99)
Job strain quadrants				
Low strain	1.00	1.00	1.00	1.00
Passive	1.18 (0.58 to 2.40)	0.93 (0.47 to 1.85)	0.89 (0.45 to 1.73)	0.74 (0.36 to 1.51)
Active	0.95 (0.45 to 2.04)	0.96 (0.47 to 1.95)	0.76 (0.35 to 1.66)	0.82 (0.40 to 1.69)
High strain	0.93 (0.38 to 2.26)	0.68 (0.31 to 1.49)	0.50 (0.23 to 1.12)	0.43 (0.19 to 0.98)
ERI				
No	1.00	1.00	1.00	1.00
Yes	1.53 (0.85 to 2.73)	1.33 (0.79 to 2.26)	*1.64 (0.91 to 2.98)*	1.37 (0.81 to 2.31)
Women				
High job strain				
No	1.00	1.00	1.00	1.00
Yes	**1.86 (1.44 to 2.41)**	**1.69 (1.29 to 2.21)**	**1.50 (1.12 to 2.01)**	**1.54 (1.16 to 2.03)**
Job strain quadrants				
Low strain	1.00	1.00	1.00	1.00
Passive	**1.67 (1.02 to 2.73)**	*1.59 (0.97 to 2.60)*	*1.57 (0.96 to 2.57)*	*1.48 (0.90 to 2.42)*
Active	*1.67 (0.99 to 2.82)*	*1.65 (0.98 to 2.79)*	1.45 (0.85 to 2.48)	*1.61 (0.95 to 2.70)*
High strain	**2.89 (1.77 to 4.72)**	**2.55 (1.55 to 4.20)**	**2.17 (1.28 to 3.69)**	**2.22 (1.34 to 3.69)**
ERI				
No	1.00	1.00	1.00	1.00
Yes	**1.66 (1.27 to 2.16)**	**1.58 (1.20 to 2.08)**	*1.34 (0.98 to 1.84)*	**1.61 (1.22 to 2.13)**

Results in bold: $p < 0.05$. Results in italic: $0.05 \le p < 0.1$.

[a] Model 1: Crude association;

[b] Model 2: Adjusted for age, education, marital status, stressful events, home load, smoking, BMI, sedentary behavior and alcohol intake (categorizations as in Table 1).

[c] Model 3: Model 2 additionally adjusted for job strain or ERI.

[d] Model 4: Model 2 additionally adjusted for low job control or low reward.

Appendix C. Hazards Ratios (95% Confidence intervals) of medically certified absence for mental health problems according to separate components of the ERI model

	Model 1[a]	Model 2[b]
Men		
Efforts		
Low	1.00	1.00
Medium	0.85 (0.44 to 1.64)	0.83 (0.43 to 1.57)
High	0.96 (0.50 to 1.85)	1.01 (0.57 to 1.80)
Reward		
High	1.00	1.00
Medium	1.74 (0.84 to 3.60)	1.66 (0.81 to 3.42)
Low	**3.30 (1.71 to 6.40)**	**2.53 (1.35 to 4.72)**
Women		
Efforts		
Low	1.00	1.00
Medium	0.92 (0.65 to 1.30)	0.94 (0.67 to 1.32)
High	1.14 (0.81 to 1.61)	1.10 (0.77 to 1.56)
Reward		
High	1.00	1.00
Medium	1.13 (0.80 to 1.58)	1.07 (0.76 to 1.50)
Low	**1.78 (1.30 to 2.43)**	**1.63 (1.19 to 2.22)**

Results in bold: $p < 0.05$. Results in italic: $0.05 \le p < 0.10$.

[a] Model 1: Crude association;

[b] Model 2: Adjusted for age, education, marital status, stressful events, home load, smoking, BMI, sedentary behavior and alcohol intake (categorizations as in Table 1).

Appendix D. Hazards Ratios (95% Confidence intervals) of medically certified absence for mental health problems according to combined exposure to factors from the DC and ERI models

	Model 1[a]	Model 2[b]
Men		
High job strain and low reward		
No exposure	1.00	1.00
High strain only	0.38 (0.09 to 1.59)	0.41 (0.10 to 1.78)
Low reward only	**2.43 (1.43 to 4.13)**	**2.15 (1.32 to 3.49)**
Combined exposure	1.95 (0.88 to 4.33)	1.21 (0.58 to 2.53)
ERI and low job control		
No exposure	1.00	1.00
Low job control only	1.46 (0.66 to 3.25)	1.32 (0.64 to 2.72)
ERI only	1.08 (0.56 to 2.06)	0.83 (0.44 to 1.56)
Combined exposure	1.77 (0.79 to 3.94)	1.18 (0.54 to 2.58)
Low job control and low reward		
No exposure	1.00	1.00
Low job control only	*2.12 (0.99 to 4.53)*	*1.89 (0.96 to 3.72)*
Low reward only	0.69 (0.32 to 1.43)	0.59 (0.27 to 1.28)
Combined exposure	**2.30 (1.22 to 4.30)**	1.51 (0.82 to 2.77)
Women		
High job strain and low reward		
No exposure	1.00	1.00
High strain only	**1.89 (1.29 to 2.76)**	**1.75 (1.18 to 2.59)**
Low reward only	**1.62 (1.17 to 2.23)**	**1.54 (1.12 to 2.12)**
Combined exposure	**2.41 (1.72 to 3.38)**	**2.14 (1.52 to 3.02)**
ERI and low job control		
No exposure	1.00	1.00
Low job control only	**2.00 (1.23 to 3.27)**	**1.88 (1.16 to 3.06)**
ERI only	**1.68 (1.16 to 2.43)**	**1.56 (1.08 to 2.25)**
Combined exposure	**2.68 (1.79 to 4.03)**	**2.35 (1.56 to 3.53)**
Low job control and low reward		
No exposure	1.00	1.00
Low job control only	**1.92 (1.16 to 3.17)**	**1.84 (1.20 to 3.02)**
ERI only	**1.50 (1.05 to 2.13)**	*1.42 (1.00 to 2.03)*
Combined exposure	**2.15 (1.51 to 3.08)**	**1.94 (1.37 to 2.77)**

Results in bold: $p < 0.05$. Results in italic: $0.05 \le p < 0.10$.

Job strain and ERI were binary variables. Low reward and low job control were categorized in tertile.

Exposed categories are compared with the reference category (first category of each variable).

[a] Model 1: Crude association;

[b] Model 2: Adjusted for age, education, marital status, stressful events, home load, smoking, BMI, sedentary behavior and alcohol intake.

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