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**Working conditions and depression in the French national working population: results from the SUMER study**

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## **Abstract**

*Objectives* The objectives were to explore the associations between various types of occupational exposures and depression in the French national working population, most of the studies in the literature focussing on a limited number of exposures and on symptom scales.

*Methods* The study was based on a nationally representative sample of 25,977 employees, 14,682 men and 11,295 women. Depression was measured using the PHQ-9 instrument and algorithm. Occupational exposures included factors related to both the psychosocial and physical work environment. Weighted logistic regression analyses were performed to study the associations between exposures and outcome with adjustment for covariates among men and women separately.

*Results* The prevalence of depression was higher for women than for men (5.70% versus 3.78%). The final models showed that low decision latitude, low reward, bullying, work-family and ethical conflicts for both genders, and high psychological demands, low social support, and long working hours among women were risk factors for depression. No occupational exposure of physical, biomechanical, chemical and biological nature was associated with depression. Sensitivity analyses confirmed the robustness of the results.

*Conclusions* Significant associations were found between psychosocial work exposures and depression, and there were some differences in these associations between genders. This study is one of the first to provide a comprehensive overview of occupational exposures in association with depression. More prevention towards the psychosocial work environment is needed to improve mental health of working populations.

**Keywords:** occupational exposures, working conditions, psychosocial work factors, job stress, mental health, depression

## Introduction

Common mental disorders, including depression, are prevalent and costly among the general population and also among the working population [1, 2]. In the working population, such disorders are indeed associated with increased sickness absence, disability, and turnover and reduced quality of life, productivity, and performance [3, 4]. Identifying occupational risk factors, that could be targeted for preventive actions, for depression is thus crucial. Psychosocial work stressors have been found to be associated with mental disorders, especially depression, in a number of literature reviews and meta-analyses [5-9]. The most robust risk factors are the job strain model factors by Karasek, especially the exposure to job strain, characterised by high psychological demands and low decision latitude at work [5-9].

However, the psychosocial work environment cannot be reduced to the job strain model factors, as it embraces a plethora of aspects. Indeed, literature reviews have suggested that other exposures may play a role in mental disorders such as effort-reward imbalance [10], workplace bullying [11], long working hours [12] or job insecurity [13]. In addition, the work environment is also characterised by other occupational exposures of physical, biomechanical, chemical and biological nature. Authors have underlined the lack of studies exploring these other exposures in association with depression [9]. To summarize, there is a major lack of studies exploring the work environment comprehensively.

Another major limitation of the current literature is that the vast majority of the studies used symptom scales and not instruments to measure mental disorders, and in particular depression. One literature review only found 6 published prospective studies only dealing with the association between job strain and clinical depression [6]. Consequently, although literature reviews have reported associations between psychosocial work exposures (job strain mainly) and depressive symptoms, it is unclear whether this is really the case for depression per se.

The present study is thus a contribution to the literature in two main different ways: it aimed at exploring the work environment comprehensively and covering all types of occupational exposures, and it used an instrument to measure depression based on the DSM-IV definition and criteria.

The objectives of the study were to explore the associations between all types of occupational exposures and depression in the national working population of employees in France.

Our hypotheses were the following:

- 1) Significant associations are expected between well-known psychosocial work factors, especially those related to the job strain model, and depression.
- 2) Significant associations are also expected between other emerging psychosocial work factors and depression.
- 3) No association is expected between other types of occupational exposures related to the physical-biomechanical-chemical-biological environment and depression.
- 4) Gender differences are expected in the prevalence of depression, occupational exposures and covariates, and also potentially in the associations between occupational exposures and depression.

## **Methods**

### *Study sample*

The study was based on the data of the last version of the SUMER (SURveillance Médicale des Expositions aux Risques professionnels) survey conducted in 2016-17. The SUMER survey is a national periodical survey set up by the French minister of labour. Its objectives are to provide up-to-date information about working conditions and occupational exposures of the French working population of employees. This survey is based on a network of occupational physicians who collect the data for a random sample of their employees. The data collection relied on both a questionnaire filled in by the occupational physicians and a self-administered questionnaire filled in by the employees. Based on their expertise of the work environment, the occupational physicians collected information about all types of occupational exposures in the questionnaire whereas the self-administered questionnaire is focused on psychosocial work factors and health outcomes. Ethical approval was granted by the French ethics committees. Our team has already published a large number of studies using the previous versions of the SUMER survey, and a selection of these publications are presented in the references [14-19].

### *Depression*

Depression was measured using the PHQ-9 instrument. According to Kroenke et al. [20], “the PHQ-9 is the self-administered version of the PRIME-MD diagnostic instrument for common mental disorders.” It includes 9 items that are the “9 criteria upon which the diagnosis of DSM-IV depressive disorders is based” [20]. We used the PHQ-9 algorithm that combines both the presence of symptoms and their frequency and defined the depression cases by people who endorsed  $\geq 5$  of the 9 symptoms as present “more than half the days” (the 9th item counts if endorsed “several days”) and one of the first two symptoms (depressed mood or loss of interest) is endorsed [20].

### *Occupational factors*

Four groups of occupational factors were studied:

#### 1) Job strain model and reward factors

We used the validated French version of the job strain model questionnaire (Job Content Questionnaire – JCQ) [21, 22] to evaluate psychological demands, decision latitude (including the subdimensions of skill discretion and decision authority) and social support (including the subdimensions of support from colleagues and supervisors). The scores were constructed according to the recommendations by Karasek and dichotomized at the median of the total sample. We also used the scale of reward from the validated French version of the effort-reward imbalance model questionnaire [23] and constructed the main dimension of reward, as well as the three subdimensions, esteem, job promotion and job security. Reward and its subdimensions were dichotomized at the median of the total sample.

#### 2) Other psychosocial work factors

Three factors were related to workplace violence: bullying (9 items), verbal aggression (2 items) and physical/sexual aggression (2 items). Exposure was defined by at least one situation of violence for each factor. We also studied work-family conflict and ethical conflict (1 item each). Temporary work (1 item) was defined by all types of temporary contracts. Three other emerging factors were also studied: (i) teleworking (1 item) defined by at least one day/week of teleworking, (ii) lean (4 items) defined by at least one exposure among just-in-time production, quality improvement, employee involvement, and eliminating wasteful activities, and (iii) meaning of work (1 item).

#### 3) Working time/hours factors

Three factors were studied; long working hours (1 item) defined using the threshold of the European Directive, i.e. 48 hours a week, shift work (1 item, i.e. working either on permanent

or alternating/rotating shifts) and night work (1 item, i.e. working between 12 and 5 am,  $\geq 1$  night/week).

#### 4) Other occupational exposures

Four main factors were constructed for physical, biomechanical, chemical and biological exposure. Physical exposure was defined by at least 20h of exposure to noise, thermic constraints, radiations or controlled air/space within the previous week. Biomechanical exposure was defined by at least 20h of exposure to manual materials handling, postural/articular constraints, repetition, vibration or driving within the previous week. Chemical and biological exposures were defined by at least one exposure within the previous week. More information about the definition of exposures can be found in a previous publication [24].

#### *Covariates*

Covariates included age, marital status, occupation and economic activity of the company that were both coded using standard classifications (PCS and NAF French classifications by INSEE -National Institute of Statistics and Economic Studies-).

#### *Statistical analysis*

All statistical analyses were performed using weighted data that allowed us to provide results that can be extrapolated to the whole national working population of employees. All analyses were done for men and women separately. The sample was described for all studied variables and differences between genders were tested using the Rao-Scott Chi-2 test. The study of the associations between occupational factors and depression was performed using weighted logistic regression models. Several models were used: (i) each factor was studied separately (models 0), (ii) all factors within each four groups were included simultaneously (models 1), (iii) all psychosocial work factors (job strain and reward factors and others) were studied simultaneously (model 2), (iv) all psychosocial work factors and working time/hours factors were included in the same model (model 3), (v) all occupational factors were included simultaneously (model 4), and finally (vi) a final model was performed including all occupational factors significant for at least one gender. All models were adjusted for covariates. Gender-related interactions were tested among the total sample to provide statistical significance for the differences in the associations between occupational factors and depression between genders in the final model. We also provided the results for job strain (i.e. the combination of high demands and low latitude) and the four job situations defined by

Karasek (high strain i.e. high demands and low latitude, active job i.e. high demands and high latitude, passive job i.e. low demands and low latitude, and low strain i.e. low demands and high latitude, as reference), with adjustment for the other variables of the final model. Several sensitivity analyses were performed to check the robustness of the results of the final model. These analyses were the following: (i) including employees working full time only, and (ii) adjusting for additional covariates that were public/private sector, company size, and chronic disease with or without limitations. All statistical analyses were done using SAS.

## Results

A total of 30,000 employees were asked to participate to the 2016 SUMER survey, and among them, 26,494 agreed to participate to the survey (participation rate: 88.3%), including 25,977 employees who completed the self-administered questionnaire (response rate: 86.6%). Thus, the studied sample included 25,977 employees, 14,682 men and 11,295 women. The description of the sample is presented in Table 1. The prevalence of depression was found to be higher among women (5.70%) than among men (3.78%). A large number of occupational factors displayed differences between genders. Men were more likely to be exposed to low esteem, low job security, ethical conflict, lean, low meaning, long working hours, shift and night work, and almost all physical, biomechanical and chemical exposures than women. Women were more likely to be exposed to low decision latitude, low skill discretion, low decision authority, high psychological demands, low job promotion, verbal aggression and biological exposure than men. Women were more likely to work in the services and men in the other sectors. Men were more likely to work as managers/professionals and blue collar workers, whereas women were more likely to work as clerks/service workers.

Table 2 for men and Table 3 for women present the results for the different models exploring the associations between occupational factors and depression. For models 0 (including each factor separately), almost all psychosocial work factors were associated with depression, except temporary work, lean, and low meaning among men (Table 2) and except physical/sexual aggression, teleworking, and lean among women (Table 3). No factor related to working time/hours or the physical work environment was associated with depression except long working hours for women (Table 3). For models 1 to 4, the results were highly robust. Low decision latitude, low reward, bullying, work-family and ethical conflicts were found to be significant risk factors for depression for men and women. The magnitude of the



associations was particularly strong for bullying and low reward. Among women, additional risk factors were observed: high psychological demands, low social support, low meaning, and long working hours. All these factors were included in the final models.

Table 4 presents the results of the final model including the main dimensions of the studied factors. The results were consistent with those from Tables 2-3. A significant interaction between gender and reward suggested a stronger association of reward with depression among women than among men. The study of the subdimensions (Table 5) showed that all subdimensions of reward (except job promotion among men) for both genders, and low supervisor support among women were significantly associated with depression. Two gender-related interactions were observed: the associations were significant among women and not among men between low supervisor support and depression and between low job promotion and depression.

The results for job strain in association with depression were the following: OR=1.49 95% CI: 1.03-2.16 for men and OR=1.54 95% CI: 1.14-2.07 for women. The ORs associated with the four job situations by Karasek are presented in Figure 1. The magnitude of the ORs of high strain, passive job, and active job was higher among women (OR=8.15 95% CI: 4.40-15.10, OR=5.99 95% CI: 3.19-11.24, and OR=6.40 95% CI: 3.37-12.16 respectively) than among men (OR=3.57 95% CI: 1.79-7.12, OR=2.97 95% CI: 1.39-6.31, and OR=2.48 95% CI: 1.21-5.09 respectively).

Sensitivity analyses confirmed the robustness of the results.

## **Discussion**

### *Main results*

The study provided a comprehensive overview of occupational exposures of all natures in association with depression. The most striking finding is that all significant risk factors were related to the psychosocial work environment and not to the physical work environment, confirming the importance of psychosocial work exposures in this topic. The classical factors of the job strain model, i.e. low decision latitude, high psychological demands, low social support, job/high strain, passive and active job were found to be risk factors of depression. Understudied factors were also associated with depression: low reward, bullying, work-family

and ethical conflicts, low meaning, and long working hours. Bullying and low reward had particularly strong associations with depression for both genders. Some differences were observed between genders in these associations.

### *Comparison with the literature*

To make the comparison with the literature more reliable, we compared as far as possible our results to the studies that also measured depression (and not depressive symptoms) and we also provided results from literature reviews and meta-analyses.

The prevalence of depression found in this study was consistent with the expected prevalence of depression in France [25] and other countries [1]. Women had a higher prevalence of depression than men in our study, which is also in line with previous studies [1, 25].

One of our main findings was that psychosocial work factors were more likely to be associated with depression than the other occupational exposures of physical, biomechanical, chemical and biological nature. Theorell et al. [9] underlined in their literature review that these last exposures were understudied in association with depression and that more attention should be given to these exposures. Our study may be one of the first to provide a comprehensive assessment of all types of occupational exposures and to suggest that the main occupational risk factors for depression are psychosocial work exposures. One of our previous studies reached the same conclusion but did not use validated questionnaires to assess occupational exposures [25].

Our study reported that the classical factors of the job strain model were associated with depression, i.e. low decision latitude, high psychological demands, low social support, job strain, and also the three job situations of high strain, passive and active job as compared to low strain job. The review and meta-analysis by Madsen et al. [6] showed that job strain was associated with clinical depression in both published (summary estimate of 1.77, 95% CI: 1.47–2.13) and unpublished datasets (summary estimate of 1.27, 95% CI: 1.04–1.55). We found an OR of 1.5 for the association between job strain and depression which is perfectly consistent with the results by Madsen et al. The review and meta-analysis by Theorell et al. [9] found moderately strong evidence for the associations of job strain and low decision latitude with depressive symptoms. Previous studies using diagnostic instruments showed that low decision latitude [26-28], high psychological demands [26-30], and low social support [26-28, 31-33] were risk factors for clinical depression. One study [34] reported that active job was associated with an increased risk of depression. Our study may be one of the first to demonstrate that passive job was a risk factor.

We found that reward and the subdimensions of reward were associated with depression in our study. A review and meta-analysis [10] showed that effort-reward imbalance was associated with depressive disorders with a summary estimate of 1.49 (95% CI: 1.23–1.80) but only a part of the included studies used a diagnostic instrument for depression. Another review and meta-analysis [13] reported a summary estimate of 1.29 (95% CI: 1.06–1.57) for the association between job insecurity and depressive symptoms. Some studies using diagnostic instruments confirmed this association for clinical depression [26, 28, 30, 33, 35]. Workplace bullying increased the risk of depression in our study. Two literature reviews [9, 11] underlined the association between bullying and depressive symptoms and a meta-analysis [9] provided a summary estimate of 2.82 (95% CI: 2.21-3.59), but the studies using diagnostic instruments remain seldom. Some rare studies reported a significant association between bullying and major depression [36, 37].

A significant association was observed between long working hours and depression among women in our study. A review and meta-analysis reported a significant association between long working hours and depressive symptoms among women and not among men [12]. Only very rare studies reported an association between long working hours and major depressive episode [38].

To our knowledge, there has been no literature review or meta-analysis for work-family and ethical conflicts and meaning at work in association with depressive disorders. Three studies reported an association between work-family conflict and major depression [33, 35, 39]. Another study found an association between ethical conflict and depression but this association was not observed in all models [25].

#### *Strengths and limitations of the study*

Many strengths of this study deserve to be underlined. The study sample was large and representative of the national working population of employees. The participation and response rates were high and weights were used to provide results that can be extrapolated to the target population. Men and women were studied separately following the best practices [40]. Indeed, men and women displayed differences in the prevalence of a vast majority of variables, including occupational exposures and depression, as well as in the associations between some psychosocial work factors and depression, confirming the interest to study each gender separately. The study had the major strength to include an instrument using an algorithm based on DSM-IV definition and criteria to measure depression. It also included the validated questionnaires for the measurement of the job strain model and reward factors.

Understudied psychosocial work factors were explored and our findings suggested that some of them may be particularly relevant for depression such as those related to bullying, family-work conflict, ethical conflict, low meaning, and long working hours. Occupational factors of physical, biomechanical, chemical and biological nature were also studied, which is seldom in the literature. In addition, these exposures were based on the expertise of the occupational physicians who collected the data. A number of important covariates were included in the main analyses or studied in sensitivity analyses. It is worth noticing that these covariates did not play a role of confounding factors in the associations between occupational exposures and depression. Various statistical models and sensitivity analyses were done and confirmed the robustness of the results. The results found in this study were consistent with the expected results, as mainly psychosocial work factors were observed as risk factors and not the other occupational exposures.

The study had however some limitations. The study design was cross-sectional and did not allowed us to conclude to causal associations, as reverse causation may be possible. Depression might influence the reporting of occupational factors. Depression might also reduce work ability and lead to adverse experience of working conditions and occupational exposures. However, psychosocial work factors only (and not the other occupational factors) were associated with depression, supporting our hypotheses and the plausibility of the associations. A healthy worker effect may have reduced the associations between exposures and outcome if sick employees had left the labour market or the most exposed jobs. The PHQ-9 is a self-administered instrument and is not a clinical diagnostic interview administered by clinicians. Indeed, as interview type either by clinicians or by lay interviewers may not lead to equivalent methods to classify depression [41], we may assume that self-administered instruments might also influence research findings and might induce misclassification. However, the PHQ-9 is not a symptom scale using an arbitrary threshold. Indeed, the PHQ-9 relies on an algorithm based on DSM-IV definition and criteria combining both the presence of symptoms and their frequency. As most exposures and outcome were based on self-reported data, a reporting bias is possible that may have increased the associations between exposures and outcome. The other psychosocial work factors were not based on previous scales. However, these factors are emerging factors and there may not be available scales to measure all of them. Some rare occupational exposures may be missing such as organisational injustice.

*Conclusion*

Our study underlined the role of psychosocial work factors in depression. It also suggested that the other occupational exposures may have a low contribution in this outcome. Classical psychosocial work stressors such as those related to the job strain model were associated with depression. Other understudied factors may also play a role such as low reward, job insecurity, bullying, work-family and ethical conflicts, low meaning at work, and long working hours. All these occupational exposures could be the subject of preventive measures in order to improve mental health at the workplace.

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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. KC and JFC performed the statistical analysis. All authors made contributions to interpretations of results and manuscript revisions.

**Conflict of interest**

None

**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).

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Table 1. Description of the study sample for all studied variables among men and women

|   | Men (N = 14 682) | Women (N = 11 295) | p-value |
|---|------------------|--------------------|---------|
|   | w%               | w%                 |         |
| <b>Depression</b>                                 | 3.78             | 5.70               | ***     |
| <b>Job strain model and reward factors</b>        |                  |                    |         |
| Low skill discretion <sup>□</sup>                 | 49.09            | 57.36              | ***     |
| Low decision authority <sup>□</sup>               | 59.24            | 62.88              | ***     |
| Low decision latitude <sup>□</sup>                | 47.88            | 54.28              | ***     |
| High psychological demands <sup>□</sup>           | 44.97            | 47.29              | *       |
| Low supervisor support <sup>□</sup>               | 38.37            | 38.81              | NS      |
| Low colleague support <sup>□</sup>                | 61.41            | 59.28              | NS      |
| Low social support <sup>□</sup>                   | 38.35            | 37.81              | NS      |
| Low esteem <sup>□</sup>                           | 53.55            | 49.20              | ***     |
| Low job promotion <sup>□</sup>                    | 46.42            | 49.93              | **      |
| Low job security <sup>□</sup>                     | 36.64            | 33.34              | **      |
| Low reward <sup>□</sup>                           | 45.55            | 47.23              | NS      |
| <b>Other psychosocial work factors</b>            |                  |                    |         |
| Bullying  | 15.87            | 16.35              | NS      |
| Verbal aggression                                 | 15.91            | 20.85              | ***     |
| Physical/sexual aggression                        | 1.57             | 1.78               | NS      |
| Work-family conflict <sup>□</sup>                 | 37.36            | 36.75              | NS      |
| Ethical conflict <sup>□</sup>                     | 33.35            | 30.39              | **      |
| Temporary work                                    | 11.94            | 10.28              | NS      |
| Teleworking                                       | 3.25             | 2.92               | NS      |
| Lean  | 40.79            | 32.85              | ***     |
| Low meaning <sup>□</sup>                          | 63.52            | 58.08              | ***     |
| <b>Working time/hours</b>                         |                  |                    |         |
| Long working hours                                | 8.87             | 3.96               | ***     |
| Shift work  | 15.71            | 12.55              | ***     |
| Night work  | 6.93             | 2.36               | ***     |
| <b>Other occupational exposures</b>               |                  |                    |         |
| Physical exposure (all)                           | 17.78            | 7.01               | ***     |
| Physical exposure (noise)                         | 9.28             | 5.05               | ***     |
| Physical exposure (temperature)                   | 10.91            | 1.99               | ***     |
| Physical exposure (radiations)                    | 0.62             | 0.18               | ***     |
| Physical exposure (controlled air/space)          | 0.82             | 0.56               | NS      |
| Biomechanical exposure (all)                      | 38.05            | 31.10              | ***     |
| Biomechanical exposure (manual material handling) | 6.37             | 2.16               | ***     |
| Biomechanical exposure (posture)                  | 33.29            | 30.06              | **      |
| Biomechanical exposure (repetition)               | 4.24             | 3.72               | NS      |
| Biomechanical exposure (vibration)                | 4.24             | 0.27               | ***     |
| Biomechanical exposure (driving)                  | 7.83             | 0.82               | ***     |
| Chemical exposure                                 | 35.68            | 28.71              | ***     |
| Biological exposure                               | 18.45            | 31.59              | ***     |
| <b>Work characteristics</b>                       |                  |                    |         |
| Economic activity                                 |                  |                    | ***     |
| <i>Agriculture</i>                                | 1.79             | 0.76               |         |
| <i>Manufacturing</i>                              | 18.09            | 7.51               |         |
| <i>Construction</i>                               | 9.16             | 1.91               |         |
| <i>Services</i>                                   | 70.97            | 89.83              |         |
| Occupation  |                  |                    | ***     |
| <i>Managers/professionals</i>                     | 19.67            | 13.99              |         |

|  |       |       |     |
|--|-------|-------|-----|
| <i>Associate professionals/technicians</i> | 18.80 | 21.86 |     |
| <i>Clerks/service workers</i>              | 18.79 | 53.53 |     |
| <i>Blue collar workers</i>                 | 42.74 | 10.63 |     |
| <b>Personal characteristics</b>            |       |       |     |
| Age (years)                                |       |       | *** |
| <30  | 19.02 | 16.04 |     |
| 30-39                                      | 24.96 | 23.29 |     |
| 40-49                                      | 26.08 | 27.85 |     |
| ≥50  | 29.94 | 32.82 |     |
| Marital status                             |       |       | NS  |
| <i>Alone</i>                               | 29.54 | 31.17 |     |
| <i>In couple</i>                           | 70.46 | 68.83 |     |

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w%: weighted %

▣: Variables dichotomized at the median of the total sample

p-value: for the comparison between men and women (Rao-Scott Chi-2 test)

\*: p<0.05 \*\*: p<0.01 \*\*\*: p<0.001

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Table 2. Associations between occupational factors and depression according to various weighted logistic regression models among men

|  | Models 0        |                     |            | Models 1        |                    |            | Model 2 (N = 13 617) |                   |            | Model 3 (N = 13 462) |                   |            | Model 4 (N = 13 462) |                   |            |
|--|-----------------|---------------------|------------|-----------------|--------------------|------------|----------------------|-------------------|------------|----------------------|-------------------|------------|----------------------|-------------------|------------|
|  | OR <sup>§</sup> | 95 % CI             | p          | OR <sup>§</sup> | 95 % CI            | p          | OR <sup>§</sup>      | 95 % CI           | p          | OR <sup>§</sup>      | 95 % CI           | p          | OR <sup>§</sup>      | 95 % CI           | p          |
| <b>Job strain model and reward</b>     |                 |                     |            |                 |                    |            |                      |                   |            |                      |                   |            |                      |                   |            |
| Low decision latitude                  | <b>2.35</b>     | <b>1.64 - 3.37</b>  | <b>***</b> | <b>1.71</b>     | <b>1.17 - 2.50</b> | <b>**</b>  | <b>1.71</b>          | <b>1.16-2.52</b>  | <b>**</b>  | <b>1.70</b>          | <b>1.15 -2.51</b> | <b>**</b>  | <b>1.68</b>          | <b>1.14 -2.50</b> | <b>**</b>  |
| High psychological demands             | <b>3.62</b>     | <b>2.45 - 5.36</b>  | <b>***</b> | <b>2.25</b>     | <b>1.50 - 3.37</b> | <b>***</b> | 1.48                 | 0.99-2.23         | NS         | 1.46                 | 0.97 -2.20        | NS         | 1.43                 | 0.96 -2.14        | NS         |
| Low social support                     | <b>3.69</b>     | <b>2.60 - 5.25</b>  | <b>***</b> | <b>1.91</b>     | <b>1.28 - 2.86</b> | <b>**</b>  | 1.30                 | 0.84-2.00         | NS         | 1.28                 | 0.84 -1.97        | NS         | 1.26                 | 0.82 -1.95        | NS         |
| Low reward                             | <b>5.26</b>     | <b>3.09 - 8.94</b>  | <b>***</b> | <b>3.09</b>     | <b>1.72 - 5.54</b> | <b>***</b> | <b>2.16</b>          | <b>1.15-4.04</b>  | <b>*</b>   | <b>2.15</b>          | <b>1.15 -4.01</b> | <b>*</b>   | <b>2.20</b>          | <b>1.21 -4.00</b> | <b>*</b>   |
| <b>Other psychosocial work factors</b> |                 |                     |            |                 |                    |            |                      |                   |            |                      |                   |            |                      |                   |            |
| Bullying                               | <b>7.45</b>     | <b>5.37 - 10.33</b> | <b>***</b> | <b>4.99</b>     | <b>3.49 - 7.15</b> | <b>***</b> | <b>3.53</b>          | <b>2.48 -5.03</b> | <b>***</b> | <b>3.48</b>          | <b>2.44 -4.96</b> | <b>***</b> | <b>3.57</b>          | <b>2.50 -5.10</b> | <b>***</b> |
| Verbal aggression                      | <b>3.46</b>     | <b>2.46 - 4.89</b>  | <b>***</b> | 1.47            | 1.00 - 2.16        | NS         | 1.24                 | 0.84 -1.84        | NS         | 1.25                 | 0.84 -1.84        | NS         | 1.24                 | 0.84 -1.84        | NS         |
| Physical/sexual aggression             | <b>5.14</b>     | <b>2.38 - 11.13</b> | <b>***</b> | 2.44            | 0.94 - 6.37        | NS         | 2.16                 | 0.75 -6.18        | NS         | 2.29                 | 0.74 -7.08        | NS         | 2.39                 | 0.76 -7.48        | NS         |
| Work-family conflict                   | <b>2.66</b>     | <b>1.91 - 3.71</b>  | <b>***</b> | <b>1.96</b>     | <b>1.39 - 2.77</b> | <b>***</b> | <b>1.81</b>          | <b>1.27 -2.58</b> | <b>**</b>  | <b>1.89</b>          | <b>1.32 -2.70</b> | <b>***</b> | <b>1.91</b>          | <b>1.33 -2.73</b> | <b>***</b> |
| Ethical conflict                       | <b>3.27</b>     | <b>2.35 - 4.56</b>  | <b>***</b> | <b>1.80</b>     | <b>1.22 - 2.66</b> | <b>**</b>  | 1.46                 | 0.98 -2.19        | NS         | 1.49                 | 1.00 -2.23        | NS         | <b>1.52</b>          | <b>1.02 -2.26</b> | <b>*</b>   |
| Temporary work                         | 0.83            | 0.42 - 1.65         | NS         | 1.03            | 0.47 - 2.26        | NS         | 0.92                 | 0.41 -2.09        | NS         | 0.95                 | 0.42 -2.13        | NS         | 0.95                 | 0.43 -2.10        | NS         |
| Teleworking                            | <b>2.20</b>     | <b>1.11 - 4.36</b>  | <b>*</b>   | 1.84            | 0.93 - 3.64        | NS         | 1.89                 | 0.94 -3.78        | NS         | 1.90                 | 0.95 -3.81        | NS         | 1.92                 | 0.95 -3.87        | NS         |
| Lean                                   | 1.06            | 0.76 - 1.47         | NS         | 1.09            | 0.78 - 1.52        | NS         | 0.97                 | 0.69 -1.37        | NS         | 1.00                 | 0.71 -1.40        | NS         | 0.99                 | 0.71 -1.38        | NS         |
| Low meaning                            | 1.40            | 0.97 - 2.04         | NS         | <b>1.56</b>     | <b>1.07 - 2.26</b> | <b>*</b>   | 1.28                 | 0.87 -1.90        | NS         | 1.32                 | 0.88 -1.96        | NS         | 1.30                 | 0.87 -1.93        | NS         |
| <b>Working time/hours</b>              |                 |                     |            |                 |                    |            |                      |                   |            |                      |                   |            |                      |                   |            |
| Long working hours                     | 1.14            | 0.70 - 1.87         | NS         | 1.07            | 0.64 - 1.77        | NS         |                      |                   |            | 0.86                 | 0.51 -1.47        | NS         | 0.87                 | 0.51 -1.49        | NS         |
| Shift work                             | 1.15            | 0.75 - 1.77         | NS         | 1.17            | 0.75 - 1.81        | NS         |                      |                   |            | 0.95                 | 0.58 -1.56        | NS         | 0.95                 | 0.58 -1.55        | NS         |
| Night work                             | 1.13            | 0.69 - 1.87         | NS         | 1.07            | 0.64 - 1.76        | NS         |                      |                   |            | 0.75                 | 0.40 -1.41        | NS         | 0.74                 | 0.41 -1.35        | NS         |
| <b>Other exposures</b>                 |                 |                     |            |                 |                    |            |                      |                   |            |                      |                   |            |                      |                   |            |
| Physical exposures                     | 1.11            | 0.74 - 1.68         | NS         | 1.06            | 0.69 - 1.62        | NS         |                      |                   |            |                      |                   |            | 1.16                 | 0.75 -1.79        | NS         |
| Biomechanical exposures                | 1.18            | 0.82 - 1.70         | NS         | 1.19            | 0.83 - 1.72        | NS         |                      |                   |            |                      |                   |            | 1.07                 | 0.73 -1.55        | NS         |
| Chemical exposures                     | 0.82            | 0.56 - 1.20         | NS         | 0.78            | 0.53 - 1.16        | NS         |                      |                   |            |                      |                   |            | 0.69                 | 0.45 -1.05        | NS         |
| Biological exposures                   | 1.07            | 0.69 - 1.67         | NS         | 1.13            | 0.70 - 1.80        | NS         |                      |                   |            |                      |                   |            | 0.97                 | 0.55 -1.70        | NS         |

§: odds-ratios adjusted for age, marital status, occupation, and economic activity

\*: p<0.05 \*\*: p<0.01 \*\*\*: p<0.001

Models 0: each factor separately

Models 1: 4 models including all factors of each group

Model 2: job strain model and reward factors + other psychosocial work factors

Model 3: model 2 + working time/hours factors

Model 4: model 3 + other exposures

Table 3 – Associations between occupational factors and depression according to various weighted logistic regression models among women

|  | Models 0        |                     |     | Models 1        |                    |     | Model 2 (N = 10 121) |                    |     | Model 3 (N = 10 012) |                    |     | Model 4 (N = 10 012) |                   |     |
|--|-----------------|---------------------|-----|-----------------|--------------------|-----|----------------------|--------------------|-----|----------------------|--------------------|-----|----------------------|-------------------|-----|
|  | OR <sup>§</sup> | 95 % CI             | p   | OR <sup>§</sup> | 95 % CI            | p   | OR <sup>§</sup>      | 95 % CI            | p   | OR <sup>§</sup>      | 95 % CI            | p   | OR <sup>§</sup>      | 95 % CI           | p   |
| <b>Job strain model and reward</b>     |                 |                     |     |                 |                    |     |                      |                    |     |                      |                    |     |                      |                   |     |
| Low decision latitude                  | <b>2.30</b>     | <b>1.74 - 3.04</b>  | *** | <b>1.63</b>     | <b>1.21 - 2.20</b> | **  | <b>1.59</b>          | <b>1.16 - 2.17</b> | **  | <b>1.65</b>          | <b>1.20 - 2.26</b> | **  | <b>1.64</b>          | <b>1.19 -2.25</b> | **  |
| High psychological demands             | <b>4.96</b>     | <b>3.68 - 6.68</b>  | *** | <b>2.75</b>     | <b>1.99 - 3.79</b> | *** | <b>1.91</b>          | <b>1.37 - 2.65</b> | *** | <b>1.88</b>          | <b>1.35 - 2.63</b> | *** | <b>1.87</b>          | <b>1.34 -2.60</b> | *** |
| Low social support                     | <b>4.84</b>     | <b>3.67 - 6.39</b>  | *** | <b>2.32</b>     | <b>1.71 - 3.14</b> | *** | <b>1.65</b>          | <b>1.21 - 2.25</b> | **  | <b>1.64</b>          | <b>1.20 - 2.25</b> | **  | <b>1.65</b>          | <b>1.20 -2.25</b> | **  |
| Low reward                             | <b>10.60</b>    | <b>7.09 - 15.86</b> | *** | <b>5.06</b>     | <b>3.28 - 7.79</b> | *** | <b>4.29</b>          | <b>2.71 -6.78</b>  | *** | <b>4.30</b>          | <b>2.71 - 6.83</b> | *** | <b>4.27</b>          | <b>2.69 -6.79</b> | *** |
| <b>Other psychosocial work factors</b> |                 |                     |     |                 |                    |     |                      |                    |     |                      |                    |     |                      |                   |     |
| Bullying                               | <b>7.73</b>     | <b>5.99 - 9.98</b>  | *** | <b>5.69</b>     | <b>4.29 - 7.53</b> | *** | <b>3.20</b>          | <b>2.40 - 4.27</b> | *** | <b>3.20</b>          | <b>2.39 - 4.27</b> | *** | <b>3.18</b>          | <b>2.38 -4.25</b> | *** |
| Verbal aggression                      | <b>2.47</b>     | <b>1.90 - 3.20</b>  | *** | 1.25            | 0.93 - 1.68        | NS  | 0.97                 | 0.71 - 1.32        | NS  | 0.98                 | 0.71 - 1.33        | NS  | 0.97                 | 0.71 -1.32        | NS  |
| Physical/sexual aggression             | 1.56            | 0.72 - 3.36         | NS  | 0.98            | 0.40 - 2.40        | NS  | 0.78                 | 0.28 - 2.15        | NS  | 0.81                 | 0.29 - 2.29        | NS  | 0.82                 | 0.29 -2.30        | NS  |
| Work-family conflict                   | <b>2.58</b>     | <b>2.00 - 3.32</b>  | *** | <b>2.03</b>     | <b>1.56 - 2.64</b> | *** | <b>1.81</b>          | <b>1.38 - 2.36</b> | *** | <b>1.74</b>          | <b>1.33 - 2.29</b> | *** | <b>1.74</b>          | <b>1.32 -2.28</b> | *** |
| Ethical conflict                       | <b>3.48</b>     | <b>2.70 - 4.49</b>  | *** | <b>2.20</b>     | <b>1.66 - 2.91</b> | *** | <b>1.63</b>          | <b>1.22 - 2.18</b> | **  | <b>1.60</b>          | <b>1.19 - 2.15</b> | **  | <b>1.61</b>          | <b>1.21 -2.16</b> | **  |
| Temporary work                         | <b>0.55</b>     | <b>0.31 - 0.99</b>  | *   | 0.71            | 0.39 - 1.30        | NS  | 0.75                 | 0.38 - 1.50        | NS  | 0.75                 | 0.38 - 1.50        | NS  | 0.74                 | 0.37 -1.49        | NS  |
| Teleworking                            | 1.43            | 0.71 - 2.87         | NS  | 1.32            | 0.62 - 2.80        | NS  | 1.47                 | 0.65 - 3.32        | NS  | 1.43                 | 0.63 - 3.22        | NS  | 1.43                 | 0.63 -3.23        | NS  |
| Lean                                   | 1.04            | 0.80 - 1.35         | NS  | 0.92            | 0.70 - 1.21        | NS  | 0.87                 | 0.66 - 1.15        | NS  | 0.89                 | 0.66 - 1.18        | NS  | 0.88                 | 0.66 -1.18        | NS  |
| Low meaning                            | <b>1.69</b>     | <b>1.30 - 2.20</b>  | *** | <b>1.74</b>     | <b>1.32 - 2.28</b> | *** | <b>1.40</b>          | <b>1.04 - 1.88</b> | *   | <b>1.41</b>          | <b>1.05 - 1.89</b> | *   | <b>1.41</b>          | <b>1.05 -1.90</b> | *   |
| <b>Working time/hours</b>              |                 |                     |     |                 |                    |     |                      |                    |     |                      |                    |     |                      |                   |     |
| Long working hours                     | <b>2.11</b>     | <b>1.33 - 3.36</b>  | **  | <b>2.03</b>     | <b>1.26 - 3.27</b> | **  |                      |                    |     | <b>1.80</b>          | <b>1.04 - 3.12</b> | *   | <b>1.79</b>          | <b>1.03 -3.11</b> | *   |
| Shift work                             | 0.98            | 0.67 - 1.42         | NS  | 0.95            | 0.64 - 1.41        | NS  |                      |                    |     | 0.86                 | 0.57 - 1.30        | NS  | 0.86                 | 0.56 -1.32        | NS  |
| Night work                             | 1.59            | 0.82 - 3.07         | NS  | 1.36            | 0.66 - 2.79        | NS  |                      |                    |     | 1.19                 | 0.54 - 2.66        | NS  | 1.20                 | 0.54 -2.70        | NS  |
| <b>Other exposures</b>                 |                 |                     |     |                 |                    |     |                      |                    |     |                      |                    |     |                      |                   |     |
| Physical exposures                     | 1.34            | 0.86 - 2.08         | NS  | 1.22            | 0.78 - 1.90        | NS  |                      |                    |     |                      |                    |     | 1.14                 | 0.68 -1.92        | NS  |
| Biomechanical exposures                | 1.28            | 0.98 - 1.66         | NS  | 1.27            | 0.96 - 1.67        | NS  |                      |                    |     |                      |                    |     | 1.07                 | 0.77 -1.47        | NS  |
| Chemical exposures                     | 0.84            | 0.62 - 1.13         | NS  | 0.81            | 0.58 - 1.12        | NS  |                      |                    |     |                      |                    |     | 0.88                 | 0.61 -1.26        | NS  |
| Biological exposures                   | 0.94            | 0.71 - 1.24         | NS  | 1.00            | 0.74 - 1.34        | NS  |                      |                    |     |                      |                    |     | 1.06                 | 0.75 -1.51        | NS  |

§: odds-ratios adjusted for age, marital status, occupation, and economic activity

\*: p<0.05 \*\*: p<0.01 \*\*\*: p<0.001

Models 0: each factor separately

Models 1: 4 models including all factors of each group

Model 2: job strain model and reward factors + other psychosocial work factors

Model 3: model 2 + working time/hours factors

Model 4: model 3 + other exposures

Table 4. Associations between occupational factors (main dimensions) and depression: final weighted logistic regression models and gender-related interactions

|  | Men (N = 13 550) |                   |     | Women (N = 10 080) |                   |     | p-value for gender-related interaction |
|--|------------------|-------------------|-----|--------------------|-------------------|-----|--|
|  | OR <sup>§</sup>  | 95 % CI           | p   | OR <sup>§</sup>    | 95 % CI           | p   |  |
| <b>Job strain model and reward factors</b> |                  |                   |     |                    |                   |     |  |
| Low decision latitude                      | <b>1.74</b>      | <b>1.17 -2.57</b> | **  | <b>1.62</b>        | <b>1.17 -2.23</b> | **  | NS                                     |
| High psychological demands                 | 1.47             | 0.96 -2.24        | NS  | <b>1.83</b>        | <b>1.31 -2.56</b> | *** | NS                                     |
| Low social support                         | 1.33             | 0.88 -2.02        | NS  | <b>1.66</b>        | <b>1.21 -2.28</b> | **  | NS                                     |
| Low reward                                 | <b>2.23</b>      | <b>1.21 -4.12</b> | *   | <b>4.28</b>        | <b>2.72 -6.74</b> | *** | *                                      |
| <b>Other psychosocial work factors</b>     |                  |                   |     |                    |                   |     |  |
| Bullying                                   | <b>3.70</b>      | <b>2.62 -5.22</b> | *** | <b>3.19</b>        | <b>2.40 -4.24</b> | *** | NS                                     |
| Work-family conflict                       | <b>1.94</b>      | <b>1.37 -2.74</b> | *** | <b>1.75</b>        | <b>1.33 -2.32</b> | *** | NS                                     |
| Ethical conflict                           | <b>1.52</b>      | <b>1.02 -2.25</b> | *   | <b>1.59</b>        | <b>1.19 -2.13</b> | **  | NS                                     |
| Low meaning                                | 1.27             | 0.86 -1.88        | NS  | <b>1.43</b>        | <b>1.06 -1.92</b> | *   | NS                                     |
| <b>Working time/hours</b>                  |                  |                   |     |                    |                   |     |  |
| Long working hours                         | 0.92             | 0.55 -1.53        | NS  | <b>1.88</b>        | <b>1.10 -3.19</b> | *   | NS                                     |

All occupational factors included in the model simultaneously

§: odds-ratios adjusted for age, marital status, occupation, and economic activity

\*: p<0.05 \*\*: p<0.01 \*\*\*: p<0.001

Table 5. Associations between occupational factors (subdimensions) and depression: final weighted logistic regression models and gender-related interactions

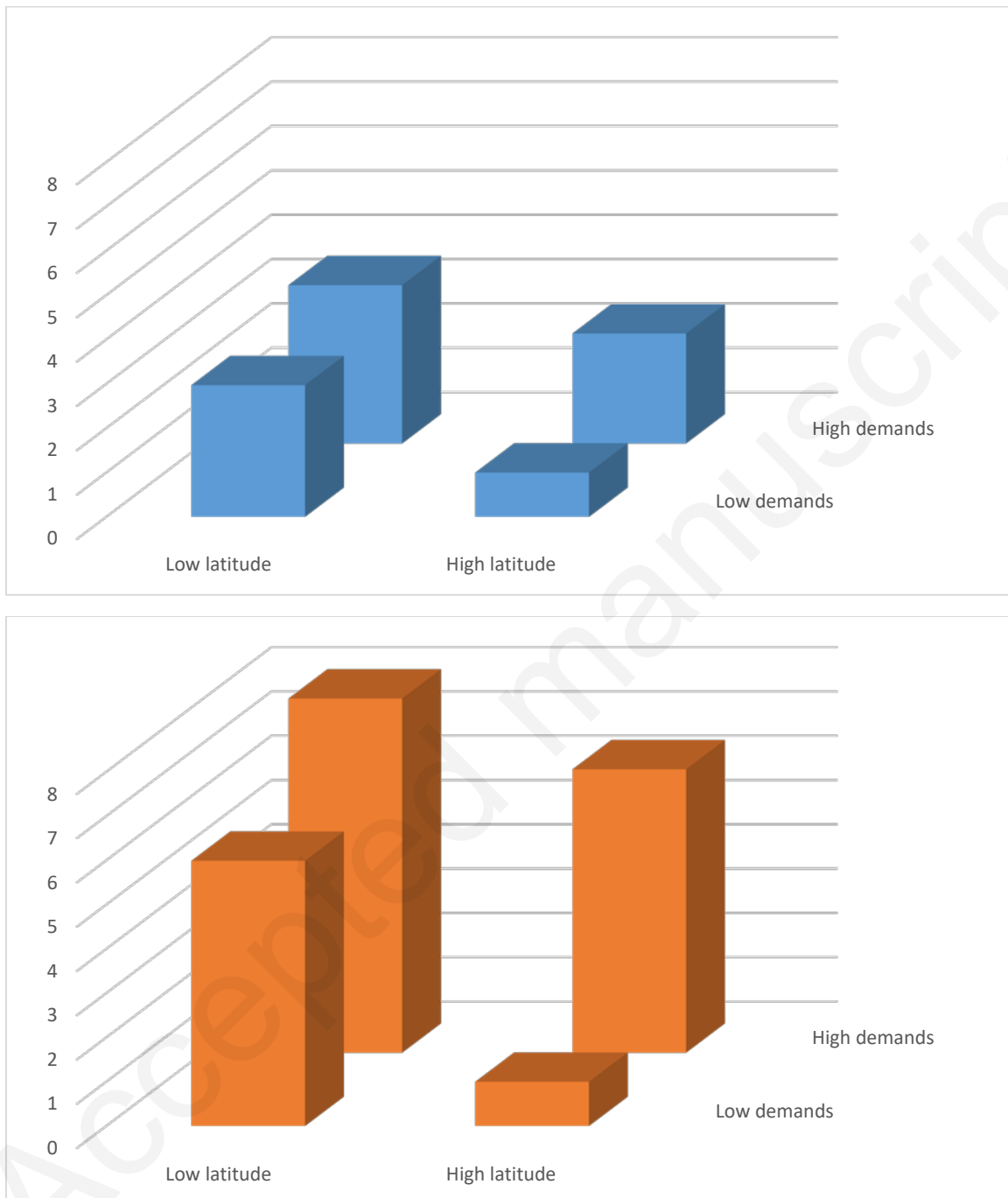
|  | Men (N = 13 550) |                   |     | Women (N = 10 080) |                   |     | p-value for gender-related interaction |
|--|------------------|-------------------|-----|--------------------|-------------------|-----|--|
|  | OR <sup>§</sup>  | 95 % CI           | p   | OR <sup>§</sup>    | 95 % CI           | p   |  |
| <b>Job strain model and reward factors</b> |                  |                   |     |                    |                   |     |  |
| Low skill discretion                       | 1.17             | 0.75 -1.85        | NS  | 1.11               | 0.81 -1.51        | NS  | NS                                     |
| Low decision authority                     | 1.41             | 0.92 -2.15        | NS  | 1.33               | 0.94 -1.89        | NS  | NS                                     |
| High psychological demands                 | 1.37             | 0.90 -2.09        | NS  | <b>1.66</b>        | <b>1.18 -2.33</b> | **  | NS                                     |
| Low support from supervisors               | 0.98             | 0.65 -1.49        | NS  | <b>1.59</b>        | <b>1.17 -2.16</b> | **  | *                                      |
| Low support from colleagues                | 1.06             | 0.70 -1.61        | NS  | 1.23               | 0.90 -1.68        | NS  | NS                                     |
| Low esteem                                 | <b>2.05</b>      | <b>1.13 -3.74</b> | *   | <b>2.70</b>        | <b>1.65 -4.41</b> | *** | NS                                     |
| Low promotion                              | 1.27             | 0.81 -2.01        | NS  | <b>2.19</b>        | <b>1.54 -3.12</b> | *** | *                                      |
| Low security                               | <b>2.15</b>      | <b>1.38 -3.32</b> | *** | <b>1.53</b>        | <b>1.15 -2.03</b> | **  | NS                                     |
| <b>Other psychosocial work factors</b>     |                  |                   |     |                    |                   |     |  |
| Bullying                                   | <b>3.53</b>      | <b>2.51 -4.97</b> | *** | <b>3.07</b>        | <b>2.31 -4.08</b> | *** | NS                                     |
| Work-family conflict                       | <b>1.86</b>      | <b>1.32 -2.62</b> | *** | <b>1.69</b>        | <b>1.28 -2.24</b> | *** | NS                                     |
| Ethical conflict                           | 1.41             | 0.95 -2.11        | NS  | <b>1.48</b>        | <b>1.10 -1.97</b> | **  | NS                                     |
| Low meaning                                | 1.28             | 0.84 -1.93        | NS  | <b>1.42</b>        | <b>1.06 -1.91</b> | *   | NS                                     |
| <b>Working time/hours</b>                  |                  |                   |     |                    |                   |     |  |
| Long working hours                         | 0.91             | 0.55 -1.52        | NS  | <b>1.77</b>        | <b>1.04 -3.01</b> | *   | NS                                     |

All occupational factors included in the model simultaneously

§: odds-ratios adjusted for age, marital status, occupation, and economic activity

\*: p<0.05 \*\*: p<0.01 \*\*\*: p<0.001

Figure 1. Odds-ratios of depression associated with the four job situations of the job strain model (reference: low strain i.e. low demands and high latitude) among men (in blue) and women (in orange)



Odds-ratios adjusted for age, marital status, occupation, economic activity, social support at work, reward, bullying, work-family and ethical conflicts, meaning at work, and long working hours