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## **Workplace bullying and sleep disturbances: findings from a large scale cross-sectional survey in the French working population**

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## **ABSTRACT**

**Study objectives:** This study was aimed at exploring the association between workplace bullying, and its characteristics, and sleep disturbances in a large sample of employees of the French working population.

**Design:** Workplace bullying, evaluated using the validated instrument developed by Leymann, and sleep disturbances, as well as covariates, were measured using a self-administered questionnaire. Covariates included age, marital status, presence of children, education, occupation, working hours, night work, physico-chemical exposures at work, self-reported health, and depressive symptoms. Statistical analysis was performed using logistic regression analysis, and was carried out separately for men and women.

**Setting:** General working population.

**Participants:** The study population consisted of a random sample of 3132 men and 4562 women of the working population in the South-East of France.

**Results:** Workplace bullying was strongly associated with sleep disturbances. Past exposure to bullying also increased the risk for this outcome. The more frequent the exposure to bullying, the higher the risk of sleep disturbances. Observing bullying on someone else at the workplace was also associated with the outcome. Adjustment for covariates did not modify the results. Additional adjustment for self-reported health and depressive symptoms diminished the magnitude of the associations that remained significant.

**Conclusions:** The prevalence of workplace bullying (around 10%) was found to be high in this study as well as the impact of this major job stress factor on sleep disturbances. Although no conclusion about causality could be drawn from this cross-sectional study, it suggests that the contribution of workplace bullying to the burden of sleep disturbances may be substantial.

**Key words:** sleep disturbances, workplace bullying

## INTRODUCTION

Sleep disorders may display high prevalences among middle-aged populations; studies have reported prevalences ranging from 10% to 40% in working populations,<sup>1-13</sup> with insomnia being one of the most common disorders. In addition, the direct costs of insomnia were estimated to be more than \$2 billion in France in 1995.<sup>14</sup> Consequently, sleep disorders may be a serious public health issue, because of the high prevalence of these disorders, and their social and economic consequences. Poor sleep may also be associated with occupational and health related problems, such as an increased risk of accidents, mortality, and illnesses, for example, coronary heart diseases, diabetes, and mental disorders, as well as sickness absence, reduced productivity, etc.<sup>15-18</sup> The causes of poor sleep are complex and certainly multifactorial. Studies have reported the following risk factors of sleep disorders: older age, female gender, low socioeconomic status, living alone, some environmental and occupational factors, as well as poor mental and psychological health.<sup>2-4;7-9;11;19;20</sup>

Research has been undertaken that targets sleep disorders in the working population, and numerous studies have focused on shift work and its association with sleep.<sup>21;22</sup> The association between work and sleep has been considered to be worth studying, because sleep disorders are expected to occur in people of working age, and because psychosocial aspects of work, such as job stress, may be strongly related to sleep. Some studies have shown that measures of job stress, such as perceived stress, hectic work, high job demands, job under time pressure, low job control, high job strain, low social support at work, bad atmosphere at work, role conflicts, effort-reward imbalance, job dissatisfaction, low levels of interest in job, and job insecurity were associated with sleep disorders.<sup>1-7;9-13;19;20;23-27</sup> These studies, however, were done on relatively small or selective samples, examined non-standard measures for the assessment of job related factors, and/or did not take adequate account of potential confounding factors such as socio-demographic factors, physical and psychological health status, or important occupational risk factors such as shift work and working hours. Furthermore, the effects of workplace bullying, considered to be one of the most damaging job stress factors, on sleep disorders have been understudied, and the literature in this area appears sparse.<sup>3;28-30</sup>

Workplace bullying is difficult to evaluate, and no consensus exists regarding its definition. Here, the definition by Leymann<sup>31</sup> was adopted: workplace bullying or mobbing ‘involves

hostile and unethical communication, which is directed in a systematic way by one or a few individuals mainly towards one individual who, due to mobbing, is pushed into a helpless and defenceless position, being held there by means of continuing mobbing activities'. Two approaches using self-reported questionnaires have been developed in surveys: 1) inventories of various forms of bullying and 2) self-report of being exposed to bullying on the basis of a given definition. According to some authors, the combination of both approaches would be adequate to define cases of bullying.<sup>30,32-34</sup> Duration and frequency of bullying would also be crucial elements. In the present study, we combined the two approaches: 1) the questionnaire developed by Leymann, the Leymann Inventory of Psychological Terror (LIPT),<sup>35</sup> considered to have the greatest coverage and acceptable reliabilities,<sup>36</sup> and evaluating 45 forms of bullying, and 2) self-report of being exposed to bullying.

Studies exploring the associations between workplace bullying and health outcomes are still lacking. Nevertheless, workplace bullying has been found to be associated with sickness absence,<sup>37</sup> psychosomatic complaints and somatic symptoms,<sup>38-40</sup> and mental health outcomes such as job induced stress, psychological health and well-being, anxiety, depression,<sup>29,30,39-47</sup> use of psychotropic drugs,<sup>28,30</sup> and physician-diagnosed psychiatric morbidity.<sup>48</sup>

The objectives of this study were to examine the associations between workplace bullying and sleep disturbances. This study attempted to take the limitations described above into account, as it was based on a large and non-selective sample of the French working population, it included a standard measure of exposure to workplace bullying, and detailed information on this exposure, and took account of a large number of confounding factors.

## **METHODS**

### **Study sample**

This cross-sectional survey was performed by the National Institute for Health and Medical Research (INSERM) in 2004 among the general working population in the South-East of France in collaboration with a network of 143 voluntary occupational physicians, who, if working full-time, each selected 150 employees randomly, and invited them to participate in the survey. Occupational medicine is mandatory for all employees in France, consequently, every employee has a medical examination with an occupational physician periodically, at the

time of the survey this was annually. In order to be included in the survey, employees had to have worked for at least 3 months in their company. The survey was based on a self-administered questionnaire which was anonymous, and was returned using a prepaid envelope to the INSERM. As employees included in the survey were all working at the time of the survey, it could be assumed that those suffering from major mental health and/or severe sleep disorders might be under-represented in the sample, as these people are more likely to be on sick leave. Several papers have already been published on the topic of workplace bullying using this study sample.<sup>49-51</sup>

### **Measurement of workplace bullying**

Our questionnaire included the French version of the LIPT, measuring the experience of 45 forms of bullying within the previous 12 months, as well as frequency and duration of bullying. The 45 forms of bullying, derived from interviews and heuristic analyses by Leymann,<sup>31</sup> are presented in 5 thematic-sections depending on the effects these situations may have on the victim: social relationships (no possibility to communicate, verbal aggression, criticism, etc.), exclusion (isolation, rejection, etc.), job situations and tasks (no tasks, too many tasks, uninteresting tasks, humiliating tasks, tasks inferior/superior to skills, etc.), personal attacks (attacks on opinions/origins, rumours, gossiping, etc.), and physical violence and threats of physical violence (including sexual harassment). Afterwards, the employees were given the following definition developed by the authors: ‘Bullying may be defined by a situation in which someone is exposed to hostile behaviour on the part of one or more persons in the work environment which aim continually and repeatedly to offend, oppress, maltreat, or to exclude or isolate over a long period of time.’ The employees were asked if they perceived themselves as being exposed to bullying within the past 12 months. Cases of bullying were defined using both Leymann’s definition, i.e. exposure to at least one form of bullying within the previous 12 months, weekly or more, and for at least 6 months,<sup>31</sup> and the self-report of being exposed to bullying, as recommended previously.<sup>30;32-34</sup> The psychometric properties of the French version of the LIPT questionnaire were studied in a previous paper,<sup>49</sup> and we found that the combined evaluation of bullying increased the convergent and predictive validity compared with Leymann’s definition alone.

Several variables were used to characterize the exposure to workplace bullying within the previous 12 months: period of exposure (current or past), frequency and duration of exposure,

and the fact that the employees may have been observers of bullying over someone else at their workplace within the past 12 months. We also constructed a variable combining the two variables of exposure to bullying and observing bullying by creating four categories: no exposure at all, observer of bullying, exposure to bullying, and both exposure to bullying and observer of bullying.

### **Measurement of sleep disturbances**

Sleep disturbances were measured using two items evaluating trouble initiating sleep and trouble falling asleep again in case of premature awakening. These two items were based on 4 response categories which were: 'no trouble at all', 'little trouble', 'important trouble' and 'very important trouble'. These items were dichotomized to distinguish people with no or little trouble and those with important or very important trouble. Thereafter, sleep disturbances were defined by either trouble initiating sleep, or trouble falling asleep again in case of premature awakening, or both.

### **Covariates**

Several variables were used as covariates: age, marital status, presence of children, educational level, occupational groups, working hours per week, night work (time schedules involving night work, such as permanent night work or alternating shifts including night shift), and the number of physico-chemical exposures at work to thermic constraints (outdoor work, cold or hot temperatures), noise, radiation, chemical exposures, or other exposures. Two health-related variables were also studied: poor self-reported health, based on a 4-level scale ranging from 'very good' (coded 1) to 'very poor' (coded 4), and defined by levels 3 and 4, and depressive symptoms measured using the CES-D scale<sup>50</sup> and defined using the available thresholds established for the French population ( $\geq 17$  for men and  $\geq 23$  for women) to dichotomize the CES-D score.<sup>52</sup>

### **Statistical analysis**

In the first place, the crude associations between 6 variables characterizing bullying (i.e. exposure, period, frequency, duration of bullying, and the two variables of observing bullying) and sleep disturbances were studied using Pearson's Chi-Square test. The

associations between covariates and sleep disturbances were also studied using the same test. In the second place, logistic regression analysis was used to adjust for the same covariates (except self-reported health and depressive symptoms). Consequently, we constructed 6 different models with sleep disturbances as the dependent variable. In each model, we included as independent variables simultaneously one of the 6 variables describing bullying, as well as the covariates. Additional models were also performed with additional adjustment for poor self-reported health and depressive symptoms.

Statistical analysis was performed using SAS.<sup>53</sup> As differences may be observed between men and women for the prevalences of occupational exposures (bullying), and of health outcomes (sleep disturbances), and as the associations between exposures and outcomes may also differ between genders, analysis was carried out separately for men and women.<sup>54</sup>

## **RESULTS**

### **Description of the study sample**

In 2004, 19655 employees were asked to participate in the survey. Among them, 7770 responded to the self-administered questionnaire, leading to a response rate of 40%. Seventy six employees were excluded from the analysis, 57 because they had worked for less than 3 months in their company, and 19 because sex response was missing in the questionnaire. Thus, the study was based on 7694 employees, 3132 men and 4562 women, with a mean age of 40 (standard deviation: 10.3). A description of the study sample is shown in Table 1.

Table 2 shows the description of the characteristics of bullying in the study sample. Leymann's definition alone (exposure to at least one form of bullying within the past 12 months, for more than 6 months and weekly or more) led to a 12-month prevalence of 11% for men and 13% for women. Using the definition of exposure to bullying combining Leymann's definition and the self-reporting of bullying by the employees within the same period, the 12-month prevalence of exposure to bullying were respectively 9% and 11% for men and women. These results show that most of those defined as exposed to bullying using Leymann's definition also reported being exposed.

### **Crude associations between bullying and sleep disturbances**



Table 3 provides the results of the associations between the variables of bullying and sleep disturbances. All of these associations were strongly significant at  $p < 0.001$ . The prevalence of sleep disturbances increased among people exposed to workplace bullying, especially among those who were currently exposed. People who were exposed to bullying in the past were also at higher risk of sleep disturbances than those who had never been exposed. The more frequent the exposure to workplace bullying, the higher the prevalence of sleep disturbances. No dose-response association was observed between the duration of exposure to bullying and sleep disturbances; the prevalence of sleep disturbances was high whatever the duration of bullying. Observing bullying was also associated with an increase in the prevalence of sleep disturbances. The study of the combination of exposure to bullying and observing bullying led to differential results for men and women. For men, the highest prevalence of sleep disturbances was observed for those exposed to bullying (with or without observing it), and for women, it was found among those who were simultaneously exposed to bullying and observers of bullying.

### **Crude associations between covariates and sleep disturbances**

The associations between the covariates studied and sleep disturbances were found to be significant at least for one sex, except for marital status and occupation (Table 4). The prevalence of sleep disturbances increased with age, among men having children, among women having a lower educational level, among those working 40 hours or more a week, among female night workers, and among those exposed to physico-chemical exposures at work. The prevalence of sleep disturbances also increased strongly with poor self-reported health and depressive symptoms.

### **Associations between bullying and sleep disturbances after controlling for covariates**

Table 5 provides the results of logistic regression analysis. Each model shows the association between each variable of bullying and sleep disturbances after adjustment for covariates. All of these associations were strongly significant at  $p < 0.001$ , suggesting that covariates did not modify the strong associations observed in Table 3. Exposure to workplace bullying within the last 12 months was found to be a strong risk factor for sleep disturbances. Past exposure to bullying also increased this risk among women. The more frequent the exposure to bullying,

the higher the prevalence of sleep disturbances. Observing bullying of someone else increased the risk of sleep disturbances. The combination of exposure to bullying and observing bullying at the workplace led to the highest increase in risk for women.

Additional adjustment for poor self-reported health and depressive symptoms led to a reduction in the magnitude of the odds-ratios, but the associations remained significant at  $p < 0.01$  (Table 6). These additional results confirmed those provided in Table 5. Note that dose-response associations were observed for duration of bullying for both genders.

## **DISCUSSION**

### **Main findings**

This study shows that workplace bullying was strongly associated with sleep disturbances. Past exposure to bullying increased the risk of sleep disturbances among women, and the more frequent the exposure to bullying, the higher this risk. Observing bullying of someone else at the workplace was a risk factor of sleep disturbances. Women exposed to both bullying and observing it were at particular increased risk of sleep disturbances. All of these associations were independent of potential confounding factors.

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

The response rate may be considered low (40%), but it is similar to previous studies on this sensitive topic.<sup>42;55-57</sup> Selection bias may not be ruled out, but the differences between respondents and non-respondents were small for sex, age, economic activities, and occupation. In addition, a comparison between the census population and the sample studied suggested that the study sample was roughly representative for age, economic activities, and occupations.<sup>49</sup> In addition, this potential selection bias may have an impact on prevalence estimates of workplace bullying for example, but it seems unlikely that it has greatly altered the association between workplace bullying and sleep disturbances.

A healthy worker effect may have operated, if people in poor health shifted to less exposed jobs or left their jobs, leading to a potential under-estimation of the association between workplace bullying and sleep disturbances. This is reinforced by the fact that this survey

included employees who were working at the time of the survey, and did not include employees on sickness absence within the survey period, including those who were on sick leave because of the health consequences of workplace bullying. This suggests that our findings on the associations between workplace bullying and sleep disturbances may be more underestimated than overestimated.

The cross-sectional design of our study did not allow us to make conclusions on the causal nature of the association between workplace bullying and sleep disturbances, and a reverse causation may not be excluded (workers with sleep disturbances may be more likely to be exposed to bullying). A reporting bias may also be suspected as both workplace bullying and sleep disturbances were measured using self-report. This reporting bias, which is connected to ‘common method variance’, for example through negative affectivity and social desirability, may lead to inflated associations between bullying and outcome.

Another limitation is related to the use of a rather crude measure for sleep disturbances (already used by others),<sup>58</sup> that did not allow us to study severity and duration of these disturbances. We also studied sleep disturbances by a score higher than 4 on the basis of the sum of the two initial items (score ranging from 2 to 8) and found very similar results to those provided in our Tables, confirming the robustness of our results. We were also able to study the two subtypes of sleep disturbances (trouble falling asleep and trouble staying asleep) separately, and found significant associations between all bullying variables and both subtypes of sleep disturbances, even after adjustment for all covariates. Stronger associations (ORs of larger magnitude) were observed for trouble staying asleep. In addition, as strong and consistent associations were found between classical risk factors (age, education, working hours, night work, physico-chemical exposures at work, self-reported health, and depressive symptoms) and sleep disturbances, these results reinforce the validity of our study. Finally, our study did not include some previously reported risk factors of sleep disturbances such as use of alcohol and stimulants like caffeine or tobacco, poor sleeping environment, specific family stressors, past medical and psychiatric history, etc. However, it seems unlikely that these factors would completely explain the strong associations observed here between workplace bullying and sleep disturbances.

The strengths of this study were: (i) our sample included a very large number of employees of the general working population, allowing us to study a non-selective population, as well as

men and women separately, which has been shown to be crucial,<sup>54</sup> (ii) a validated instrument was used to measure workplace bullying (LIPT), and various variables were constructed to describe the exposure to workplace bullying, which has never been done before in the study of sleep disturbances, and provided detailed information on exposure to bullying and its associations with sleep disturbances, (iii) the statistical analysis took into account important covariates; sociodemographic and occupational factors, and these covariates did not modify the strong associations between bullying and sleep disturbances. Additional adjustment for health-related variables diminished the associations, that remained significant. It is likely that the additional adjustment for poor self-reported health and depressive symptoms constitutes an over-adjustment, as self-reported health and depressive symptoms may be intermediate variables between workplace bullying and sleep disturbances,<sup>37;47;50</sup> or even consequences of sleep disturbances.<sup>15;16;18</sup> Consequently, the actual associations between bullying and sleep disturbances may be closer to those observed in Table 5.

We also observed that the associations between bullying and sleep disturbances were significant after adjustment for the psychosocial work factors by Karasek, i.e. psychological demands, decision latitude, and social support, although the magnitude of the associations was somewhat reduced. Note, however, that adjusting for psychosocial work factors may lead to underestimate the effects of workplace bullying on sleep disturbances as these factors may be considered as risk factors of bullying. We also performed an additional analysis stratified on social support at work and observed results that were different according to sex: the association between bullying and sleep disturbances was no longer significant among men with high levels of social support at work, whereas this association remained significant among women with high levels of support. These findings suggest that, at least partly, social support at work may act as a buffer in the association between bullying and sleep disturbances, and/or that workplaces with high levels of social support may promote better working conditions with lower levels of bullying. Indeed, we observed that high social support was significantly associated with lower prevalence of bullying, lower frequency and duration of bullying, as well as lower prevalence of observing bullying on someone else.

### **Comparison with literature**

Few studies have examined the association between workplace bullying and sleep disturbances. The study by Eriksen et al.<sup>3</sup> showed that exposure to threats and violence at

work predicted poor sleep quality in a population of nurses' aides in Norway, after adjustment for age, gender, marital status, presence of preschool children, and other occupational factors. Vartia et al.<sup>30</sup> reported that bullied employees used both sleep-induced drugs and sedatives more often than the other subjects, observers were also more likely to use them than nonbullied, but the use of these drugs did not correlate with the duration or the frequency of bullying. In this study, based on a sample of Finnish municipal employees, no information was provided on confounding factors. In these two studies, the measurement of bullying and/or sleep related outcomes were based on single items. Other studies underlined the association between low levels of social support at work and sleep disorders.<sup>3;6;9;19;20;59</sup> Authors studied other markers, such as bad perceived atmosphere at work, that can also be considered as proxies of the quality of interpersonal relationships at work.<sup>4</sup>

Our results are in agreement with these studies. As never observed before, we found dose-response associations between frequency (and partly duration) of exposure to bullying and sleep disturbances. Past exposure to bullying had still an impact on sleep disturbances among women, pointing the long term effects of bullying, even when the exposure had stopped. Finally, being an observer of bullying was a risk factor of sleep disturbances, and the combination of exposure to bullying and observing was still a stronger risk factor, especially for women. Our results are in agreement with the study by Vartia et al.<sup>30</sup> finding an association between observing bullying and the use of sleep-induced drugs and sedatives, although these authors did not distinguish, among people observing bullying, between those who were directly exposed to bullying and those who were not.

## **Conclusion**

Our findings underline the strong association between workplace bullying and sleep disturbances, and suggest that workplaces prone to bullying may have a detrimental effect on employees' sleep, even if employees are not directly concerned by the phenomenon. Given the high prevalence of workplace bullying observed in France, and its impact on sleep, it may be assumed that such a job stress factor may substantially contribute to the burden of sleep related disorders. As this study did not provide information about causality, more prospective studies are needed to better understand bullying, its determinants, and consequences. Efforts toward prevention should also be increased.

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**Table 1-** Description of the sample studied

|   | Men<br>N=3132 |       | Women<br>N=4562 |       |
|---|---------------|-------|-----------------|-------|
|   | N             | %     | N               | %     |
| <b>Age (years)</b>                          |               |       |                 |       |
| < 30  | 523           | 16.75 | 853             | 18.76 |
| 30-39                                       | 1017          | 32.56 | 1349            | 29.67 |
| 40-49                                       | 862           | 27.60 | 1344            | 29.57 |
| 50 or more                                  | 721           | 23.09 | 1000            | 22.00 |
| <b>Marital status</b>                       |               |       |                 |       |
| Married, cohabiting                         | 2131          | 68.06 | 2876            | 63.13 |
| Single, separated, divorced, widowed        | 1000          | 31.94 | 1680            | 36.87 |
| <b>Presence of children</b>                 |               |       |                 |       |
| Yes   | 1681          | 53.76 | 2497            | 54.98 |
| No  | 1446          | 46.24 | 2045            | 45.02 |
| <b>Education</b>                            |               |       |                 |       |
| Primary, lower vocational, lower secondary  | 1367          | 43.79 | 1589            | 34.91 |
| Upper secondary                             | 462           | 14.80 | 1044            | 22.93 |
| University                                  | 1293          | 41.41 | 1919            | 42.16 |
| <b>Occupation</b>                           |               |       |                 |       |
| Blue collar worker                          | 784           | 25.14 | 180             | 3.97  |
| Clerks, service workers                     | 582           | 18.67 | 2432            | 53.64 |
| Associate professionals                     | 1104          | 35.41 | 1573            | 34.69 |
| Managers, engineers                         | 648           | 20.78 | 349             | 7.70  |
| <b>Working hours a week</b>                 |               |       |                 |       |
| <40   | 1738          | 58.26 | 3680            | 82.96 |
| ≥40   | 1245          | 41.74 | 756             | 17.04 |
| <b>Night work</b>                           |               |       |                 |       |
| No  | 2792          | 89.92 | 4258            | 94.14 |
| Yes   | 313           | 10.08 | 265             | 5.86  |
| <b>Number of physico-chemical exposures</b> |               |       |                 |       |
| 0   | 1667          | 53.23 | 3079            | 67.49 |
| 1   | 443           | 14.14 | 883             | 19.36 |
| 2   | 322           | 10.28 | 348             | 7.63  |
| ≥ 3   | 700           | 22.35 | 252             | 5.52  |
| <b>Self-reported health</b>                 |               |       |                 |       |
| Good  | 2766          | 88.97 | 3899            | 86.28 |
| Poor  | 343           | 11.03 | 620             | 13.72 |
| <b>Depressive symptoms</b>                  |               |       |                 |       |
| No  | 2270          | 74.57 | 3499            | 78.82 |
| Yes <sup>a</sup>                            | 774           | 25.43 | 940             | 21.18 |
| <b>Sleep disturbances</b>                   |               |       |                 |       |
| No  | 2597          | 82.92 | 3548            | 77.77 |
| Yes   | 535           | 17.08 | 1014            | 22.23 |

<sup>a</sup>CES-D score ≥17 for men and ≥23 for women

**Table 2-** Description of the exposure to bullying within the previous 12 months

|  | Men<br>N=3132 |       | Women<br>N=4562 |       |
|--|---------------|-------|-----------------|-------|
|  | N             | %     | N               | %     |
| <b>Exposure to bullying</b>                      |               |       |                 |       |
| No   | 2857          | 91.22 | 4074            | 89.30 |
| Yes  | 275           | 8.78  | 488             | 10.70 |
| <b>Period of exposure to bullying</b>            |               |       |                 |       |
| No exposure                                      | 2857          | 91.34 | 4074            | 89.46 |
| Past exposure                                    | 38            | 1.21  | 130             | 2.85  |
| Current exposure                                 | 233           | 7.45  | 350             | 7.69  |
| <b>Frequency of exposure to bullying</b>         |               |       |                 |       |
| No exposure                                      | 2857          | 91.22 | 4074            | 89.30 |
| Weekly   | 149           | 4.76  | 225             | 4.93  |
| Daily or almost daily                            | 126           | 4.02  | 263             | 5.77  |
| <b>Duration of exposure to bullying</b>          |               |       |                 |       |
| No exposure                                      | 2857          | 91.22 | 4074            | 89.31 |
| < 2 years  | 94            | 3.00  | 209             | 4.58  |
| ≥ 2 years, but < 5 years                         | 114           | 3.64  | 179             | 3.92  |
| 5 years or more                                  | 67            | 2.14  | 100             | 2.19  |
| <b>Observer of bullying</b>                      |               |       |                 |       |
| No   | 2165          | 69.13 | 3115            | 68.28 |
| Yes  | 967           | 30.87 | 1447            | 31.72 |
| <b>Combination exposure to bullying/observer</b> |               |       |                 |       |
| No exposure                                      | 2111          | 67.40 | 2998            | 65.72 |
| Observer   | 746           | 23.82 | 1076            | 23.59 |
| Exposure to bullying                             | 54            | 1.72  | 117             | 2.56  |
| Exposure to bullying and observer                | 221           | 7.06  | 371             | 8.13  |

**Table 3-** Associations between exposure to bullying and sleep disturbances

|  | Cases<br>(N) | Men<br>Cases<br>(%) | Women<br>Cases<br>(%) |       |
|--|--------------|---------------------|-----------------------|-------|
| <b>Exposure to bullying</b>                      |              |                     |                       |       |
| No   | 416          | 14.56               | 777                   | 19.07 |
| Yes  | 119          | 43.27               | 237                   | 48.57 |
| <b>Period of exposure to bullying</b>            |              |                     |                       |       |
| No exposure                                      | 416          | 14.56               | 777                   | 19.07 |
| Past exposure                                    | 5            | 13.16               | 49                    | 37.69 |
| Current exposure                                 | 113          | 48.50               | 183                   | 52.29 |
| <b>Frequency of exposure to bullying</b>         |              |                     |                       |       |
| No exposure                                      | 416          | 14.56               | 777                   | 19.07 |
| Weekly   | 55           | 36.91               | 103                   | 45.78 |
| Daily or almost daily                            | 64           | 50.79               | 134                   | 50.95 |
| <b>Duration of exposure to bullying</b>          |              |                     |                       |       |
| No exposure                                      | 416          | 14.56               | 777                   | 19.07 |
| < 2 years  | 40           | 42.55               | 89                    | 42.58 |
| ≥ 2 years, but < 5 years                         | 47           | 41.23               | 96                    | 53.63 |
| 5 years or more                                  | 32           | 47.76               | 52                    | 52.00 |
| <b>Observer of bullying</b>                      |              |                     |                       |       |
| No   | 272          | 12.56               | 553                   | 17.75 |
| Yes  | 263          | 27.20               | 461                   | 31.86 |
| <b>Combination exposure to bullying/observer</b> |              |                     |                       |       |
| No exposure                                      | 249          | 11.80               | 508                   | 16.94 |
| Observer   | 167          | 22.39               | 269                   | 25.00 |
| Exposure to bullying                             | 23           | 42.59               | 45                    | 38.46 |
| Exposure to bullying and observer                | 96           | 43.44               | 192                   | 51.75 |

Chi-Square test

All associations significant at  $p < 0.001$

**Table 4-** Associations between covariates and sleep disturbances

|   | Men          |              | Women        |              |
|---|--------------|--------------|--------------|--------------|
|   | Cases<br>(N) | Cases<br>(%) | Cases<br>(N) | Cases<br>(%) |
| <b>Age (years)</b>                          |              | *            |              | ***          |
| < 30  | 70           | 13.38        | 140          | 16.41        |
| 30-39                                       | 169          | 16.62        | 266          | 19.72        |
| 40-49                                       | 161          | 18.68        | 297          | 22.10        |
| 50 or more                                  | 134          | 18.59        | 304          | 30.40        |
| <b>Marital status</b>                       |              | NS           |              | NS           |
| Married, cohabiting                         | 373          | 17.50        | 620          | 21.56        |
| Single, separated, divorced, widowed        | 162          | 16.20        | 392          | 23.33        |
| <b>Presence of children</b>                 |              | **           |              | NS           |
| Yes   | 320          | 19.04        | 563          | 22.55        |
| No  | 215          | 14.87        | 443          | 21.91        |
| <b>Education</b>                            |              | NS           |              | **           |
| Primary, lower vocational, lower secondary  | 240          | 17.56        | 397          | 24.93        |
| Upper secondary                             | 76           | 16.45        | 229          | 21.93        |
| University                                  | 217          | 16.78        | 386          | 20.11        |
| <b>Occupation</b>                           |              | NS           |              | NS           |
| Blue collar worker                          | 121          | 15.43        | 46           | 25.56        |
| Clerks, service workers                     | 109          | 18.73        | 551          | 22.66        |
| Associate professionals                     | 198          | 17.93        | 348          | 22.12        |
| Managers, engineers                         | 107          | 16.51        | 67           | 19.20        |
| <b>Working hours a week</b>                 |              | **           |              | ***          |
| <40   | 267          | 15.36        | 779          | 21.17        |
| ≥40   | 247          | 19.84        | 204          | 26.98        |
| <b>Night work</b>                           |              | NS           |              | *            |
| No  | 472          | 16.91        | 933          | 21.91        |
| Yes   | 62           | 19.81        | 73           | 27.55        |
| <b>Number of physico-chemical exposures</b> |              | **           |              | ***          |
| 0   | 249          | 14.94        | 608          | 19.75        |
| 1   | 87           | 19.64        | 231          | 26.16        |
| 2   | 55           | 17.08        | 90           | 25.86        |
| ≥ 3   | 144          | 20.57        | 85           | 33.73        |
| <b>Self-reported health</b>                 |              | ***          |              | ***          |
| Good  | 360          | 13.02        | 614          | 15.75        |
| Poor  | 173          | 50.44        | 395          | 63.71        |
| <b>Depressive symptoms</b>                  |              | ***          |              | ***          |
| No  | 206          | 9.09         | 466          | 13.32        |
| Yes <sup>a</sup>                            | 320          | 41.34        | 524          | 55.74        |

Chi-Square test \*: p&lt;0.05 \*\*: p&lt;0.01 \*\*\*: p&lt;0.001

<sup>a</sup>CES-D score ≥17 for men and ≥23 for women

**Table 5-** Exposure to bullying and sleep disturbances according to logistic regression analysis

|  | Men         |                  | Women       |                  |
|--|-------------|------------------|-------------|------------------|
|  | OR          | 95% CI           | OR          | 95% CI           |
| <b>Exposure to bullying</b>                      |             |                  |             |                  |
| No   | 1           |                  | 1           |                  |
| Yes  | <b>4.40</b> | <b>3.35-5.78</b> | <b>3.83</b> | <b>3.12-4.70</b> |
| <b>Period of exposure to bullying</b>            |             |                  |             |                  |
| No exposure                                      | 1           |                  | 1           |                  |
| Past exposure                                    | 0.91        | 0.35-2.38        | <b>2.63</b> | <b>1.80-3.86</b> |
| Current exposure                                 | <b>5.47</b> | <b>4.09-7.32</b> | <b>4.35</b> | <b>3.44-5.51</b> |
| <b>Frequency of exposure to bullying</b>         |             |                  |             |                  |
| No exposure                                      | 1           |                  | 1           |                  |
| Weekly   | <b>3.25</b> | <b>2.27-4.66</b> | <b>3.38</b> | <b>2.54-4.49</b> |
| Daily or almost daily                            | <b>6.34</b> | <b>4.31-9.33</b> | <b>4.28</b> | <b>3.27-5.60</b> |
| <b>Duration of exposure to bullying</b>          |             |                  |             |                  |
| No exposure                                      | 1           |                  | 1           |                  |
| < 2 y  | <b>4.52</b> | <b>2.91-7.03</b> | <b>3.22</b> | <b>2.38-4.34</b> |
| ≥ 2 y, but < 5 y                                 | <b>4.20</b> | <b>2.81-6.28</b> | <b>4.63</b> | <b>3.37-6.36</b> |
| 5 years or more                                  | <b>4.58</b> | <b>2.74-7.66</b> | <b>3.91</b> | <b>2.57-5.95</b> |
| <b>Observer of bullying</b>                      |             |                  |             |                  |
| No   | 1           |                  | 1           |                  |
| Yes  | <b>2.53</b> | <b>2.07-3.09</b> | <b>2.20</b> | <b>1.89-2.57</b> |
| <b>Combination exposure to bullying/observer</b> |             |                  |             |                  |
| No exposure                                      | 1           |                  | 1           |                  |
| Observer   | <b>2.08</b> | <b>1.66-2.62</b> | <b>1.70</b> | <b>1.42-2.03</b> |
| Exposure to bullying                             | <b>5.33</b> | <b>2.96-9.60</b> | <b>3.04</b> | <b>2.03-4.55</b> |
| Exposure to bullying and observer                | <b>5.71</b> | <b>4.18-7.79</b> | <b>5.12</b> | <b>4.03-6.50</b> |

OR adjusted for age, marital status, presence of children, education, occupation, working hours a week, night work, and physico-chemical exposures

All bullying variables were significant at  $p < 0.001$

**Table 6-** Exposure to bullying and sleep disturbances according to logistic regression analysis including additional adjustment for poor self-reported health and depressive symptoms

|  | Men         |                  | Women       |                  |
|--|-------------|------------------|-------------|------------------|
|  | OR          | 95% CI           | OR          | 95% CI           |
| <b>Exposure to bullying</b>                      | ***         |                  | ***         |                  |
| No   | 1           |                  | 1           |                  |
| Yes  | <b>1.84</b> | <b>1.34-2.53</b> | <b>1.60</b> | <b>1.26-2.05</b> |
| <b>Period of exposure to bullying</b>            | ***         |                  | ***         |                  |
| No exposure                                      | 1           |                  | 1           |                  |
| Past exposure                                    | 0.34        | 0.11-1.06        | <b>1.58</b> | <b>1.02-2.47</b> |
| Current exposure                                 | <b>2.29</b> | <b>1.64-3.22</b> | <b>1.61</b> | <b>1.21-2.13</b> |
| <b>Frequency of exposure to bullying</b>         | ***         |                  | ***         |                  |
| No exposure                                      | 1           |                  | 1           |                  |
| Weekly   | 1.48        | 0.98-2.24        | <b>1.47</b> | <b>1.05-2.06</b> |
| Daily or almost daily                            | <b>2.39</b> | <b>1.54-3.71</b> | <b>1.73</b> | <b>1.26-2.38</b> |
| <b>Duration of exposure to bullying</b>          | **          |                  | ***         |                  |
| No exposure                                      | 1           |                  | 1           |                  |
| < 2 y  | <b>1.73</b> | <b>1.05-2.85</b> | 1.33        | 0.94-1.90        |
| ≥ 2 y, but < 5 y                                 | <b>1.74</b> | <b>1.09-2.77</b> | <b>1.82</b> | <b>1.25-2.65</b> |
| 5 years or more                                  | <b>2.21</b> | <b>1.23-3.96</b> | <b>1.87</b> | <b>1.14-3.06</b> |
| <b>Observer of bullying</b>                      | ***         |                  | **          |                  |
| No   | 1           |                  | 1           |                  |
| Yes  | <b>1.71</b> | <b>1.37-2.14</b> | <b>1.30</b> | <b>1.09-1.56</b> |
| <b>Combination exposure to bullying/observer</b> | ***         |                  | ***         |                  |
| No exposure                                      | 1           |                  | 1           |                  |
| Observer   | <b>1.60</b> | <b>1.25-2.05</b> | 1.20        | 0.98-1.47        |
| Exposure to bullying                             | 1.71        | 0.89-3.30        | 1.46        | 0.91-2.34        |
| Exposure to bullying and observer                | <b>2.38</b> | <b>1.66-3.40</b> | <b>1.81</b> | <b>1.36-2.40</b> |

OR adjusted for age, marital status, presence of children, education, occupation, working hours a week, night work, physico-chemical exposures, self-reported health, and depressive symptoms

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