



# Association of workplace violence and bullying with later suicide risk: a multicohort study and meta-analysis of published data

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## Summary

**Background** Workplace offensive behaviours, such as violence and bullying, have been linked to psychological symptoms, but their potential impact on suicide risk remains unclear. We aimed to assess the association of workplace violence and bullying with the risk of death by suicide and suicide attempt in multiple cohort studies.

**Methods** In this multicohort study, we used individual-participant data from three prospective studies: the Finnish Public Sector study, the Swedish Work Environment Survey, and the Work Environment and Health in Denmark study. Workplace violence and bullying were self-reported at baseline. Participants were followed up for suicide attempt and death using linkage to national health records. We additionally searched the literature for published prospective studies and pooled our effect estimates with those from published studies.

**Findings** During 1 803 496 person-years at risk, we recorded 1103 suicide attempts or deaths in participants with data on workplace violence ( $n=205\,048$ ); the corresponding numbers for participants with data on workplace bullying ( $n=191\,783$ ) were 1144 suicide attempts or deaths in 1 960 796 person-years, which included data from one identified published study. Workplace violence was associated with an increased risk of suicide after basic adjustment for age, sex, educational level, and family situation (hazard ratio 1.34 [95% CI 1.15–1.56]) and full adjustment (additional adjustment for job demands, job control, and baseline health problems, 1.25 [1.08–1.47]). Where data on frequency were available, a stronger association was observed among people with frequent exposure to violence (1.75 [1.27–2.42]) than occasional violence (1.27 [1.04–1.56]). Workplace bullying was also associated with an increased suicide risk (1.32 [1.09–1.59]), but the association was attenuated after adjustment for baseline mental health problems (1.16 [0.96–1.41]).

**Interpretation** Observational data from three Nordic countries suggest that workplace violence is associated with an increased suicide risk, highlighting the importance of effective prevention of violent behaviours at workplaces.

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## Introduction

Workplace offensive behaviours, such as violence (ie, behaviours or threats thereof with the objective of physical, psychological, sexual, or economic harm<sup>1</sup>) and bullying (a repeated and enduring form of harassment), are relatively common phenomena. Workplace violence is prevalent, particularly in industries that involve contact with patients or clients, such as service and health-care industries.<sup>2</sup> Globally, the estimated 12-month prevalence of workplace violence among health-care workers is 62%.<sup>2</sup>

Offensive behaviours are potentially serious stressors that can have a marked effect on employee health and wellbeing. Cohort studies suggest an increased risk of emotional and psychosomatic symptoms, depression, post-traumatic stress syndrome, diabetes, and cardiovascular disease that might partly explain elevated rates

of absenteeism in this group of employees.<sup>3–8</sup> Studies have also linked employee sexual harassment with increased suicide risk in women,<sup>9</sup> and workplace bullying with suicidal ideation<sup>10</sup> and suicidal behaviour.<sup>11</sup> However, few prospective studies have been published on workplace violence.

Using data from three prospective cohort studies and published research identified in a systematic search we aimed to investigate the association of workplace violence, workplace bullying, and the risk of subsequent suicide attempts or death by suicide.

## Methods

### Study population

In this multicohort study, we used data from two cohort studies from the individual-participant data meta-analysis in working populations consortium: the Finnish

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**Research in context****Evidence before this study**

Workplace offensive behaviours, such as violence and bullying, are a source of emotional stress for employees and a risk factor for depression and cardiovascular disease, but evidence on the potential impact on self-harm and suicide is scarce.

We searched the literature (PROSPERO registration CRD 42022301704), Web of Science (including PubMed), Scopus, PsycInfo, and Embase from database inception to June 31, 2022, for prospective observational studies published in English investigating the associations of workplace violence and bullying with risk of suicide using the search terms (“violence” OR “bullying”) AND (“work” OR “organization”) AND (“suicide” OR “suicidal behaviors”). Our search yielded more than 800 potentially relevant articles, of which only one fulfilled Population, Exposure, Comparator, and Outcomes criteria. In a pooled dataset of 98 330 participants from nine Danish surveys, suicide risk was almost two times higher among men exposed to workplace bullying than non-exposed men. In women, suicide risk was imprecisely estimated and no strong evidence of an association was identified.

No prospective evidence was available on the association of workplace violence and suicide risk.

**Added value of this study**

Our multicohort study showed that the risk of suicide death or attempt was 1.3 times higher in employees who reported exposure to workplace violence than those who reported no exposure. Pooled analyses on workplace bullying suggested the risk of suicide death or attempt was 1.3 times higher among individuals who reported exposure to workplace bullying than those not exposed. However, the association attenuated after controlling for prevalent mental health problems at baseline.

**Implications of all the available evidence**

In the present analyses of multiple studies, employees exposed to workplace violence had an increased risk of suicide. These findings are consistent with the few existing studies reporting adverse effects of workplace offensive behaviours on other health outcomes such as depression and cardiovascular disease. Although the evidence base is modest in scale, it highlights the importance of eliminating such behaviours from the workplace for employee health and supports the establishment of zero tolerance policies.

See Online for appendix

Public Sector Study (FPS)<sup>12</sup> and the Swedish Work Environment Surveys (SWES;<sup>13</sup> appendix pp 1–2) and a study from Denmark, the Work Environment and Health in Denmark study (WEHD).<sup>14</sup> A detailed description of the included studies is provided in the appendix (p 1). This study followed the STROBE reporting guideline for cohort studies.

FPS comprised 151 901 employees with a minimum 6-month employment contract in ten towns and five hospital districts in Finland. Workplace violence and bullying were assessed in selected postal surveys conducted in 1997, 2000, 2004, 2008, and 2012 and employees were followed up for suicide attempt or death until Dec 31, 2018. SWES is a representative cross-sectional survey of the Swedish workforce (individuals aged 16–64 years), performed every 2 years since 1989. Data for the present analyses were derived from self-completion questionnaires completed between 1995 and 2013 and follow-up register data on suicide attempt or death available until Dec 31, 2016. The eligible population included 154 677 individuals. WEHD is based on a random selection of individuals 18–64 years of age in the national workforce of Denmark. Starting in 2012, a series of biennial postal or web-based data collections have been performed. For this study, the eligible population included 133 924 individuals from the 2012, 2014, and 2016 surveys. Follow-up of suicide attempts or deaths in the register data was completed until Dec 31, 2016.

Questionnaire-based and register-based studies do not require approval from central ethical committees,

according to Danish law; thus the requirement for ethical approval was waived. Participants provided written consent by filling out and returning the questionnaires.

**Measurement of workplace violence, bullying, and covariates**

In individual participant data, respondents were considered exposed to any workplace violence if they reported that they had been targeted with violence or threats of violence within the past 12 months or within the current year (FPS). The wording varied slightly between the cohorts (appendix p 3). To examine any dose–response associations, we divided SWES participants into three groups: individuals with no exposure, individuals exposed less than once a week (occasionally exposed), and individuals with weekly exposure (frequently exposed).

Regarding workplace bullying, participants were asked whether they were currently being bullied at work (FPS), or had experienced bullying within the past 12 months (SWES). We defined exposure to workplace bullying as giving an affirmative response to the question (appendix p 3). For the purpose of dose–response analyses, we identified people with no exposure, occasional exposure (less than weekly), or frequent exposure (weekly) to bullying in SWES. However, since bullying data from WEHD were already published, we restricted analyses from WEHD to workplace violence only.

Sex, age, family situation (combination of cohabitation status and presence of children in the household), and educational level were considered potential confounding

factors.<sup>5-7</sup> In FPS, data were collected from employers registers (age and sex), surveys (family situation), and Statistics Finland (education). In SWES, sex, age, family situation, and educational level were collected from linked administrative records from Statistics Sweden. The corresponding WEHD data were collected from administrative records from Statistics Denmark. Educational level was classified into three categories: 9 years or younger, 10–12 years, and 13 years or older. Baseline family situation was categorised as: single, divorced, separated, or widowed without children; single, divorced, separated, or widowed with children; married or living with partner without children; and married or living with partner with children. Work characteristics included high job demands and low control, measured as in previous studies (appendix pp 4–5).<sup>15,16</sup> Mental health was denoted by history of physician-diagnosed depression (FPS), baseline reports of being tired or listless every day<sup>17</sup> (in SWES), and self-reported treatment for depression in the previous year (WEHD), or previous mental disorders as indicated by a diagnosis of International Classification of Diseases (ICD; version 8–10) F01–F99/290–319 codes in administrative registers (all cohorts). Somatic health problems were considered by assessing the presence or history of any diagnosis within the Charlson's comorbidity index in the administrative registers.<sup>18,19</sup>

#### Follow-up of suicide death and attempt

Suicide events were identified from hospital discharge registers (FPS) and causes of death registers (FPS, SWES, and WEHD), patient registers (including both inpatient and outpatient data since 2001; SWES), and the Danish Psychiatric Central Research Register (WEHD). Events recorded with ICD (versions 8–10) X60–X84 or E950–959 (self-inflicted harm) or Y10–Y34 or E980–989 (death with undetermined intent) codes in the Cause of Death register were defined as suicide death cases, while individuals with a record of self-inflicted harm or harm with undetermined intent in the hospital discharge, patient, or psychiatric central research registries (appendix p 6) were considered cases of suicide attempt. We identified the first incident suicide attempt or suicide death occurring after response to the surveys. The main outcome variable included both suicide death and suicide attempt. Separate outcome variables for suicide death and suicide attempt were also used for two of the studies (SWES and FPS) with a larger number of events.

#### Assessment of a negative control outcome

We selected incident tumours or neoplasms at follow-up as a negative control outcome because no or only weak association (relative risk <1.2) has been observed between work-related stressors and this endpoint in meta-analyses and large-scale studies.<sup>20-22</sup> Tumours and neoplasms were identified from linked records from

the same health registries as suicides, using the ICD (version 8–10) C00–D49/140–239 codes, including both benign and malignant cancer tumours. An equally strong association of workplace violence or bullying with suicide death or attempt and tumours or neoplasms was considered informative of potential underlying confounding or bias, whereas a robust association with suicide death or attempt combined with no or weak association with tumours or neoplasms was assumed to strengthen an observation of an excess risk of suicide among individuals exposed to workplace violence or bullying.

#### Systematic review and assessment

We conducted a systematic search of the literature following the PRISMA guidelines and the protocol outlined in PROSPERO (CRD42022301704). We searched Web of Science (including Medline), Scopus, PsycInfo, and Embase from database inception to June 31, 2022, using the search terms “violence”, “bullying”, “work”, “organization”, “suicide”, and “suicidal behaviors” for observational studies with a prospective or longitudinal design. Two authors (LLMH and TX) independently determined whether the records fulfilled the following Population, Exposure, Comparator, and Outcomes (PECO) criteria: (1) included individuals of working age (15–65 years); (2) reported results regarding associations between work-related violence or bullying and suicidal behaviour; (3) used a relevant comparison group (eg, compared exposed with unexposed or cases with controls or with the general population); and (4) studied any type of suicidal behaviour as outcome, defined as “behaviours that may result in ending of one life, whether fatal or not”,<sup>23</sup> including suicide attempt and suicide death. We also screened previous reviews on workplace bullying and related topics (eg, work stressors) and suicidality for relevant publications not identified by the search of original articles. We assessed risk of bias using ROBINS-E, a tool for non-randomised studies of exposure, assessing risk of bias due to confounding, in selection of participants into the study, classification of exposure, due to missing data, in measurement of outcomes, and in selection of the reported results. The overall risk of bias was regarded as high if risk of bias was considered high in at least one of the domains (appendix pp 7–8).

#### Statistical analysis

In analyses of the individual participant data, we first calculated estimates separately in each cohort. We then combined study-specific estimates using meta-analysis (inverse variance method). Considering the small number of studies, fixed-effect rather than random-effect meta-analysis was used to pool study-specific estimates.<sup>24,25</sup> The respondents were followed from the date or year of response to questionnaires to the time of either first registered suicide attempt or suicide death, death

For more on **Statistics Finland** see [https://www.stat.fi/index\\_en.html](https://www.stat.fi/index_en.html)

For more on **Statistics Sweden** see <https://www.scb.se/en/>

For more on **Statistics Denmark** see <https://www.dst.dk/en>

from another cause, or end of follow-up, whichever came first. Since there was no deviation from the proportional hazard's assumption (tested using log-log plot and interaction between time and exposure), we used Cox proportional hazard regression with age as the underlying time scale to estimate the risk of suicide death or suicide attempt. We fitted separate models for exposure to workplace violence and workplace bullying versus no exposure in relation to suicide death or attempt combined, and repeated these analyses for suicide death and suicide attempt separately. The analyses were initially adjusted for sex, age, education, and family situation (basic model), with further control for baseline job demands and control and prior, baseline mental and somatic health problems (fully adjusted model).

To examine the robustness of the associations, we repeated analyses in subgroups according to sex, age, and educational level,<sup>23,26</sup> categorising age (<40 or ≥40 years) and educational level (≤12 years or >12 years of education)

into two groups to ascertain sufficient numbers in each group. Due to small case numbers, it was not possible to do these analyses for WEHD, and thus the analyses were only done for workplace violence based on FPS and SWES. Additionally, we did supplementary analyses only among people without mental health problems at baseline. We tested for trends across the categories of violence and bullying (never, occasional, frequent) in SWES by treating the variable as a continuous predictor of suicide death or attempt. To evaluate validity using the negative control outcome, we analysed the association between workplace violence and tumours or neoplasms using similar methods as for suicide death or attempt.

We did a fixed-effect meta-analysis to pool study-specific estimates and published findings identified in our systematic review. We also did subgroup analyses according to sex, work sector (mixed occupations vs social and health-care workers, based on study population), and outcome. Due to the small number of

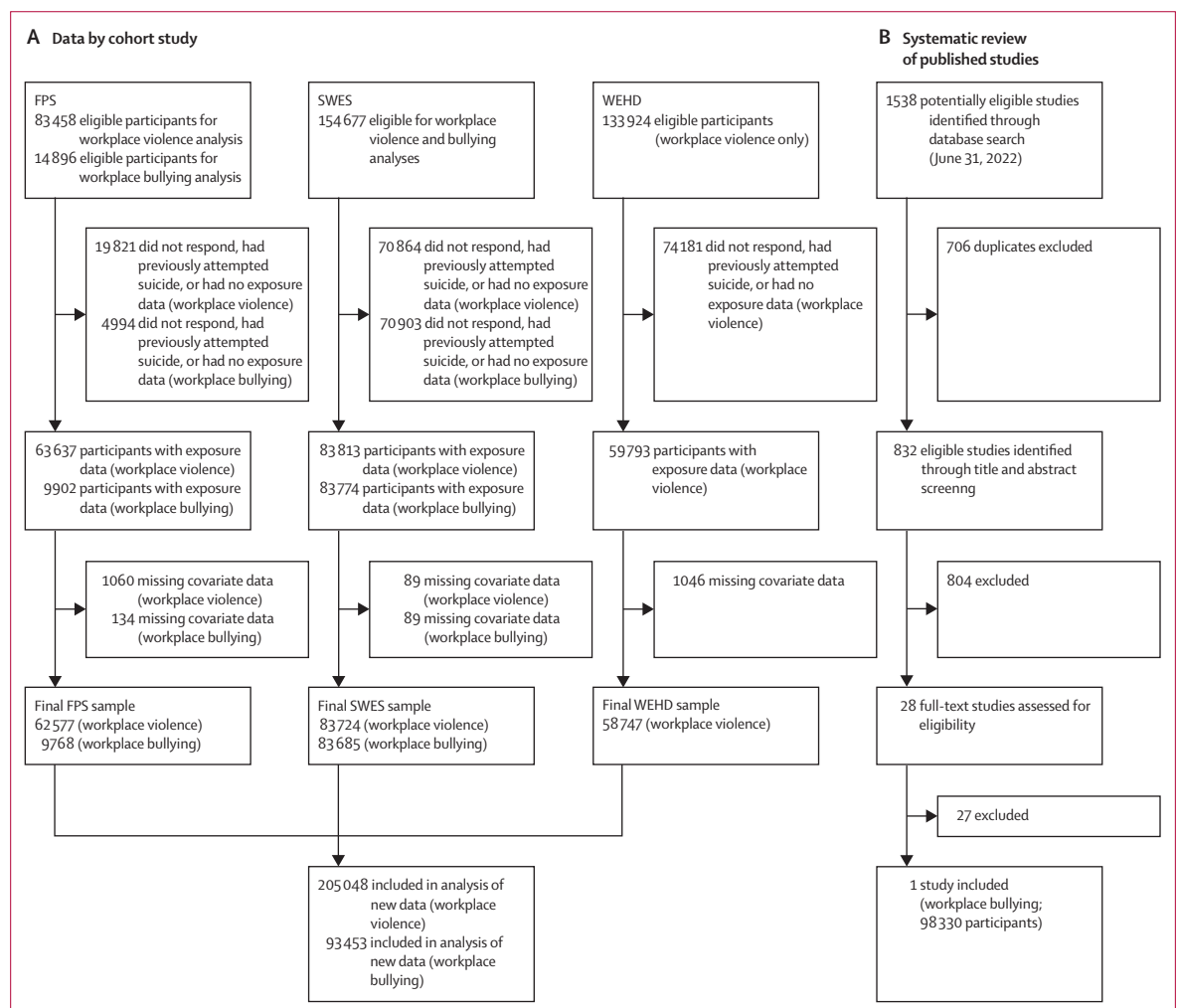


Figure 1: Flow chart for sample selection by cohort and for previously published data

FPS=Finnish Public Sector Study. SWES=Swedish Work Environment Surveys. WEHD=Work Environment and Health in Denmark study.

studies, heterogeneity was not assessed. We used SAS (version 9.4) and Stata (version 16.0) to analyse study-specific associations of workplace violence and bullying with suicide outcomes, and R (version 4.1.1) was used to meta-analytically aggregate study-specific effect estimates.

### Role of the funding source

The funders of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

### Results

205 048 participants had available data on exposure, outcome, and covariates for workplace violence and were included in the analysis (62 577 from FPS, 83 724 from SWES, and 58 747 from WEHD) and 93 453 participants had available data on exposure, outcome, and covariates for workplace bullying and were included in the analysis (9768 from FPS and 83 685 from SWES; figure 1). Our systematic review identified one study on workplace bullying,<sup>11</sup> which included 98 330 participants; thus 191 780 individuals were included in the bullying

	FPS		SWES		WEHD workplace violence (n=58 747)
	Workplace violence (n=62 577)	Workplace bullying (n=9768)	Workplace violence (n=83 724)	Workplace bullying (n=83 685)	
<b>Sex</b>					
Men	13 141 (21.0%)	1202 (12.3%)	40 174 (48.0%)	40 138 (48.0%)	27 617 (47.0%)
Women	49 436 (79.0%)	8566 (87.7%)	43 550 (52.0%)	43 547 (52.0%)	31 130 (53.0%)
Age, years	45.5 (9.8)	42.8 (9.6)	43.1 (11.9)	43.1 (11.9)	46.2 (11.3)
<b>Family situation</b>					
Married or living with partner with children	24 408 (39.0%)	4694 (48.1%)	39 066 (46%)	39 045 (46.7%)	25 288 (43.3%)
Married or living with partner without children	22 929 (36.6%)	2811 (28.8%)	15 157 (18.1%)	15 131 (18.1%)	10 438 (17.8%)
Single, divorced, separated, or widowed with children	4194 (6.7%)	664 (6.8%)	6408 (7.7%)	6411 (7.7%)	25 068 (42.7%)
Single, divorced, separated, or widowed without children	11 046 (17.7%)	1599 (16.4%)	23 093 (27.6%)	23 098 (27.6%)	20 713 (35.3%)
<b>Education, years</b>					
≤9	5053 (8.1%)	688 (6.8%)	12 253 (14.6%)	12 241 (14.6%)	7827 (13.3%)
10–12	21 921 (35.0%)	2606 (26.7%)	40 864 (48.8%)	40 868 (48.8%)	25 780 (43.9%)
≥13	35 603 (56.9%)	6474 (66.3%)	30 607 (36.6%)	30 576 (36.5%)	25 140 (42.8%)
<b>Mental health problems</b>					
No	53 646 (85.7%)	8943 (91.6%)	76 408 (91.3%)	76 368 (91.3%)	51 566 (87.8%)
Yes	8931 (14.3%)	825 (8.4%)	7316 (8.7%)	7317 (8.7%)	7181 (12.2%)
<b>Somatic health problems*</b>					
No	56 224 (89.8%)	8947 (91.6%)	76 584 (91.5%)	76 554 (91.5%)	24 525 (41.7%)
Yes	6353 (10.2%)	821 (8.4%)	7140 (8.5%)	7131 (8.5%)	34 222 (58.3%)
<b>Job demands</b>					
Low	32 380 (51.7%)	4794 (49.1%)	58 168 (69.5%)	58 130 (69.5%)	33 144 (56.4%)
High	30 197 (48.3%)	4974 (50.9%)	25 556 (30.5%)	25 555 (30.5%)	25 603 (43.6%)
<b>Job control</b>					
Low	28 353 (45.3%)	5168 (52.9%)	38 361 (45.8%)	38 384 (45.9%)	14 087 (24.0%)
High	34 224 (54.7%)	4600 (47.1%)	45 363 (54.2%)	45 301 (54.1%)	44 660 (76.0%)
<b>Workplace violence</b>					
No	44 773 (71.5%)	..	72 369 (86.4%)	..	52 318 (89.1%)
Yes	17 804 (28.5%)	..	11 355 (13.6%)	..	6429 (10.9%)
<b>Workplace bullying</b>					
No	..	9104 (93.2%)	..	76 575 (91.5%)	..
Yes	..	664 (6.8%)	..	7110 (8.5%)	..

Data are n (%) or mean (SD). FPS=Finnish Public Sector Study. SWES=Swedish Work Environment Surveys. WEHD=Work Environment and Health in Denmark study.

\*Presence or history of any diagnosis within the Charlson's comorbidity index including myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, pulmonary diseases, rheumatic disease, dementia, hemiplegia, diabetes, chronic kidney disease, liver disease, peptic ulcer disease, cancer, and HIV/AIDS.

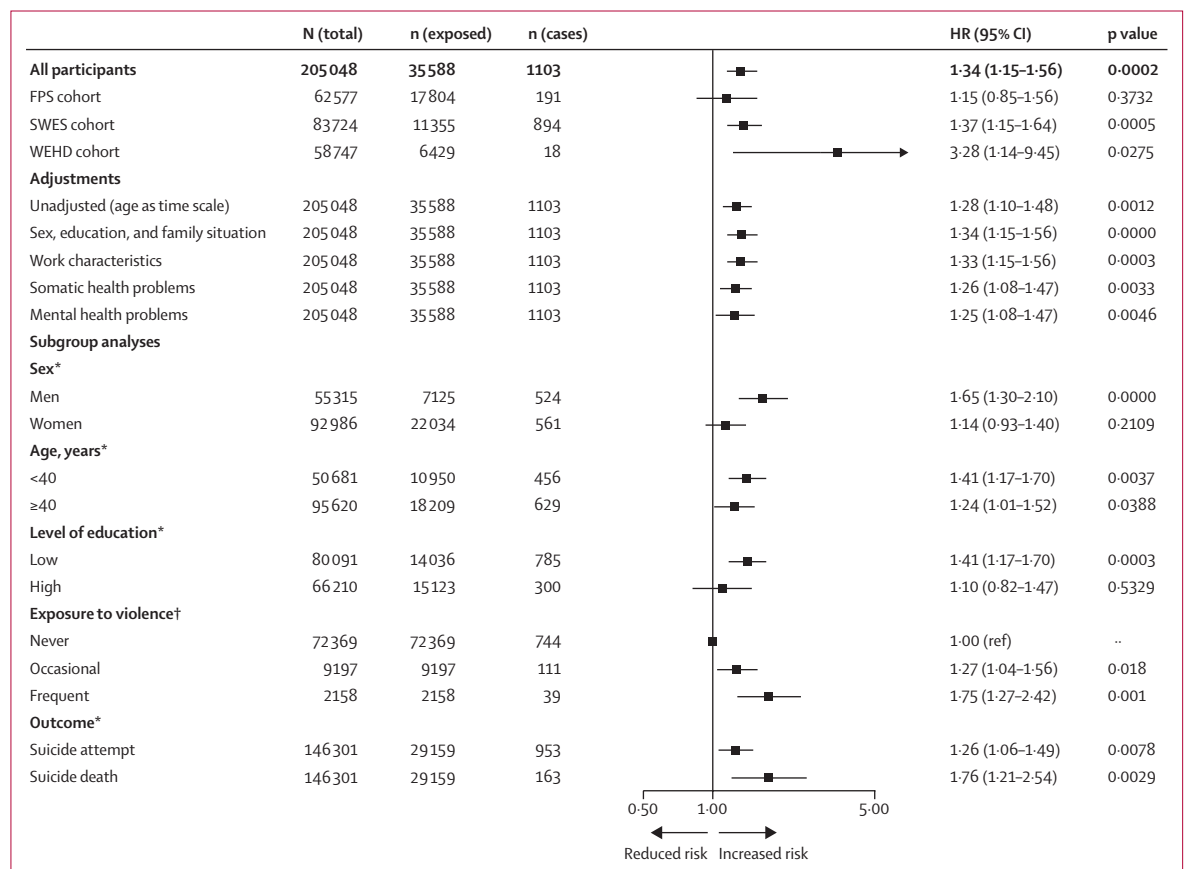
**Table: Characteristics of participants from the FPS, SWES, and WEHD cohort studies**

analyses. The study populations included 124 116 (61%) women and 80 932 (39%) men for samples of workplace violence, and 52 113 (56%) women and 41 340 (44%) men for analyses of workplace bullying with mean age ranging from 43 to 46 years (table). A higher proportion of employees included in FPS (17 804 [28%] of 62 577 participants) had been exposed to workplace violence than in SWES (11 355 [14%] of 83 724 participants) and WEHD (6 429 [11%] of 58 747 participants; table). The prevalence of workplace bullying was 7–8% in FPS and SWES. The risk of bias in these studies was rated as high because of concerns about residual confounding (appendix p 8).

For the analysis of workplace violence, the mean follow-up was 9·1 years (SD 3·3) for FPS, 12·8 years (SD 5·5) for SWES, and 2·7 years (1·7) for WEHD. 1103 suicide deaths or attempts were recorded during 1 803 496 person-years at risk (figure 2; appendix pp 9–11). After adjustment for age, sex, education, and family situation, the risk of suicide attempt or death was 1·3 times higher in participants exposed to workplace violence than those who were unexposed (hazard ratio [HR] 1·34 [95% CI 1·15–1·56]) and the effect estimates were directionally

consistent across the three cohorts and across outcomes in the two cohorts with data on both suicide attempts (1·26 [1·06–1·49]) and suicide deaths (1·76 [1·21–2·54]). The association was also robust to additional adjustment for work characteristics (1·33 [1·15–1·56]) and for mental and somatic health problems (1·25 [1·08–1·47]). In SWES, frequent exposure to workplace violence (weekly) was associated with a higher risk of suicide death or attempt (1·75 [1·27–2·42]) than occasional exposure (less than weekly; 1·27 [1·04–1·56]; trend across frequency categories,  $p < 0·0001$  for suicide attempts and deaths). This dose-response relation was observed for suicide deaths and suicide attempts (appendix p 12). Subgroup analyses showed that the association between workplace violence and suicide was stronger in men (1·65 [1·30–2·10]) than women (1·14 [0·93–1·40];  $p = 0·02$ ), whereas no difference was observed between younger (1·41 [1·17–1·70]) and older (1·24 [1·01–1·52]) participants ( $p = 0·16$ ), or by educational level (high 1·10 [0·82–1·47]; low 1·41 [1·17–1·70];  $p = 0·16$ ).

Analyses of the negative control outcome showed no association between workplace violence and risk of tumours or neoplasms (HR adjusted for age, sex,



**Figure 2: Association of workplace violence with risk of suicide attempt or death in three cohort studies**

HRs and 95% CIs pooled from FPS, SWES, and WEHD and adjusted for age, sex, education, and family situation, unless otherwise stated. HR=hazard ratio. FPS=Finnish Public Sector Study. SWES=Swedish Work Environment Surveys. WEHD=Work Environment and Health in Denmark study. \*Data pooled from FPS and SWES, therefore the number of individuals in these categories does not sum to the total for all participants. †Data from SWES.

education, and family situation, 1.02 [95% CI 0.98–1.05]; appendix p 12).

Analyses on workplace bullying were based on 960 attempted suicides or deaths by suicide in 1246 998 person-years at risk among 93 453 participants (mean follow-up 17.6 years [SD 1.8] for FPS, 12.8 years [5.6] for SWES). The basic adjusted HR was 1.22 (95% CI 0.99–1.51), with little change after further adjustment for work characteristics and somatic diseases (figure 3). However, additional adjustments for mental health problems at baseline attenuated this estimate to 1.07 (0.86–1.33). A supplementary analysis excluding participants with mental health problems at baseline confirmed the null finding. In this subpopulation, the basic adjusted HR was 0.87 (0.21–3.60) in FPS and 1.06 (0.81–1.38) in SWES. No association was identified between workplace bullying and tumours or neoplasms: the pooled HRs varied between 1.02 and 1.03, depending on which factors were adjusted for (appendix p 13).

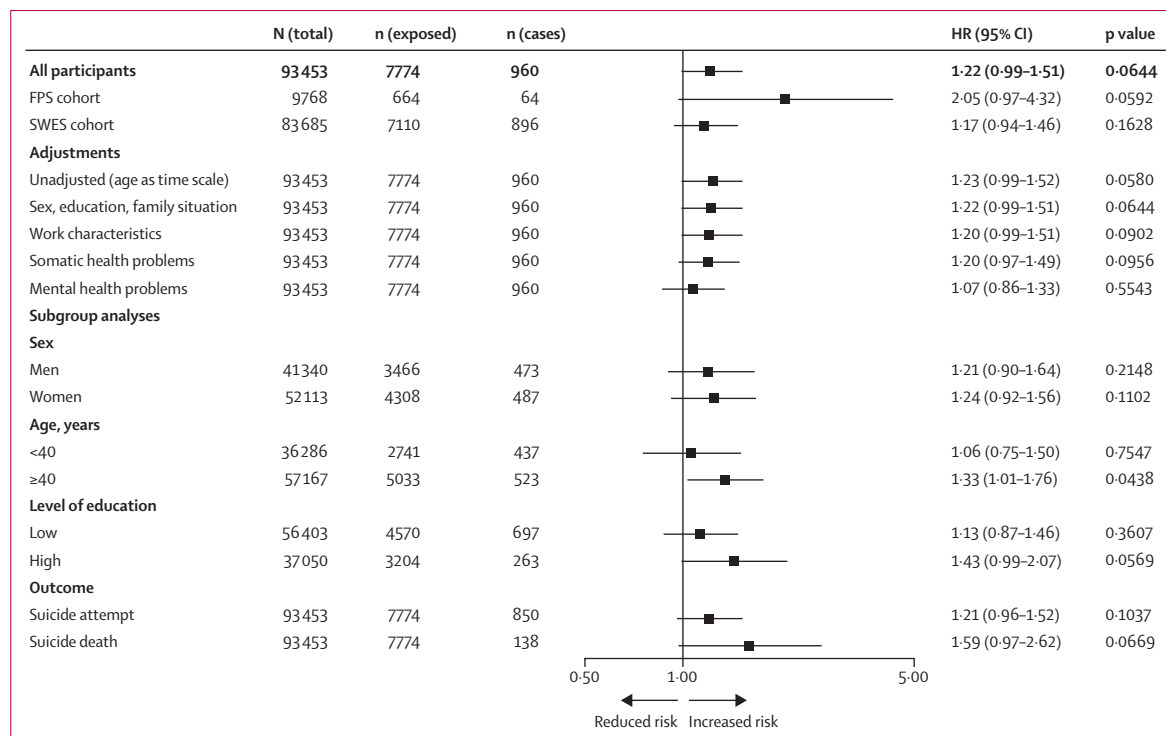
In the systematic review, we identified 832 articles, but only one fulfilled the PECO criteria (figure 1A). The included study from Denmark consisted of 98 330 participants (62 582 [63.6%] women and 35 748 [36.4%] men; mean age 44.5 years [SD 11.2]) of whom 10 259 (10.4%) reported workplace bullying at baseline. The study population consisted of participants from several Danish surveys,<sup>11</sup> and WEHD, in which bullying

was measured between 2004 and 2014 depending on cohort and collection wave, and suicide follow-up was obtained from linked electronic health records. The risk of bias in this study was judged as high because of concerns of unmeasured confounding (appendix p 8). No published studies were identified on workplace violence and suicide.

Figure 4 shows results from analyses combining the findings from two cohorts with those of the published study. The combined analysis included data for 191 783 participants among whom 1144 suicides or suicide attempts were recorded during 1 960 796 person-years at risk. In a model with basic adjustments, the pooled HR for workplace bullying was 1.32 (1.09–1.59). No major differences in these estimates were identified between men and women, cohorts of mixed occupations versus social and health workers, or in relation to suicide death or suicide attempts. Adjustment for mental health attenuated the findings (1.16 [0.96–1.41]; appendix p 14).

## Discussion

This analysis of prospective population-based cohort studies from Finland, Sweden, and Denmark found a 1.3 times higher risk of suicide death or attempt among employees exposed to workplace violence and a potentially increased risk in those exposed to workplace bullying when compared with unexposed individuals.



**Figure 3: Association of workplace bullying with risk of suicide attempt or death in two cohort studies**

HRs and 95% CIs pooled from FPS and SWES and adjusted for age, sex, and family situation, unless otherwise stated. HR=hazard ratio. FPS=Finnish Public Sector Study. SWES=Swedish Work Environment Surveys.

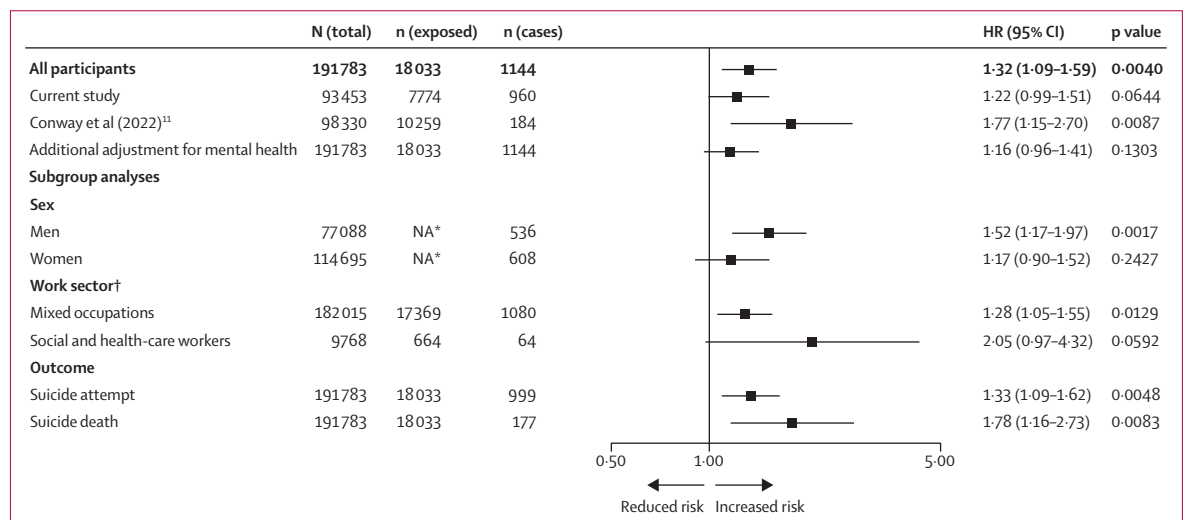
The excess risk associated with workplace violence followed a dose-response pattern and was not attributable to differences in age, sex, education, family situation, other work characteristics, or mental or physical health between exposed and unexposed employees. The association was observed in subgroups by age and education, but sex-specific analyses indicate that risk was greater among men than women. Although we observed variation in cohort-specific effect estimates, the findings were directionally consistent such that the HRs indicated increased risk in all three Nordic countries. In pooled analyses, including published research, workplace bullying was associated with an increased risk of suicide attempt and death by suicide. However, the excess suicide risk associated with workplace bullying attenuated after adjustment for mental health at baseline, suggesting that this association was not robust between workplace violence and suicide.

We are not aware of previous large-scale studies on workplace violence or bullying in relation to suicide and identified only one previously published paper on bullying. Thus, the present study fills an important knowledge gap. A 2018 narrative overview found associations of low socioeconomic position, social isolation, low scores on tests of intelligence, and mental health problems with elevated suicide rates, but found a paucity of studies on psychosocial stress.<sup>27</sup> A 2017 systematic review suggested an association between workplace bullying and suicidal ideation,<sup>10</sup> but that review identified only one study on workplace bullying and suicide attempts, which was a case-control investigation based on 69 participants,<sup>28</sup> and no studies on death by suicide. A 2022 Danish study, which was included in our meta-analysis, found that exposure to workplace bullying was associated with an elevated risk of suicidal behaviour

among men, but not women.<sup>11</sup> However, the analysis did not account for potential confounding by family situation and work stressors, such as high work demands or low job control, which might also affect suicide risk.<sup>29,30</sup> Our analysis, which controlled for a wider set of potential confounders, suggests that part of the observed excess suicide risk associated with workplace bullying might be attributable to prevalent mental health problems that could confound the association.

Adjustment for baseline mental health might be relevant since individuals with mental health problems might be more likely to be bullied or perceive bullying and be at increased risk of suicide. Similarly, other stressful working conditions could drive the association between workplace bullying and suicide.<sup>29</sup> Adjustments for work characteristics could therefore reduce the risk that the association between workplace bullying and suicide is explained by reverse causation or health selection.<sup>10</sup> Both mental health and work characteristics could also act as mediators of the relationship between workplace bullying and suicide and controlling for these factors could be considered an overadjustment and the fully adjusted multivariate model could underestimate the real association. Future longitudinal research with repeated data collection is needed to clarify the role of mental health in this association.

Our results suggested a stronger association between workplace violence and suicide attempts among men than women. This is consistent with the findings indicating a greater risk for suicide among men than women exposed to job stressors.<sup>29</sup> A possible explanation could be that men have been found to be more susceptible to external social and economic stressors<sup>31</sup> and less likely to seek health care for psychological disorders than women. Additionally, due to use of higher lethality



**Figure 4: Association of workplace bullying with risk of suicide attempt or death in two cohort studies and previously published data**

HRs and 95% CIs pooled from the current study and Conway et al,<sup>11</sup> and adjusted for age, sex, education, socioeconomic status, and family situation. HR=hazard ratio. NA=not applicable. \*Data not reported in Conway et al.<sup>11</sup> †Data for mixed occupations are from the Swedish Work Environment Surveys and Conway et al,<sup>11</sup> and data for social and health-care workers are from the Finnish Public Sector Study.



suicide methods among men,<sup>23</sup> suicide attempts among men might be more likely to be recorded in hospital registers. Generally, there is a higher risk for under-ascertainment of suicide attempts owing to absence of recorded clinical care. Furthermore, since this is an observational study, we cannot exclude the possibility that unaccounted confounding is the true cause of the effect modification.

Although absolute differences in suicide risk are small in employee populations such as that included in this study, the moderate relative differences combined with an observed dose-response gradient for workplace violence strengthen the plausibility of workplace offensive behaviours contributing to suicidal behaviour. The excess risk remained increased after adjustment for multiple covariates including baseline mental health and working conditions, suggesting that the observed associations were not attributable to several known risk factors for suicide. A null finding for a negative control outcome further strengthens the likelihood that our findings are not attributable to bias.

The large sample size, use of data from three different settings, the register-based case definition, and integration of our results on workplace bullying into a meta-analysis of published data are important strengths of this study. In contrast to many previous case-control and other self-report studies in the field, recall bias and stigma did not affect the results. The data on exposure and outcome derived from independent sources also reduce the risk of common method variance, a common problem that affects validity in observational studies. Although the inclusion of deaths with undetermined intent might increase the number of false positives suicides,<sup>32</sup> it has been found to reduce bias due to spatial and secular trends in detecting and classifying cases of suicide when intent was indeterminable.<sup>33</sup>

This study has several limitations. It remains unclear to what extent our findings are generalisable to countries or settings other than Finland, Sweden, and Denmark, which have strong occupational health and safety legislations. We used single-item measures of workplace violence and bullying, which might be less accurate than multi-item measures.<sup>34</sup> The length of follow-up varied between participants due to multiple baselines and might have been too short or too long for some individuals to optimally detect effects of workplace violence and bullying. Since this was an observational study, we cannot exclude the possibility that there are other unmeasured factors contributing to confounding. For example, childhood adversities could be associated both with workplace bullying and suicidal behaviour.<sup>35</sup> We used linked health-care records to ascertain attempted suicides, although such data might in some cases indicate self-harm rather than the patient's intention to die.<sup>32</sup> Similar to a previous review,<sup>10</sup> our literature search used a relatively narrow set of predefined terms and therefore it is possible that some relevant studies were missed.

In conclusion, observational data from three Nordic countries suggests that workplace violence or bullying might subsequently result in an increased risk of suicide attempt or death. These findings highlight the potentially serious consequences of offensive workplace behaviours.

#### Contributors

LLMH developed the hypotheses, acquired funding for the study, and wrote the first draft of the report and designed the study together with MK and GDB. LMH, JP, MN, TX, RR, IEHM, PMC, HW, JV, JE, GDB, and MK contributed to the design of the study, generation of hypotheses, interpretation of the data, and critical review of the paper. LMH, JP, and MN analysed cohort data, had full access to the data, and take responsibility for the integrity of the data and the accuracy of the data analysis. LMH is the guarantor. The final responsibility for the decision to submit for publication was shared by all the authors.

#### Declaration of interests

MN changed employment during the conduct of this study and is now an employee of Novo Nordisk A/S. All other authors declare no competing interests.

#### Data sharing

In the Finnish Public Sector Study, pseudonymised questionnaire data as used in this study can be shared by request to the investigators (jenni.ervasti@ttl.fi). Linked health records require separate permission from the National Institute of Health and Welfare and Statistics Finland.

SWES data are not publicly available due to legislative or ethical restrictions, but can be requested for research directly from Statistics Sweden, while linked health records can be requested from the Swedish National Board of Health and Welfare. The WEHD study is based on anonymised microdata available from Statistics Denmark. Access to data can only be permitted through an affiliation with a Danish authorised environment.

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#### References

- 1 International Labour Organization. Eliminating violence and harassment in the world of work. Switzerland: International Labour Organization, 2019.
- 2 Liu J, Gan Y, Jiang H, et al. Prevalence of workplace violence against healthcare workers: a systematic review and meta-analysis. *Occup Environ Med* 2019; **76**: 927–37.
- 3 Høgh A, Viitasara E. A systematic review of longitudinal studies of nonfatal workplace violence. *Eur J Work Organ Psychol* 2005; **14**: 291–313.
- 4 Nyberg A, Kecklund G, Hanson LM, et al. Workplace violence and health in human service industries: a systematic review of prospective and longitudinal studies. *Occup Environ Med* 2021; **78**: 69–81.
- 5 Xu T, Magnusson Hanson LL, Lange T, et al. Workplace bullying and workplace violence as risk factors for cardiovascular disease: a multi-cohort study. *Eur Heart J* 2019; **40**: 1124–34.
- 6 Rudkjoebing LA, Bungum AB, Flachs EM, et al. Work-related exposure to violence or threats and risk of mental disorders and symptoms: a systematic review and meta-analysis. *Scand J Work Environ Health* 2020; **46**: 339–49.
- 7 Birkeland Nielsen MB, Einarsen S. What we know, what we do not know, and what we should and could have known about workplace bullying: an overview of the literature and agenda for future research. *Aggress Violent Behav* 2018; **42**: 71–83.
- 8 Harvey SB, Modini M, Joyce S, et al. Can work make you mentally ill? A systematic meta-review of work-related risk factors for common mental health problems. *Occup Environ Med* 2017; **74**: 301–10.

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- 9 Magnusson Hanson LL, Nyberg A, Mittendorfer-Rutz E, Bondestam F, Madsen IEH. Work related sexual harassment and risk of suicide and suicide attempts: prospective cohort study. *BMJ* 2020; **370**: m2984.
- 10 Leach LS, Poyser C, Butterworth P. Workplace bullying and the association with suicidal ideation/thoughts and behaviour: a systematic review. *Occup Environ Med* 2017; **74**: 72–79.
- 11 Conway PM, Erlangsen A, Grynderup MB, et al. Workplace bullying and risk of suicide and suicide attempts: a register-based prospective cohort study of 98 330 participants in Denmark. *Scand J Work Environ Health* 2022; **48**: 425–34.
- 12 Joensuu M, Kivimäki M, Pentti J, et al. Components of job control and mortality: the Finnish Public Sector Study. *Occup Environ Med* 2014; **71**: 536–42.
- 13 Corin L, Poussette A, Berglund T, Dellve L, Hensing G, Björk L. Occupational trajectories of working conditions in Sweden: development trends in the workforce, 1997–2015. *Scand J Work Environ Health* 2021; **47**: 335–48.
- 14 Johnsen NF, Thomsen BL, Hansen JV, et al. Job type and other socio-demographic factors associated with participation in a national, cross-sectional study of Danish employees. *BMJ Open* 2019; **9**: e027056.
- 15 Magnusson Hanson LL, Theorell T, Bech P, et al. Psychosocial working conditions and depressive symptoms among Swedish employees. *Int Arch Occup Environ Health* 2009; **82**: 951–60.
- 16 Magnusson Hanson LL, Rod NH, Vahtera J, et al. Multicohort study of change in job strain, poor mental health and incident cardiometabolic disease. *Occup Environ Med* 2019; **76**: 785–92.
- 17 Bech P. Depressed mood as a core symptom of depression. *Medicographia* 2008; **94**: 9–13.
- 18 Quan H, Sundararajan V, Halfon P, et al. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. *Med Care* 2005; **43**: 1130–39.
- 19 Ludvigsson JF, Appelros P, Askling J, et al. Adaptation of the Charlson Comorbidity Index for register-based research in Sweden. *Clin Epidemiol* 2021; **13**: 21–41.
- 20 Lipsitch M, Tchetgen Tchetgen E, Cohen T. Negative controls: a tool for detecting confounding and bias in observational studies. *Epidemiology* 2010; **21**: 383–88.
- 21 Heikkilä K, Nyberg ST, Theorell T, et al. Work stress and risk of cancer: meta-analysis of 5700 incident cancer events in 116,000 European men and women. *BMJ* 2013; **346**: f165.
- 22 Yang T, Qiao Y, Xiang S, Li W, Gan Y, Chen Y. Work stress and the risk of cancer: a meta-analysis of observational studies. *Int J Cancer* 2019; **144**: 2390–400.
- 23 Turecki G, Brent DA, Gunnell D, et al. Suicide and suicide risk. *Nat Rev Dis Primers* 2019; **5**: 74.
- 24 Hedges LV, Vevea JL. Fixed- and random-effects models in meta-analysis. *Psychol Methods* 1998; **3**: 486–504.
- 25 von Hippel PT. The heterogeneity statistic I(2) can be biased in small meta-analyses. *BMC Med Res Methodol* 2015; **15**: 35.
- 26 Crump C, Sundquist K, Sundquist J, Winkleby MA. Sociodemographic, psychiatric and somatic risk factors for suicide: a Swedish national cohort study. *Psychol Med* 2014; **44**: 279–89.
- 27 Batty GD, Kivimäki M, Bell S, et al. Psychosocial characteristics as potential predictors of suicide in adults: an overview of the evidence with new results from prospective cohort studies. *Transl Psychiatry* 2018; **8**: 22.
- 28 Lac G, Dutheil F, Brousse G, Triboulet-Kelly C, Chamoux A. Saliva DHEAS changes in patients suffering from psychopathological disorders arising from bullying at work. *Brain Cogn* 2012; **80**: 277–81.
- 29 Milner A, Witt K, LaMontagne AD, Niedhammer I. Psychosocial job stressors and suicidality: a meta-analysis and systematic review. *Occup Environ Med* 2018; **75**: 245–53.
- 30 Almqvist M, Hemmingsson T, Kjellberg K, et al. Job control, job demands and job strain and suicidal behaviour among three million workers in Sweden. *Occup Environ Med* 2022; **79**: 681–89.
- 31 Möller-Leimkühler AM. The gender gap in suicide and premature death or: why are men so vulnerable? *Eur Arch Psychiatry Clin Neurosci* 2003; **253**: 1–8.
- 32 Swain RS, Taylor LG, Braver ER, Liu W, Pinheiro SP, Mosholder AD. A systematic review of validated suicide outcome classification in observational studies. *Int J Epidemiol* 2019; **48**: 1636–49.
- 33 Linsley KR, Schapira K, Kelly TP. Open verdict v. suicide—importance to research. *Br J Psychiatry* 2001; **178**: 465–68.
- 34 Nielsen MB, Matthiesen SB, Einarsen S. The impact of methodological moderators on prevalence rates of workplace bullying. A meta-analysis. *J Occup Organ Psychol* 2010; **83**: 955–79.
- 35 Hughes K, Bellis MA, Hardcastle KA, et al. The effect of multiple adverse childhood experiences on health: a systematic review and meta-analysis. *Lancet Public Health* 2017; **2**: e356–66.