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Supplementary appendix

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Supplement to: Magnusson Hanson LL, Pentti J, Nordentoft M, et al. Association of workplace violence and bullying with later suicide risk: a multicohort study and meta-analysis of published data. *Lancet Public Health* 2023; **8**: e494–503.

Appendix

Individual participant data

The Finnish Public Sector Study (FPS) was established in 1997/1998, has data from national health registers covering the years 1987/1994 to 2011 of all 151,618 employees with ≥ 6 -month job contract in any year from 1991/1996 to 2005 in 10 towns and 5 hospital districts in Finland. Additional repeated survey data with 2-4 years intervals of a nested cohort of over 100000 individuals has been collected.^{S1} For participants who responded to multiple surveys, only the first response to bullying and violence was used in present analysis.

The Swedish Work Environment Survey (SWES) is a largely representative biennial cross-sectional survey of the Swedish workforce (individuals 16-64 year of age), performed every second year since 1989. Data for the analyses were derived from self-completion questionnaires 1995-2013 for which updated register data until 2016 (3-25 years of follow-up) was available at the time of study completion. Of the 154677 originally selected individuals, 130944 responded to telephone interviews, and 98164 to self-report surveys in the respective years. In total, there were 85462 unique respondents 1995-2013, after exclusion of individuals with reused personal identification numbers.

The 'Work Environment and Health in Denmark' (WEHD) study target the national work force in Denmark and consists of a random selection of individuals 18-64 years of age with records of an address in Denmark, a minimum of 35 monthly working hours and a minimum of 3000 Danish kroner (\$530/€400) in monthly income subject to taxation.^{S2} Starting in 2012, a series of biennial data collections have been performed via postal or web-based questionnaires. For this study data from the 2012, 2014 and 2016 wave were used, with a response rate of approximately 50% across waves (62289 respondents in total).

References

^{S1}. Joensuu M, Kivimaki M, Pentti J, et al. Components of job control and mortality: the Finnish Public Sector Study. *Occup Environ Med* 2014;71(8):536-42.

^{S2}. 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(8):e027056.

The IPD-Work consortium

The IPD-Work consortium (individual participant data meta-analysis in working populations) is a large ongoing multicohort study of work and health. IPD-Work investigations have focussed on a number of work stressors, including job strain, long working hours, and effort-reward imbalance, and several health outcomes with public health significance (e.g. cardiovascular diseases, diabetes, cancer, depression, dementia and total mortality).^{w1-w9} The composition of cohorts included in each analysis has depended on the availability of relevant

data. Of the three cohorts of the present study, FPS and SWES belong to the IPD-Work consortium.

References

- ^{w1}Dragano N, Siegrist J, Nyberg ST, Lunau T, Fransson EI, Alfredsson L, et al. Effort-reward imbalance at work and incident coronary heart disease: A multicohort study of 90,164 individuals. *Epidemiol* 2017;28(4):619-626.
- ^{w2}Ervasti J, Pentti J, Nyberg ST, Shipley MJ, Leineweber C, Sørensen JK, et al. Long working hours and risk of 50 health conditions and mortality outcomes: a multicohort study in four European countries. *Lancet Reg Health Eur*. 2021 Sep 6;11:100212.
- ^{w3}Virtanen M, Nyberg ST, Batty GD, Jokela M, Heikkilä K, Fransson EI, et al. Perceived job insecurity as a risk factor for incident coronary heart disease: systematic review and meta-analysis. *BMJ*. 2013 Aug 8;347:f4746.
- ^{w4}Kivimäki M, Walker KA, Pentti J, Nyberg ST, Mars N, Vahtera J, et al. Cognitive stimulation in the workplace, plasma proteins, and risk of dementia: three analyses of population cohort studies. *BMJ*. 2021 Aug 18;374:n1804.
- ^{w5}Kivimäki M, Pentti J, Ferrie JE, Batty GD, Nyberg ST, Jokela M, et al. Work stress and risk of death in men and women with and without cardiometabolic disease: a multicohort study. *Lancet Diabetes Endocrinol*. 2018 Sep;6(9):705-713.
- ^{w6}Kivimäki M, Nyberg ST, Batty GD, Fransson EI, Heikkilä K, Alfredsson L, et al. Job strain as a risk factor for coronary heart disease: a collaborative meta-analysis of individual participant data. *Lancet*. 2012 Oct 27;380(9852):1491-7.
- ^{w7}Kivimäki M, Jokela M, Nyberg ST, Singh-Manoux A, Fransson EI, Alfredsson L, et al. Long working hours and risk of coronary heart disease and stroke: a systematic review and meta-analysis of published and unpublished data for 603,838 individuals. *Lancet*. 2015 Oct 31;386(10005):1739-46.
- ^{w8}Madsen IEH, Nyberg ST, Magnusson Hanson LL, Ferrie JE, Ahola K, Alfredsson L, et al. Job strain as a risk factor for clinical depression: systematic review and meta-analysis with additional individual participant data. *Psychol Med*. 2017 Jun;47(8):1342-1356.
- ^{w9}Nyberg ST, Fransson EI, Heikkilä K, Ahola K, Alfredsson L, Bjorner JB, et al. Job strain as a risk factor for type 2 diabetes: a pooled analysis of 124,808 men and women. *Diabetes Care*. 2014 Aug;37(8):2268-75.

Table S1. Measures of workplace violence and bullying by cohort

Workplace violence	
FPS	<p>“Have any if the following violent or threatening confrontations happened to you this year? ...</p> <ol style="list-style-type: none"> 1) Throwing or breaking things? 2) Psychological violence (e.g. verbal threats)? 3) Physical violence (e.g. hitting, kicking)? 4) Threatening with a weapon (firearm, edged weapon, striking weapon)?”
WEHD	<p>“In the last 12 months, have you been subjected to physical violence at your work place?”</p>
	<p>“In the last 12 months, have you been subjected to threats of violence at your work place?”</p>
SWES	<p>“Are you exposed to violence or the threat of violence in your work?”</p>
Workplace bullying	
Conway et al. 2022*	<p>“Have you been subjected to bullying at work within the past 12 months?”</p>
FPS	<p>“Psychological violence or bullying at work refers to a constant, repeated isolation of a member of the work community, belittling one’s work effort, threats, talking behind one’s back or other forms of pressure – Have you suffered from such bullying in the past 12 months?”</p>
SWES	<p>“Are you subjected to personal persecution in the form of unkind words or behavior from you supervisors or fellow workers?”</p>

* 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(6):425-34.

Table S2. Measurement of work characteristics

Job demands	
FPS	Scale consisting of 3 items based on the Job Content Questionnaire (JCQ) ^{q1} about working very hard/intensively, excessive amount of work/too much effort and having enough time.
WEHD	Scale consisting of 4 items with different wordings, but resembling those in the standardized and widely used Job Content Questionnaire (JCQ) ^{q1} or the Demand Control Questionnaire (DCQ) ^{q2} . Example item: “How often do you find that you do not have enough time for all your work tasks?” ^{q3}
SWES	Scale consisting of 4 items with different wordings, but resembling those in the standardized and widely used Job Content Questionnaire (JCQ) or the Demand Control Questionnaire (DCQ). Example item: “Is your work sometimes so stressful that you do not have time to talk or even think of anything other than work?” ^{q4}
Job control	
FPS	Scale consisting of 6 items based on the Job Content Questionnaire (JCQ) ^{q1} about learning new things, high level of skill, creativity/initiative, repetitive work, a lot of say/what to do, and little freedom/how to do.
WEHD	Scale consisting of 2 items with different wordings, but resembling those in the standardized and widely used Job Content Questionnaire (JCQ) or the Demand Control Questionnaire (DCQ). Example item: “Can you influence how you solve your work tasks?” ^{q3}
SWES	Scale consisting of 4 items with different wordings, but resembling those in the standardized and widely used Job Content Questionnaire (JCQ) or the Demand Control Questionnaire (DCQ). Example item: “Are you involved in planning your work (for example, what is to be done, how it is to be done, or who is to work with you)?” ^{q4}

Note. All scales were divided by the median to form groups with high job demands versus low job demands and groups for low job control versus high job control.

References

^{q1}Job Content Questionnaire, Recommended format.[<http://www.jcqcenter.org/>]. Theorell T: The demand-control-support model for studying health in relation to the work environment-an interactive model. In Behavioral medicine approaches to cardiovascular disease prevention. Edited by: OrthGomér K, Schneiderman N. Mahwah, NJ: Lawrence Erlbaum Associates; 1996:69-85.

Fransson EI, Nyberg ST, Heikkilä K, Alfredsson L, Bacquer de D, Batty GD, Bonenfant S, Casini A, Clays E, Goldberg M, Kittel F, Koskenvuo M, Knutsson A, Leineweber C, Magnusson Hanson LL, Nordin M, Singh-Manoux A, Suominen S, Vahtera J, Westerholm P, Westerlund H, Zins M, Theorell T, Kivimäki M. Comparison of alternative versions of the job demand-control scales in 17 European cohort studies: the IPD-Work consortium. *BMC Public Health*. 2012 Jan 20;12:62.

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^{q3} Nielsen HB, Gregersen LS, Bach ES, Dyreborg J, Ilsøe A, Larsen TP, Pape K, Pedersen J, Garde AH. A comparison of work environment, job insecurity, and health between marginal part-time workers and full-time workers in Denmark using pooled register data. *J Occup Health*. 2021 Jan;63(1):e12251.

^{q4} 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(8):951-60

SCB & Arbetsmiljöverket. Negativ stress och ohälsa Inverkan av höga krav, låg egenkontroll och bristande socialt stöd i arbetet, Information om utbildning och arbetsmarknad, SCB & Arbetsmiljöverket, 2001:2

Registers used to define suicide death or attempts

The Finnish Hospital Discharge Register and Cause of Death Register
https://www.stat.fi/hae_en

The National Patient Register and the Cause of Death Register
<https://www.socialstyrelsen.se/en/>

The Danish Psychiatric Central Research Register
www.dst.dk
<https://www.esundhed.dk/>

Risk of bias assessment of included studies

The risk of bias was assessed using the ROBINS-E* by one of the authors (TX).

To assess risk of bias, we evaluated bias in the following domains:

1. Risk of bias due to confounding
2. Risk of bias arising from measurement of the exposure
3. Risk of bias in selection of participants into the study (or into the analysis)
4. Risk of bias due to post-exposure interventions
5. Risk of bias due to missing data
6. Risk of bias arising from measurement of the outcome
7. Risk of bias in selection of the reported results

The risk of bias was assessed using the signalling questions and algorithms for each domain, resulting in the following judgements for each domain:

Low risk of bias – “There is little or no concern about bias with regard to this domain”

Some concerns – “There is some concerns about bias with regard to this domain, although it is not clear that there is an important risk of bias”

High risk of bias – “The study has some important problems in this domain: characteristics of the study give rise to a high risk of bias”

Very high risk of bias – “The study is very problematic in this domain: characteristics of the study give rise to a very high risk of bias”

For Domain 1 (“Risk of bias due to confounding), risk of bias is judged as low if confounding is very well addressed acknowledging that confounding cannot be eliminated in observational studies.

The overall judgement of risk of bias was regarded as:

Low -if found low in domain 1 and low in all other domains

Some concerns -if at least one domain is at some concerns, but no domains are at high risk of very high risk

High – if at least one domain is at high risk of bias, but no domain are at very high risk of bias or several domains are at some concerns leading to an additive judgement of high risk of bias

Very high -if at least one domain is at very high risk of bias or several domains are at high risk of bias leading to an additive judgement of very high risk of bias

Table S3. Assessment of 7 domains of risk of bias and the overall assessment of risk of bias.

Study	1 Risk of bias due to confounding	3 Bias in measurement of exposure	3 Bias in selection of participants in the study	4 Risk of bias due to post-exposure interventions	5 Risk of bias due to missing data	6 Risk of bias in measurement of outcome	7 Bias in selection of reported results	Overall risk of bias
Conway et al 2022	High	Low	Low	Low	Low	Low	Low	High
Magnusson Hanson et al.	High	Low	Low	Low	Low	Low	Low	High

*ROBINS-E Development Group (Higgins J, Morgan R, Rooney A, Taylor K, Thayer K, Silva R, Lemeris C, Akl A, Arroyave W, Bateson T, Berkman N, Demers P, Forastiere F, Glenn B, Hróbjartsson A, Kirrane E, LaKind J, Luben T, Lunn R, McAleenan A, McGuinness L, Meerpohl J, Mehta S, Nachman R, Obbagy J, O'Connor A, Radke E, Savović J, Schubauer-Berigan M, Schwingl P, Schunemann H, Shea B, Steenland K, Stewart T, Straif K, Tilling K, Verbeek V, Vermeulen R, Viswanathan M, Zahm S, Sterne J). Risk Of Bias In Non-randomized Studies - of Exposure (ROBINS-E). Launch version, 1 June 2022. Available from: <https://www.riskofbias.info/welcome/robins-e-tool>.

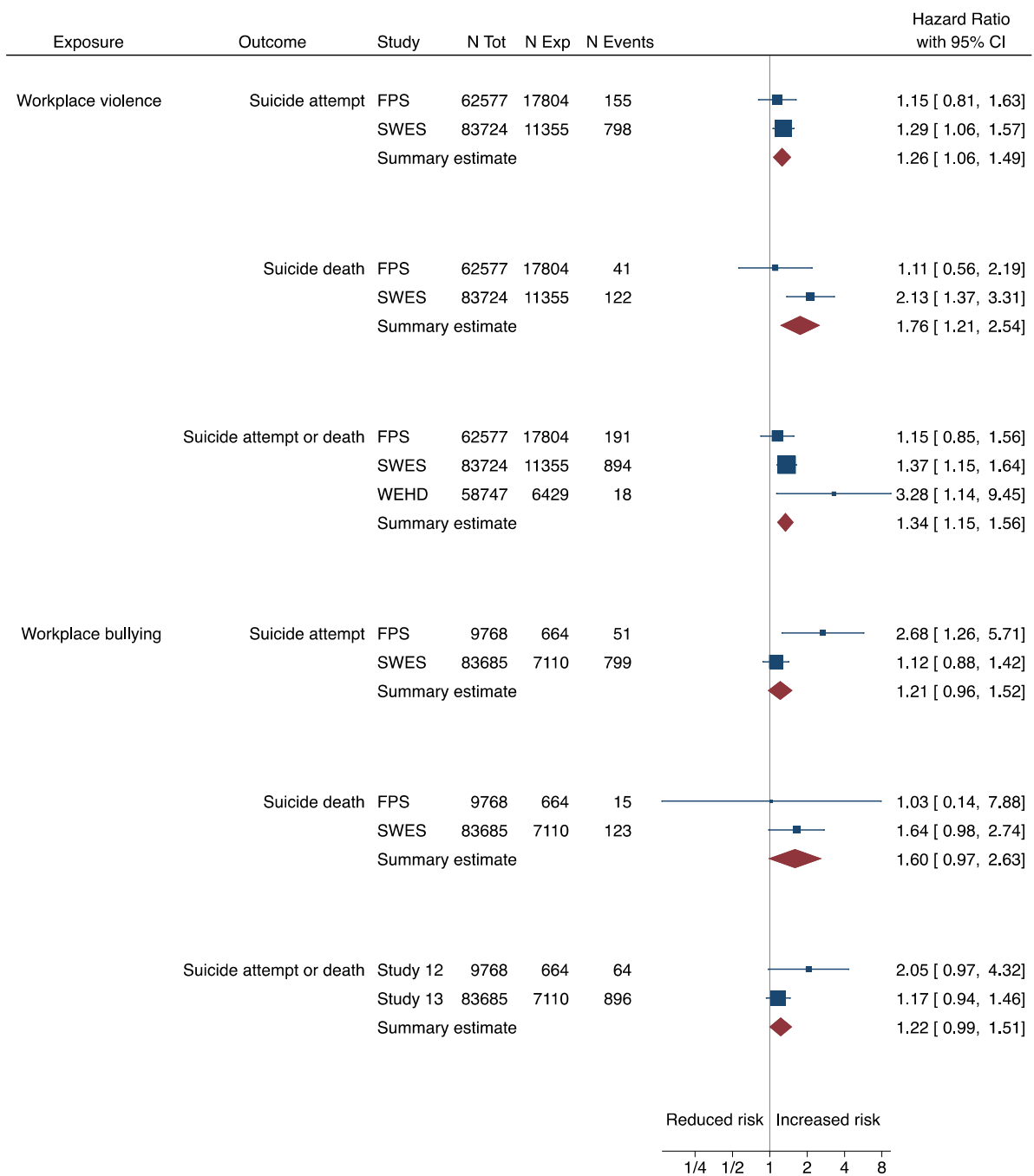


Fig S1. Association between workplace violence, workplace bullying and suicide attempt and/or suicide death in individual participant data. Hazard ratios adjusted for age, sex, education and family situation.

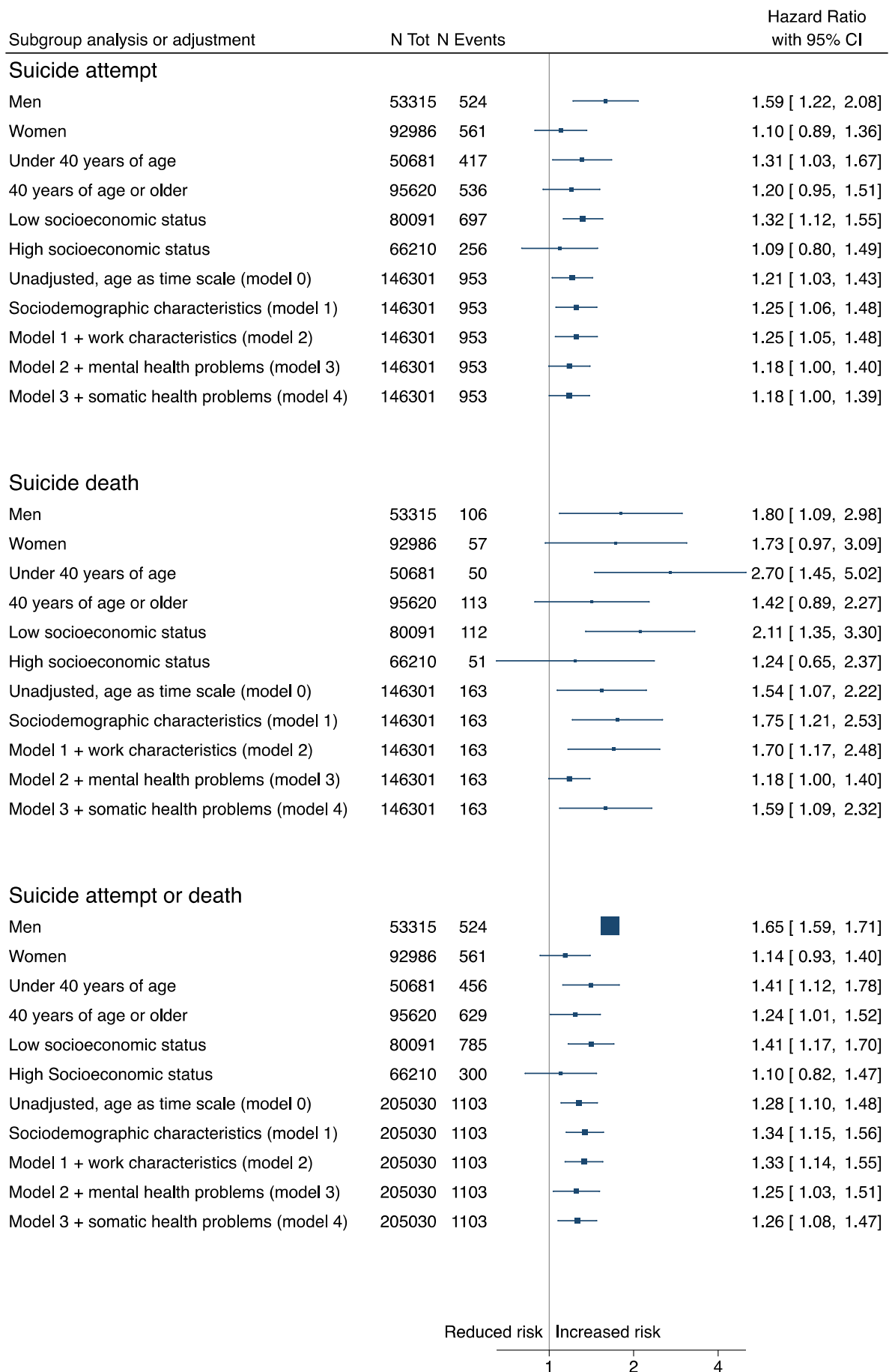


Fig S2. Association between workplace violence and suicide attempt and/or suicide death in individual participant data, according to subgroups and after serial adjustments. Hazard ratios adjusted for age, sex, education and family situation unless otherwise stated.

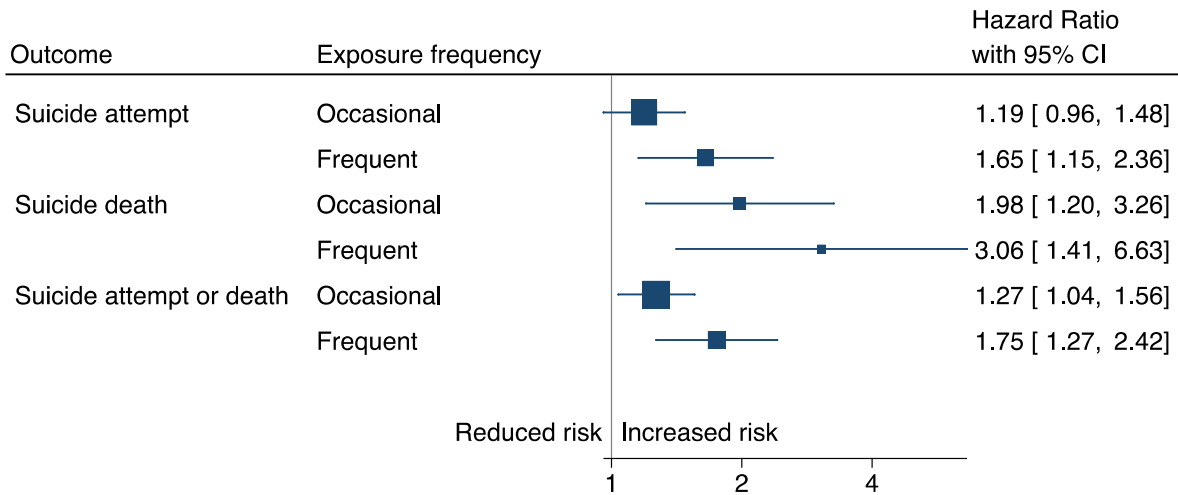


Fig S3. Association between workplace violence and suicide attempt and/or suicide death according to frequency of exposure in the SWES study. Hazard ratios adjusted for age, sex, education and family situation.

* P values for trend: <0.001 for suicide attempt of death and suicide death, <0.01 for suicide attempts

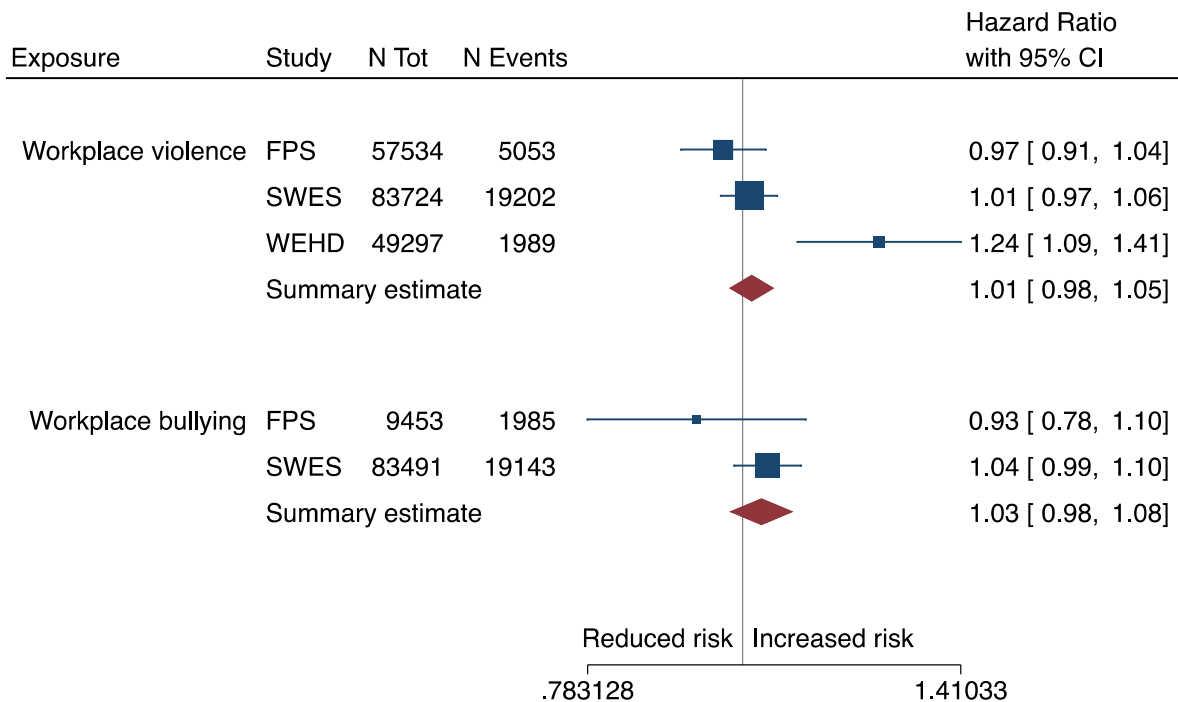


Fig S4. Association between workplace violence, workplace bullying and tumors/neoplasms in individual participant data. Hazard ratios adjusted for age, sex, education and family situation.

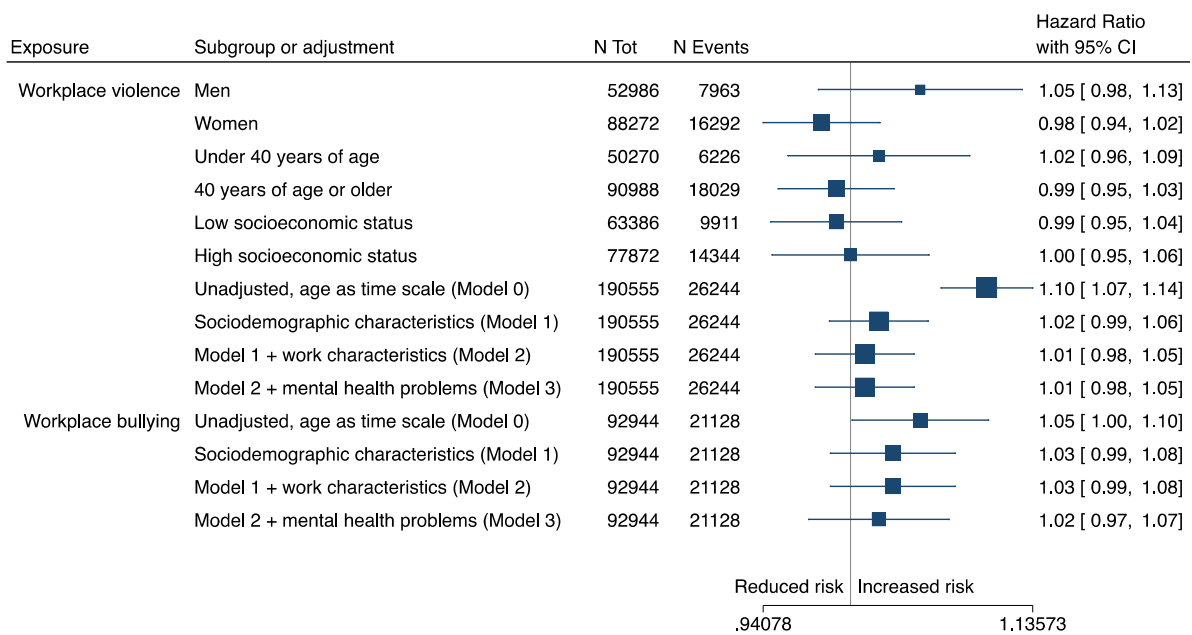


Fig S5. Association between workplace violence, workplace bullying and tumors/neoplasms in individual participant data, according to subgroups and after serial adjustments. Hazard ratios adjusted for age, sex, education and family situation unless otherwise stated.

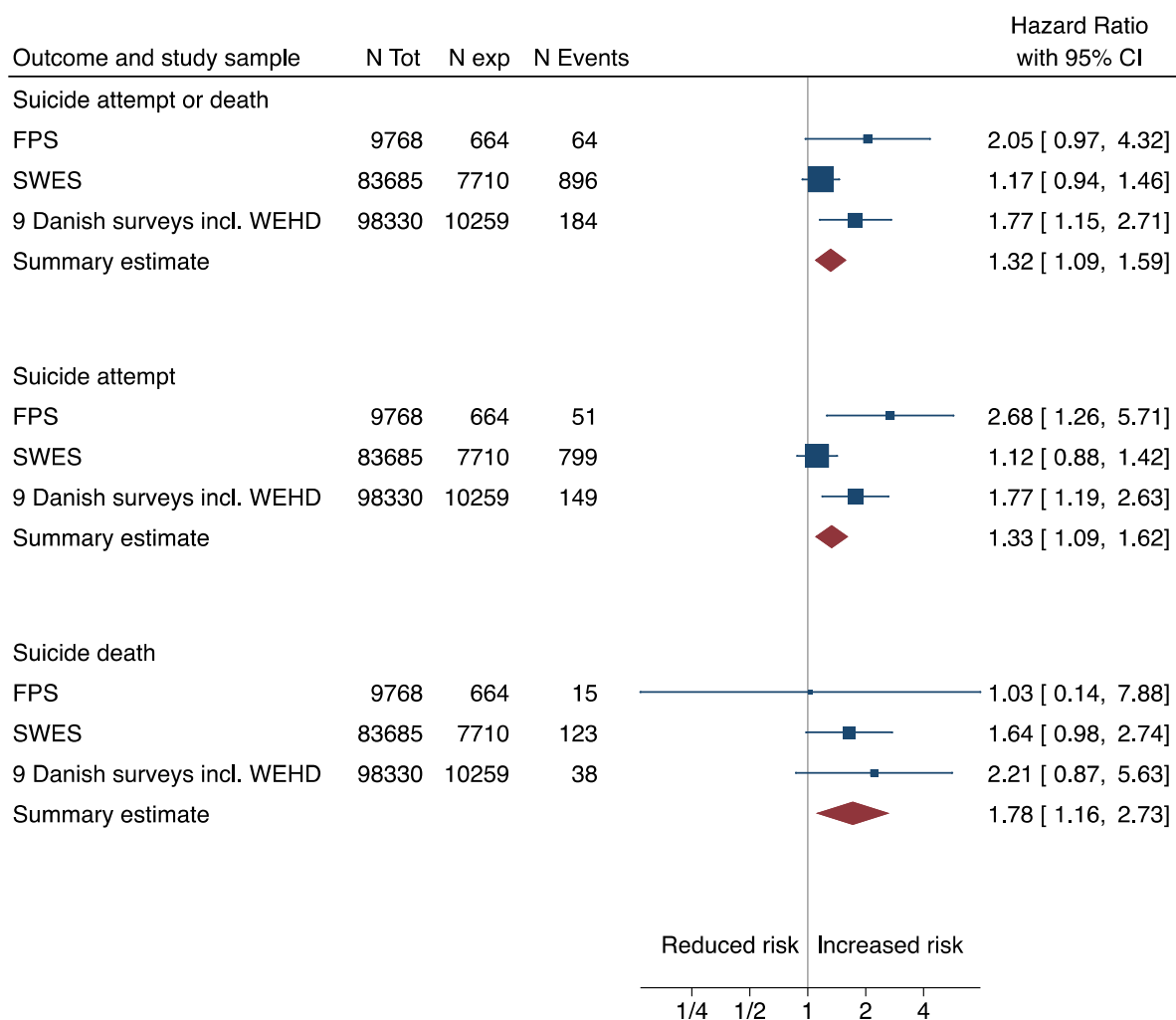


Figure S6. Association between workplace bullying and suicide attempt and/or suicide death in both published (Conway et al. 2022) and individual participant data and previously published data (Conway et al. 2022). Hazard ratios adjusted for age, sex, education or socioeconomic status and family situation. Confidence intervals for the study by Conway et al. 2022 differ slightly from the published paper since the meta-analyses were based on natural log transformed hazard ratios with estimated standard errors.

