Original research

Job control, job demands and job strain and suicidal behaviour among three million workers in Sweden

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ABSTRACT

Objective To investigate the association between job control, job demands and their combination (job strain) and suicide attempts and deaths among male and female workers in Sweden.

Methods Job control and demands were measured separately for men and women using a job exposure matrix, which was linked to around three million individuals based on their occupational title in 2005. Suicide attempts and deaths were measured in the hospital and cause of death registers from 2006 to 2016. HRs were estimated using discrete proportional hazards models with annually updated age as the time axis. Models were adjusted for sociodemographic, family, health, labour market and childhood factors, as well as the time-varying effects of unemployment, sick leave and family factors during follow-up.

Results Low job control was associated with an increased risk of suicide attempts and deaths among both men and women while high job demands tended to be associated with a decreased risk. The combination of job control and job demands (job strain) reflected the increased risk of low control jobs and the decreased risk of high demand jobs. Associations were attenuated but still present after adjustments.

Conclusions Low job control is related to suicide attempts and deaths, and this is only partially explained by important covariates measured both prebaseline and during follow-up. Attempts to increase job control among workers may be beneficial in preventing suicide.

BACKGROUND

Suicide is an important public health concern which was responsible for 34.6 million years of life lost globally in the most recent Global Burden of Diseased report.[1] In Sweden 18 per 100 000 population take their own lives each year.[2]

The aetiology of suicidal behaviour is complex and not fully understood. It has been suggested that multisectoral approaches are necessary for reducing suicide, and one such approach is to target working conditions.[3] The work environment is an important and potentially modifiable factor which may be related to suicidal behaviour. A better understanding of workplace factors in relation to suicide and suicide attempts may be necessary for optimal prevention.

Psychosocial stress at work has been found to be related to a variety of negative health outcomes.[4–6]

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Previous studies have found associations between low job control, job demands and job strain and various health outcomes, though few have investigated suicide attempts and death by suicide.

WHAT THIS STUDY ADDS

⇒ Using prospective longitudinal register data of the whole Swedish working population and measuring job control and job demands with a Job Exposure Matrix, we found that lower job control was associated with both attempted suicide and suicide death among men and women even after adjusting for sociodemographic, health, family and labour market factors both prior to baseline and during follow-up.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Job control is an important occupational factor that should be given attention for the potential prevention of suicide attempts and deaths by suicide among men and women.

For example, one recent Swedish study found that sexual harassment was associated with suicide attempts and deaths.[7] Beyond such a specific circumstance, one of the most common ways of quantifying work-related psychosocial stress is the demand-control model.[8] Some studies have found that the combination of low job control and high job demands (job strain) is related to adverse psychological outcomes,[5 9] but job control tends to be the more consistent predictor of alcohol related morbidity,[10 11] depression[12 13] and suicide ideation[14] in many studies. Some experts even argue that it may be job control which is driving observed associations between job strain and psychiatric outcomes.[15 16]

A systematic review and meta-analysis of psychosocial job stressors and suicidality reported that the majority of studies focused on suicide ideation, where both low job control and high job demands tended to be associated with this outcome.[17] Only a few studies were identified which focused on suicide attempt or death.[18–21] Job control was found to be related to suicide attempts and deaths, while

job demands did not show such an association.[17] The authors pointed to some important methodological limitations including the need for longitudinal studies designed to reduce bias.

Sociodemographic factors, previous unemployment, poor health and previous psychiatric problems may partially determine occupational and labour market factors and are predictors of suicidal behaviour.[22 23] Certain occupations may also lead to a greater risk of sick leave or unemployment, and it may be important to consider these factors both prior to baseline and during the follow-up period. Additionally, parenthood has been found to be associated with a reduced risk of suicide, especially for women.[24]

Gender differences are also important to consider for several reasons. Suicidal behaviour is different for men and women in that women are more likely to attempt suicide while men are more likely to die by suicide.[25] Additionally, men and women tend to have different experiences in the labour market. Not only do men and women tend to dominate different occupations, but within the same occupations, men tend to hold higher positions.[26] Psychosocial exposures may also vary between men and women within the same occupations. Home responsibilities may be unequal, and combinations of home and work stress have been found to be related to suicide among women.[27]

This study aims to investigate the association between job control, job demands and their combination (job strain) and suicide attempts and deaths among male and female workers in Sweden while accounting for important sociodemographic and family factors, previous psychiatric diagnoses, sick leave, and unemployment, as well as the time-varying effects of sick leave, unemployment and family factors during follow-up.

METHODS
Study population and design
This study is based on the Swedish Work, Illness and Labour market Participation (SWIP) cohort, which includes individuals registered in Sweden during 2005. SWIP includes information from the main administrative and medical registers in Sweden including hospital registers and the Longitudinal Integrated Database for Health Insurance and Labor Market Statistics (LISA). More detailed descriptions of this cohort have previously been published.[12 28]

In order to focus on those established in the labour market and more likely to stay in the same occupation, we restricted the population to those who were born between 1945 and 1975 (age 30–60 at baseline). Only those with a registered occupation during the baseline year were included, resulting in a population of around 3 million individuals.

Measures
Exposures
Job control and job demands were measured using a Job Exposure Matrix (JEM) based on the Swedish Work Environment and Health surveys where a random sample of around 10 000 individuals every 2 years are contacted. There are around 90 000 respondents for the period of 1997–2013. These surveys measure the aggregated experience of different exposures within 355 occupations based on the Swedish version of the ISCO-88 (International Standard Classification of Occupations), separately for men and women. These average exposures are then linked to the index individuals based on the same four-digit occupational code registered in 2005.

Job control was measured using four items assessing decision authority, which indicates the amount of influence that an

individual has in the way their work is done, and three items measuring skills discretion which estimates workplace monotony and repetitive tasks. Job demands were measured using three items focused on the stress, time and level of concentration of the job. These items were scored as a mean for each occupation for men and women separately and categorised according to their quintile distributions. Job strain was measured by combining job control and job demands split at their medians in order to make four quadrants (high control/low demands (low strain), high control/high demands (active), low control/low demands (passive) and low control/high demands (high strain). An alternative categorisation compares high strain jobs to all other jobs. A more detailed description of the construction of these JEMs has previously been published.[29]

Outcomes
Cases of severe suicide attempts were identified in the inpatient register which requires at least one night of overnight stay. The International Classification of Diseases (ICD-10) diagnosis codes X60–X84 and Y10–Y34 were used in order to identify cases of suicide attempt between 2006 and 2016. Cases of death by suicide were identified in the cause of death register using these same codes and time period. Both attempted suicide and suicide deaths include cases with undetermined intention, which is standard in epidemiological studies using register-based data in order to not miss true cases,[30 31] however, we performed sensitivity analyses including only those with determined intention (X60–X84).

Covariates
Age and sex were obtained from the total population register. The following covariates were taken from the LISA register in 2005 and were categorised as follows. Birth country was categorised according to whether the index person was born in Sweden or not. Highest attained education at baseline was categorised as (1) primary and lower secondary school or less (<9 years); (2) secondary (10–11 years); (3) upper-secondary (12 years); (4) postsecondary/university, 2 years or less (13–15 years) and (5) more than 3 years of postsecondary/university (>15 years). Civil status was categorised as unmarried, married, divorced or widowed, and having children living at home was dichotomised.

Previous suicide attempts, recorded in the inpatient register prior to baseline, were identified using the same ICD codes described above or their corresponding previous versions. Previous psychiatric diagnoses prior to baseline were also identified in the inpatient register from 1973 until baseline and included the diagnostic codes in the mental and behavioural disorders chapter.

Individuals were linked to their parents, where information from the population and housing censuses from 1960 (for those born 1945–1954), 1970 (for those born 1955–1964) and 1980 (for those born 1965–1975) were obtained in order to capture the parents SEP (socioeconomic position). This was estimated according to the father's occupation, (mother's was used if father's was missing) and categorised as non-manual employees at a higher level, non-manual employees at an intermediate level, assistant non-manual employees, skilled manual workers, non-skilled manual workers, farmers or those with no parental occupation reported.

Index persons were also linked to their parents' hospital records where any first-time psychiatric diagnosis among parents from 1973 up to the age of 65 and prior to the baseline year were

used to indicate whether or not either parent had experienced a psychiatric diagnosis using the same ICD codes described above.

Long-term unemployment and sick leave during the 5 years prior to baseline were reported in the LISA register and defined as a period of more than 300 days in a calendar year, respectively.

Time-varying covariates

The time-varying effects of getting divorced, having children, or experiencing a period of long-term unemployment or sick leave during follow-up were also assessed. These variables were included partly to account for periods where a person may have not been exposed to their occupational exposure level during follow-up.

Statistical analysis

Distributions of baseline covariates among men and women were calculated according to quintiles of job control and job demands.

HRs for job control, job demands and job strain in relation to suicide attempt and suicide were estimated with use of discrete-time proportional hazards models with annually updated age as the time axis. Compared with continuous-time models, discrete-time models facilitate the analysis of time-varying covariates without important changes to HR estimates. HRs are given together with 95% Wald CIs. The follow-up period lasted until the end of 2016, and censoring was done for death or emigration; information which was taken from the total population register.

Model 1 is adjusted for age, model 2 is adjusted for age, birthyear, birth country, education, baseline civil status, children at baseline, previous suicide attempt, previous psychiatric diagnosis, parents' SEP, parents' psychiatric diagnosis, long-term unemployment prior to baseline and long-term sick leave prior to baseline model 3 is adjusted for all covariates in model 2 plus getting divorced during follow-up, having children during follow-up and long-term unemployment and sick leave during follow-up. All analyses were done on men and women separately.

To see whether results may have been biased due to misclassification of the outcome, analyses were repeated including only cases with determined intention for suicide attempts and deaths.

Because the oldest individuals in the study population would likely exit the labour market during the follow-up period, we stratified the adjusted models according to those under and over fifty years old at baseline.

To investigate whether associations between job control, job demands, and job strain and suicide attempts or death differed according to socioeconomic status, models were stratified by education level.

Post hoc analyses were performed adjusting for one variable at a time in order to see which variables contributed to the greatest reduction in estimates. Analyses were done using SAS Enterprise Guide V.7.1.

RESULTS

During the follow-up period, 7100 (480 per 100 000) men and 9687 (630 per 100 000) women attempted suicide and 3572 (240 per 100 000) men and 1614 (110 per 100 000) women died by suicide.

Analysis of the baseline distribution of covariates according to quintiles of job control and demands revealed that those born in Sweden, with higher education, without previous psychiatric diagnoses, with higher parental SEP, with parents without psychiatric diagnoses and who had not been on long-term sick leave tended to be in higher control and more psychologically

demanding jobs (table 1). For men, those without a previous suicide attempt, who were married, who had children and who were not unemployed were more likely to be in higher control and higher demand jobs. This pattern was similar for women with regards to demands, but having 10–11 years of education, previous psychiatric diagnoses, previous suicide attempts and previous sick leave were most common among women in medium-low control jobs.

For men, lower job control was associated with an increased risk of attempted suicide for all categories compared with the highest category (table 2), and estimates were attenuated but still significant when adjusting for all covariates (HR 1.40 95% CI 1.27 to 1.55 for the lowest compared with the highest category). A similar pattern was found for low control with regards to suicide death among men. Higher job demands were associated with a decreased risk in suicidal events, which was also attenuated after adjusting for covariates. Estimates were similar in all groups after adjustment. Passive and high strain jobs were both associated with an increased risk of suicide attempts and deaths in the crude models and after adjustments. When comparing high strain jobs with all other jobs, there remained a slight increased risk of suicide death after adjustments (HR 1.12 95% CI 1.03 to 1.23).

For women, lower job control was also associated with an increased risk of attempted suicide, especially the medium-low category, though estimates were attenuated after all adjustments (HR 1.68 95% CI 1.56 to 1.81) (table 3). Lower job control was also associated with an increased likelihood of suicide death compared with the highest control category. Higher job demands were associated with a decreased risk of suicidal events except for the medium low demands group. These associations attenuated and were no longer significant in all quintiles after adjustments. Passive and high strain jobs were associated with an increased risk of suicide attempt, but not suicide death after adjustments. High strain jobs compared with all other jobs were not associated with an increased risk in suicidal events among women.

When repeating the analysis using only cases of suicidal events with determined intention, adjusted estimates were consistent with the estimates in the main models (online supplemental tables S1 and S2).

In analyses stratified according to those under and over 50 years old, those under 50 had stronger and those over 50 had weaker associations for job control (online supplemental table S3). For suicide deaths, the pattern was less clear and associations were similar in both age groups.

In models stratified for educational level, associations between lower job control, high strain and passive jobs and suicidal events tended to be higher among higher educated men (online supplemental table S4). For women, this pattern was less consistent.

Analyses adjusting for one covariate at a time showed that education, sick leave, previous suicide attempt or previous psychiatric diagnosis were the most influential covariates in attenuating associations (not shown). For men, having children during follow-up was also influential.

DISCUSSION

In this register-based study of the working population in Sweden, we found that low job control was related to suicide attempts and deaths in both men and women, while high job demands tended to be associated with a decreased risk. Passive and high strain jobs (jobs with low control) were associated with suicide attempts and deaths among men and suicide attempts among women. These association were partly attributable

Table 1 Covariates according to levels of job control and job demands among men and women

Covariates	Control					Demands				
	Low N (%)	Med Low N (%)	Med N (%)	Med High N (%)	High N (%)	Low N (%)	Med Low N (%)	Med N (%)	Med High N (%)	High N (%)
Age group										
30–39	103 431 (35)	111 360 (37)	90 620 (32)	102 359 (33)	95 336 (32)	103 415 (34)	102 081 (36)	113 512 (38)	98 057 (33)	86 041 (29)
40–49	119 406 (40)	113 695 (38)	109 171 (38)	116 203 (38)	113 307 (38)	121 274 (40)	110 510 (38)	111 029 (37)	114 009 (38)	114 960 (39)
50–60	75 876 (25)	76 268 (25)	86 033 (30)	87 576 (29)	88 000 (30)	81 287 (27)	74 899 (26)	75 144 (25)	88 363 (29)	94 060 (32)
Born outside Sweden	56 515 (20)	42 307 (14)	26 450 (9)	22 612 (7)	21 554 (7)	53 423 (17)	31 074 (11)	25 124 (8)	28 559 (10)	34 256 (12)
Education*										
≤9	83 920 (28)	63 693 (21)	40 338 (14)	32 256 (12)	13 668 (5)	77 921 (26)	57 116 (20)	31 178 (10)	45 358 (15)	25 305 (9)
10–11	135 339 (45)	127 290 (42)	111 368 (39)	96 154 (31)	37 058 (13)	146 664 (48)	134 647 (50)	85 723 (29)	85 611 (29)	54 564 (19)
12	45 721 (15)	45 213 (15)	45 713 (16)	58 657 (19)	37 735 (13)	48 321 (16)	45 603 (16)	49 609 (17)	48 984 (16)	40 522 (14)
13–15	19 837 (7)	28 186 (9)	41 398 (15)	65 471 (21)	63 533 (21)	21 476 (7)	23 792 (8)	70 615 (24)	54 452 (18)	48 090 (16)
>15	12 686 (4)	36 197 (12)	46 362 (16)	50 014 (16)	143 840 (49)	10 676 (4)	25 655 (9)	61 893 (21)	65 329 (22)	125 546 (43)
Civil status										
Unmarried	129 724 (43)	132 292 (44)	107 552 (38)	111 242 (36)	87 767 (30)	135 992 (44)	122 261 (43)	119 628 (40)	106 412 (35)	84 284 (29)
Married	126 907 (42)	131 701 (44)	144 223 (50)	160 849 (53)	180 378 (61)	129 253 (42)	130 943 (46)	149 702 (50)	156 878 (52)	177 282 (60)
Divorced	40 699 (14)	35 901 (12)	32 570 (11)	32 533 (11)	27 070 (9)	39 204 (13)	32 902 (11)	29 047 (10)	35 608 (12)	32 012 (11)
Widowed	1383 (0)	1429 (0)	1479 (1)	1514 (0)	1428 (0)	1527 (1)	1384 (0)	1308 (0)	1531 (1)	1483 (1)
Has children	144 413 (48)	150 900 (50)	153 186 (54)	164 202 (54)	167 546 (56)	148 147 (48)	147 897 (51)	158 184 (53)	158 905 (53)	167 114 (57)
Previous attempt	4986 (2)	4388 (1)	3050 (1)	2488 (1)	1495 (1)	5392 (2)	3564 (1)	2475 (1)	2836 (1)	2140 (1)
Previous psych	18 741 (6)	16 760 (6)	12 236 (4)	10 440 (3)	6507 (2)	20 859 (7)	13 394 (5)	10 417 (3)	11 350 (4)	8664 (3)
Parents' SEP†										
Unskilled	97 608 (33)	92 990 (31)	74 311 (26)	76 304 (25)	54 153 (18)	99 202 (32)	88 136 (31)	73 198 (24)	77 306 (26)	57 524 (20)
skilled	60 252 (20)	69 851 (23)	65 592 (23)	66 150 (22)	48 122 (16)	71 468 (23)	73 405 (26)	61 001 (20)	55 910 (19)	48 183 (16)
Assistant	22 185 (7)	26 413 (9)	29 411 (10)	36 224 (12)	39 592 (13)	21 138 (7)	23 520 (8)	34 086 (11)	36 037 (12)	39 044 (13)
Intermediate	30 600 (10)	40 489 (13)	46 363 (16)	64 755 (21)	81 553 (27)	32 598 (11)	39 586 (14)	63 950 (21)	59 004 (20)	68 622 (23)
Higher	7322 (2)	10 583 (4)	16 289 (6)	19 726 (6)	35 946 (12)	6539 (2)	8841 (3)	20 669 (7)	20 800 (7)	33 017 (11)
Farmer	16 288 (5)	13 861 (5)	22 914 (8)	15 971 (5)	12 071 (4)	16 101 (5)	17 930 (6)	17 840 (6)	18 048 (6)	11 186 (4)
No SEP	64 458 (22)	47 136 (16)	30 944 (11)	27 008 (9)	25 206 (9)	58 930 (19)	36 072 (13)	28 941 (10)	33 324 (11)	37 485 (13)
Parents' psych	8677 (3)	9546 (3)	7835 (3)	8496 (3)	6890 (2)	9840 (3)	8388 (3)	8381 (3)	7992 (3)	7203 (2)
Unemployed‡	9635 (3)	10 218 (3)	6240 (2)	6452 (2)	4413 (1)	10 835 (4)	7503 (3)	6037 (2)	7254 (2)	5329 (2)
Sick leave‡	19 184 (6)	16 779 (6)	14 574 (5)	11 792 (4)	6862 (2)	20 052 (7)	14 533 (5)	11 169 (4)	12 784 (4)	10 653 (4)
Women										
Age group										
30–40	84 076 (32)	106 285 (33)	105 466 (31)	91 203 (30)	107 528 (35)	93 709 (32)	102 407 (33)	98 041 (31)	107 570 (35)	92 831 (30)
41–50	101 130 (39)	128 418 (40)	130 433 (39)	117 455 (38)	117 121 (38)	115 156 (39)	114 133 (37)	129 347 (41)	117 189 (39)	118 732 (39)
51–60	73 970 (29)	88 581 (27)	99 200 (30)	97 199 (32)	81 256 (27)	86 909 (29)	91 864 (30)	86 782 (28)	79 403 (26)	95 248 (39)
Born outside Sweden	53 237 (21)	50 877 (16)	32 839 (10)	29 321 (10)	27 342 (9)	50 920 (17)	45 493 (15)	40 047 (13)	26 504 (9)	30 652 (10)
Education*										

Table 1 continued

Covariates	Control					Demands				
	Low	Med Low	Med	Med High	High	Low	Med Low	Med	Med High	High
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
≥9	70808 (27)	39807 (12)	14979 (5)	26384 (9)	10758 (4)	68432 (23)	53301 (17)	20664 (7)	14713 (5)	5626 (2)
10–11	106242 (41)	171153 (53)	73557 (22)	101863 (33)	43527 (14)	125991 (43)	132525 (43)	159999 (51)	50364 (17)	27463 (9)
12	40262 (16)	66611 (21)	38645 (12)	58641 (19)	38900 (13)	53568 (18)	59595 (19)	70318 (22)	40310 (13)	19268 (6)
13–15	23162 (9)	24010 (7)	95858 (29)	45834 (15)	67428 (22)	26654 (9)	33998 (11)	37157 (12)	95108 (31)	63375 (21)
>15	17834 (7)	21199 (7)	111905 (33)	72882 (24)	144967 (47)	20336 (7)	28398 (9)	25837 (8)	103438 (34)	190778 (62)
Civil status										
Unmarried	82923 (32)	100518 (31)	92956 (28)	91071 (30)	93087 (30)	95679 (32)	97284 (32)	93858 (30)	94705 (31)	79029 (26)
Married	129676 (50)	161524 (50)	194072 (58)	164169 (54)	167890 (55)	146841 (50)	155893 (51)	168112 (54)	164031 (54)	182454 (59)
Divorced	41819 (16)	55763 (17)	43707 (13)	46215 (15)	41589 (14)	48044 (16)	49875 (16)	47606 (15)	42027 (14)	41541 (14)
Widowed	4758 (2)	5479 (2)	4364 (1)	4402 (1)	3339 (1)	5210 (2)	5352 (2)	4594 (1)	3399 (1)	3787 (1)
Has children	147199 (57)	193251 (60)	211005 (63)	172152 (56)	176931 (58)	164712 (56)	175379 (57)	190851 (61)	182047 (60)	187549 (61)
Previous attempt	5531 (2)	8603 (3)	4445 (1)	5214 (2)	3416 (1)	6558 (2)	6955 (2)	6094 (2)	3977 (1)	3625 (1)
Previous psych	14045 (5)	21240 (7)	13991 (4)	13773 (5)	10212 (3)	16784 (6)	17773 (6)	15877 (5)	11575 (4)	11252 (4)
Parents SEP†										
Unskilled	79133 (31)	100866 (31)	85426 (25)	79200 (26)	59273 (19)	89187 (30)	90501 (29)	93470 (30)	69081 (23)	61659 (20)
Skilled	56199 (22)	74615 (23)	71332 (21)	64443 (21)	51691 (17)	65674 (22)	67821 (22)	72303 (23)	58392 (19)	54090 (18)
Assistant	18948 (7)	25677 (8)	37168 (11)	34637 (11)	38455 (13)	24247 (8)	27473 (9)	28479 (9)	37676 (12)	37010 (12)
Intermediate	27473 (11)	36500 (11)	63915 (19)	56130 (18)	77888 (25)	36154 (12)	42455 (14)	44380 (14)	68633 (23)	70284 (23)
Higher	6569 (3)	8507 (3)	19627 (6)	20171 (7)	33837 (11)	8902 (3)	11413 (4)	11474 (4)	25752 (8)	31169 (10)
Farmer	14211 (5)	19909 (6)	20688 (6)	17449 (6)	14469 (5)	16136 (5)	17626 (6)	19119 (6)	15206 (5)	18639 (6)
No SEP	56643 (22)	57210 (18)	36943 (11)	33827 (11)	30292 (10)	55474 (19)	51115 (17)	44944 (14)	29422 (10)	33960 (11)
Parents' psych	7003 (3)	10109 (3)	8466 (3)	8301 (3)	7535 (2)	8341 (3)	8855 (3)	9046 (3)	8088 (3)	7084 (2)
Unemployed‡	6966 (3)	6627 (2)	4527 (1)	6170 (2)	4590 (2)	8447 (3)	8399 (3)	4972 (2)	4427 (1)	2635 (1)
Sick leave‡	31945 (12)	44354 (14)	38116 (11)	31693 (10)	22535 (7)	37183 (13)	38252 (12)	38051 (12)	29233 (10)	25924 (8)

*≤9=compulsory school or less, 10–11=less than 3 years of upper secondary school, 12=3 years of upper secondary school, 13–15=less than 3 years of university, >15=more than 3 years of university.
†Parents SE: unskilled=unskilled manual workers, skilled=skilled manual workers, assistant=assistant non-manual employees, intermediate=non-manual employees at intermediate level, higher=non-manual employees at higher level, no SEP=no parental occupation reported.
‡Unemployment and sick leave refer to any period of unemployment 300 days in one calendar year between 2001 and 2005.
SEP, socioeconomic position.

Table 2 Job control, job demands and job strain and suicidal events among men

	Quintiles	N	N cases	Cases per 100 000 person years	Model 1	Model 2	Model 3
Suicide attempt							
Job	Low	298 713	2050	64	3.13 (2.87–3.43)	1.51 (1.37–1.67)	1.40 (1.27–1.55)
Control	Med low	301 323	2056	64	3.10 (2.83–3.39)	1.68 (1.52–1.85)	1.58 (1.44–1.74)
	Med	285 824	1337	44	2.15 (1.96–2.36)	1.40 (1.27–1.55)	1.35 (1.23–1.50)
	Med high	306 138	1015	31	1.52 (1.37–1.68)	1.11 (1.00–1.23)	1.08 (0.98–1.20)
	High	296 643	642	20	1	1	1
Job	Low	305 976	2263	69	1	1	1
Demands	Med low	287 490	1584	51	0.73 (0.69–0.79)	0.92 (0.87–0.99)	0.94 (0.88–1.00)
	Med	299 685	1076	33	0.48 (0.44–0.51)	0.77 (0.71–0.83)	0.78 (0.73–0.84)
	Med high	300 429	1166	36	0.53 (0.49–0.56)	0.80 (0.74–0.86)	0.80 (0.75–0.86)
	High	295 061	1011	32	0.47 (0.43–0.50)	0.88 (0.81–0.95)	0.89 (0.82–0.97)
Job	Passive	531 623	3702	65	2.09 (1.93–2.26)	1.44 (1.331.56)	1.39 (1.28–1.50)
Strain	Low strain	231 362	771	31	1	1	1
	Active	508 518	1420	26	0.85 (0.78–0.93)	1.00 (0.92–1.09)	1.00 (0.92–1.09)
	High strain	217 138	1207	52	1.67 (1.52–1.83)	1.35 (0.23–1.48)	1.29 (1.18–1.41)
High	Yes	217 138	1207	52	1.19 (1.12–1.27)	1.09 (1.02–1.16)	1.06 (0.99–1.13)
Strain	Other	1 271 503	5893	43	1	1	1
Suicide death							
Job	Low	298 713	914	29	2.26 (2.01–2.54)	1.43 (1.25–1.63)	1.36 (1.19–1.55)
Control	Med low	301 323	927	29	2.27 (2.02–2.56)	1.54 (1.36–1.75)	1.49 (1.31–1.69)
	Med	285 824	738	24	1.86 (1.65–2.10)	1.41 (1.24–1.60)	1.38 (1.22–1.57)
	Med high	306 138	588	18	1.41 (1.24–1.60)	1.16 (1.02–1.32)	1.15 (1.01–1.31)
	High	296 643	405	13	1	1	1
Job	Low	305 976	1020	31	1	1	1
Demands	Med low	287 490	821	27	0.85 (0.78–0.93)	0.99 (0.90–1.09)	1.01 (0.92–1.10)
	Med	299 685	579	18	0.58 (0.52–0.64)	0.78 (0.70–0.86)	0.79 (0.71–0.88)
	Med high	300 429	627	19	0.62 (0.56–0.69)	0.82 (0.74–0.91)	0.84 (0.76–0.93)
	High	295 061	525	17	0.52 (0.47–0.58)	0.80 (0.71–0.90)	0.83 (0.74–0.93)
Job	Passive	531 623	1677	29	1.51 (1.36–1.67)	1.20 (1.08–1.33)	1.17 (1.05–1.30)
Strain	Low strain	231 362	488	20	1	1	1
	Active	508 518	799	15	0.74 (0.66–0.83)	0.84 (0.75–0.94)	0.84 (0.75–0.95)
	High strain	217 138	608	26	1.32 (1.18–1.49)	1.18 (1.05–1.34)	1.16 (1.03–1.31)
High	Yes	217 138	608	26	1.20 (1.10–1.31)	1.13 (1.04–1.24)	1.12 (1.03–1.23)
Strain	Other	1 271 503	2964	22	1	1	1

Model 1 is adjusted for age.
Model 2 is adjusted for age, birthyear, birth country, education, civil status at baseline, children at baseline, previous suicide attempt, previous psychiatric diagnosis, parents' SEP, parents' psychiatric diagnosis, long-term unemployment prior to baseline, and long-term sick leave prior to baseline.
Model 3 is adjusted for age, birthyear, birth country, education, civil status at baseline, children at baseline, previous suicide attempt, previous psychiatric diagnosis, parents' SEP, parents' psychiatric diagnosis, long-term unemployment prior to baseline, long-term sick leave prior to baseline, getting divorced during the follow-up period, having children during the follow-up period, long term unemployment during the follow-up period and long-term sick leave during the follow-up period.
SEP, socioeconomic position.

to confounding by demographic and socioeconomic factors, previous psychiatric problems and suicide attempts, as well as baseline and time-varying family and labour market factors.

The few high-quality studies investigating the association between job control, job demands and suicidal behaviour have presented results mostly in line with our own. A meta-analysis reported an OR of 1.23 for job control and suicide death and 1.08 for job demands and suicide death.[17] However, it has been pointed out that the results were actually reported in the wrong direction for job demands in one of the more influential studies,[32] indicating that higher job demands may have been associated with a decreased risk in suicide death in the meta-analysis, which is in line with our own findings. Our estimates for the lower control categories were higher than the OR reported in the meta-analysis, but this is likely due to our use of quintiles and the lower risk among the highest control quintile which was used as the reference category.

Only two known studies looked at the association between job control and attempted suicide, and neither reported a clear association.[19 33] The two previous studies using JEMs to measure job demands also reported a decreased risk of suicide death among those with higher demand jobs[18 19] None of these mentioned studies controlled for childhood socioeconomic factors, and most did not adjust for previous mental health problems. Previous studies were also limited in the ability to identify enough cases, which made it inappropriate to stratify by gender.[20] Some studies only included men.[19 21] One study which stratified by gender found an association between job control and suicide among men, but not women,[18] which could possibly be explained by low statistical power and too few female cases. Our study found

Table 3 Job control, job demands, and job strain and suicidal events among women

	Quintiles	N	N cases	Cases per 100 000 person-years	Model 1	Model 2	Model 3
Suicide attempt							
Job	Low	259 176	2057	74	2.45 (2.27–2.64)	1.43 (1.32–1.56)	1.39 (1.28–1.51)
Control	Med low	323 284	3351	96	3.18 (2.96–3.41)	1.73 (1.60–1.87)	1.68 (1.56–1.81)
	Med	335 099	1629	45	1.50 (1.39–1.62)	1.28 (1.18–1.39)	1.29 (1.19–1.40)
	Med high	305 857	1641	50	1.68 (1.55–1.82)	1.27 (1.17–1.37)	1.25 (1.15–1.36)
	High	305 905	1009	31	1	1	1
Job	Low	295 774	2314	73	1	1	1
Demands	Med low	308 404	2653	80	1.09 (1.03–1.16)	1.10 (1.04–1.16)	1.10 (1.04–1.17)
	Med	314 170	2300	68	0.93 (0.88–0.98)	1.04 (0.98–1.10)	1.05 (0.99–1.11)
	Med high	304 162	1279	39	0.53 (0.49–0.56)	0.82 (0.76–0.88)	0.82 (0.77–0.89)
	High	306 811	1141	35	0.48 (0.45–0.51)	0.86 (0.80–0.94)	0.87 (0.81–0.95)
Job	Passive	570 343	5368	88	1.61 (1.52–1.71)	1.25 (1.17–1.32)	1.23 (1.15–1.30)
Strain	Low strain	239 017	1376	53	1	1	1
	Active	534 379	1915	33	0.61 0.57–0.65)	0.82 (0.76–0.88)	0.82 (0.76–0.88)
	High strain	185 582	1028	51	0.96 (0.88–1.04)	1.08 (0.99–1.17)	1.06 (1.15–1.30)
High	Yes	185 582	1028	51	0.87 (0.81–0.93)	1.04 (0.97–1.10)	1.03 (0.97–1.10)
Strain	Other	1 343 739	8659	60	1	1	1
Suicide death							
Job	Low	259 176	307	11	1.68 (1.41–1.99)	1.30 (1.08–1.58)	1.26 (1.04–1.53)
Control	Med low	323 284	483	14	2.11 (1.79–2.47)	1.46 (1.23–1.75)	1.43 (1.20–1.71)
	Med	335 099	281	8	1.18 (0.98–1.40)	1.07 (0.90–1.28)	1.06 (0.89–1.27)
	Med high	305 857	328	10	1.50 (1.27–1.79)	1.30 (1.09–1.55)	1.29 (1.08–1.54)
	High	305 905	215	7	1	1	1
Job	Low	295 774	363	11	1	1	1
Demands	Med low	308 404	395	12	1.04 (0.91–1.20)	1.04 (0.90–1.20)	1.05 (0.91–1.21)
	Med	314 170	347	10	0.89 (0.77–1.04)	0.96 (0.83–1.11)	0.97 (0.83–1.12)
	Med high	304 162	238	7	0.64 (0.54–0.75)	0.82 (0.69–0.98)	0.83 (0.70–0.99)
	High	306 811	271	8	0.71 (0.61–0.84)	1.00 (0.83–1.21)	1.02 (0.85–1.22)
Job	Passive	570 343	753	12	1.22 (1.06–1.40)	1.04 (0.90–1.20)	1.02 (0.89–1.18)
Strain	Low strain	239 343	260	10	1	1	1
	Active	534 379	396	7	0.68 (0.58–0.80)	0.79 (0.67–0.93)	0.79 (0.67–0.94)
	High strain	185 582	205	10	1.01 (0.84–1.21)	1.05 (0.87–1.27)	1.04 (0.87–1.26)
High	Yes	185 582	205	10	1.04 (0.90–1.21)	1.14 (0.99–1.33)	1.14 (0.98–1.32)
Strain	Other	1 343 739	1409	10	1	1	1

Model 1 is adjusted for age.
Model 2 is adjusted for age, birthyear, birth country, education, civil status at baseline, children at baseline, previous suicide attempt, previous psychiatric diagnosis, parents' SEP, parents' psychiatric diagnosis, long-term unemployment prior to baseline and long-term sick leave prior to baseline.
Model 3 is adjusted for age, birthyear, birth country, education, civil status at baseline, children at baseline, previous suicide attempt, previous psychiatric diagnosis, parents' SEP, parents' psychiatric diagnosis, long-term unemployment prior to baseline, long-term sick leave prior to baseline, getting divorced during the follow-up period, having children during the follow-up period, long-term unemployment during the follow-up period and long-term sick leave during the follow-up period.
SEP, socioeconomic position.

rather consistent associations for men and women when considering both suicide attempts and deaths.

An important theoretical explanation for the observed association between lower job control and suicidal behaviour is hopelessness. Hopelessness is related to feelings that there is no way to change one's circumstances and leads to reduced motivation to try to improve one's situation. Suicidal behaviour has been found to be closely related to feelings of hopelessness and may be used as an escape from this situation.[34 35]

High job demands have sometimes been found to be related to an increased risk in suicidal ideation,[17] but this may be due to self-report of both the exposure and outcome.[36 37] In fact, it has previously been found that self-report of psychosocial occupational exposures tends to inflate associations compared with aggregated measures.[38] This could indicate that individuals with suicidal thoughts may experience their jobs as more demanding.

On the other hand, the use of JEMs does not account for individual variation and may capture other aspects of the occupations apart from demands. The associations between job strain and suicidal events appear to be driven by the increased risk of low control and the decreased risk related to high demands.

Lack of socioeconomic and individual resources appear to be a contributing factor behind the observed associations, in that associations in this study were attenuated after adjusting for sociodemographic, previous mental health and labour market factors. This is supported by a study looking at occupational differences in suicide deaths which found that most of the increased occupational risk was explained by correlated social and economic circumstances.[22] However, that an increased risk of suicidal behaviour remained among men and women with lower job control even after adjustment in this study indicates the importance of job control beyond these factors.

For women, the medium-low job control category showed the greatest risk of attempted suicide or death by suicide. Investigation of this category of women has revealed that it consists almost entirely of lower-level healthcare workers, who have previously been found to be at higher risk for suicide compared with other occupations.[39] One explanation could be that women in these occupations may have greater access to lethal means. However, in previous studies of the same population, we have also found that this group of women has an increased risk of both depression and alcohol-related morbidity,[11 12] indicating that there may be unique risk factors of this specific group. Additionally, the medium-low control group tended to be more disadvantaged from baseline regarding childhood factors, mental health, education and sick leave.

This study has several important strengths. The large sample size including all workers in the Swedish population in 2005 reduces potential selection bias and allowed for gender-specific analyses of the relationship between job control, job demands, job strain and suicidal events. Additionally, the use of a JEM makes it possible to measure exposures among those who died by suicide. This is a methodological challenge that previous studies have tried to solve through psychological autopsy and case–control methods. Similarly, because our study was prospective in the sense that occupations and exposures were recorded in the registers before suicidal events, our study could avoid limitations of self-report and recall. Our ability to measure gradient patterns in quintiles of job control and demands was also a strength. That both suicide attempts and suicide deaths were recorded in patient and cause of death registers allows for a more objective classification of this outcome. Finally, we were able to adjust for a more comprehensive set of potentially confounding variables including childhood socioeconomic situation, education, previous psychiatric diagnoses and suicide attempt, unemployment and sick leave. That we were also able to account for the time-varying effects of marital and family factors as well as unemployment and sick leave during the follow-up was also a major strength.

This study also has some limitations. The use of JEMs can reduce common methods bias but does not account for variation within an occupation. Additionally, though our JEMs have previously been validated,[29] we have not had the possibility to conduct an external validation to determine, for example, intraclass correlation. Further, while relying on national registers for identifying cases of suicide attempts and suicide deaths has advantages, suicide research is often limited by difficulty in determining whether a suicidal incident was intentional or accidental. Analysing all potential cases as well as only those with determined intention was a strategy to avoid this potential misclassification. It is inherently difficult to disentangle the effects of social and occupational class and job control and demands. The additional stratification by education was one strategy to see whether patterns were present among both the lower and higher educated. Healthy worker survivor bias may have had some influence on the results if individuals changed or left jobs due to psychosocial exposures, which could potentially affect the HR of the most highly exposed group the most. Additionally, although we adjusted for civil status and children, we were not able to adjust for home stress and unpaid domestic work, which may disproportionately effect women and has been found to be related to suicide.[27 40] This could amplify associations between unfavourable work environments and suicidal behaviour. Furthermore, adjusting for time-varying unemployment and sick leave is important in considering time where a person may be unexposed, but could also be seen as an overadjustment. Finally,

we were able to adjust for previous psychiatric hospitalisations, but this definition only included those with more severe psychiatric problems.

That low job control was associated with suicide attempts and deaths among both men and women is cause for concern. Only part of this association could be explained by health, socioeconomic, family and labour market factors prior to baseline and during follow-up, indicating that job control is a risk factor in itself, and not only because it correlates with other negative social and economic factors.

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