Sex-specific impact of socio-economic factors on suicide risk:
A population-based case-control study in Denmark

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Abstract

Background: Although many authors have analyzed the impact of sex on the association between socio-economic status (SES) and suicide, a definite consensus has not yet emerged. This may be due to differences across studies in terms of sample, control variables, and SES proxies. Using data on 15,648 suicide deaths of individuals aged 18–65 recorded over the period 1981–1997, we investigate the variation in the risk of suicide of males and females as a function of SES. **Methods:** We use conditional logistic regression models to estimate the statistical relationship between SES and suicide. **Results:** The results show that SES, proxied by low income, unskilled blue-collar work, nonspecific wage work, and unemployment, increases suicide risk more prominently for men than for women. Marital status has a comparable influence on suicide risk in both sexes; parenthood is protective against suicide and the effect is larger for women. Living in a large city raises the risk for women but reduces it for men; foreigners in Denmark have a lower risk of suicide compared with Danish citizens, but this is mainly confined to male immigrants. **Conclusions:** Our results suggest the importance of simultaneously accounting for a range of SES proxies and health status indicators in gauging the complex determinants of suicide risk.

Keywords: suicide, socioeconomic status, case-control study, Denmark

Keypoints:

- We contribute to the literature by employing a recent and innovative national Danish individual dataset which allows us to indentify the individual socioeconomic factors that affect differences in suicide mortality.

- Although the effects of SES indicators employed are partly attenuated after controlling for a number of individual level socio-economic factors, they still remain statistically significant.

- Suicide prevention policies should not only focus on efforts to refine and targe public health campaigns but also to consider social and workplace interventions to reduce the suicide and close the sex gap in suicide mortality.

INTRODUCTION

Since Durkheim's germinal work[1], the impact of socioeconomic factors on the risk of suicide has attracted much scholarly interest. The socio-demographic characteristics of individuals, especially income,[2,3] unemployment,[3,4,5,6,7] ethnicity,[8,9] marital status,[3,8,10] childbearing,[11,12] and place of residence[8,13,14], are key predictors of suicide.

The link between socioeconomic factors and suicide is multi-factorial. Variation in SES implies a differential exposure to physical, psychological, environmental, and occupational factors; differences in access to health care; in the quality of life; and in lifestyles.[15] Typical proxies for SES include variables that reflect social status and access to resources. Examples include income, education, marriage, employment, and occupational status.[3,5,7,9,16] Few studies have estimated the relative importance of these factors in affecting suicide risk.

Much of the literature focuses on the determinants of suicide mortality at the macro-level.[17,18,19] However, aggregate measures cannot account accurately for the impact of individual-level SES without risking ecological fallacy. Men and women play different roles in the family and society, which is reflected differentially in SES. Although several scholars have investigated the impact of sex on the association of SES with suicide, using both individual and population data,[3,7,8] the results have been mixed. This is probably due to differences in sample size, the nature of controls, and the SES measures used.

In this study, we use a rich dataset based on the Danish population longitudinal registers to estimate the impact of SES factors on male and female suicide risk (in a population aged 18–65), and to explore sex-specific aspects of this relationship.

METHODS

Setting, design, and subjects

This study uses a nested case-control design[20] based upon the entire population of Denmark. Data was drawn from four Danish longitudinal registers. The Danish Cause-of-Death Registry[21] contains dates and causes of all deaths in Denmark recorded from the Cause of Death Certificates for suicide since 1970. The *Integrated Database for Labour Market Research* (IDA Database)[22] contains detailed information on labour market conditions and socio-demographic data for all individuals living in Denmark and is updated annually with information from administrative registers since 1980. The *Danish Psychiatric Central Register*[23] covers all psychiatric facilities in Denmark and keeps computerized records of all personal contacts with psychiatric hospitals since 1969. Finally, the Danish Civil Registration System[24] contains unique personal identification numbers known as CPR-numbers for all residents of Denmark, their birth information, and links to parents. The CPR-number is used in all national registers and can be automatically checked for errors, making linkage of personal data across registers almost 100 percent correct.[24] Each subject's personal identification was used to retrieve and link personal information from the various databases.

Deaths by suicide between 1981–1997 from the Danish Cause-of-Death Registry were coded according to the International Classification of Diseases (ICD), using E950–959 in ICD–8 before 1994, and using X60–X84 in ICD–10 thereafter. We retained those cases of suicide for individuals aged 18–65 who lived in Denmark on December 31 in the year before death. These individuals represent the socio-economically active part of the population, and had complete information on SES in the IDA database for that year. Our final sample includes a total of 10,438 men and 5,210 women suicide deaths.

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Population controls were drawn from a 5 percent random sub-sample of the total population in the IDA database. Each index suicide case was matched with 20 individuals who were alive at the time of the index suicide and who had the same age/sex profile as the index suicide case. This provides a control group of 208,760 male and 104,200 female observations.

Variables

Our socioeconomic variables include: occupation and labour market status, gross annual income, citizenship status, place of residence, marital status, and parenthood status. The data was drawn from the IDA Database based on records as of the last week of November in the year before death.

We used the Statistics Denmark classification of occupation and labour market status.[22] This was grouped into 11 mutually exclusive categories: (1) top or high-level manager (manager, superior salaried employee), (2) low-level manager (head of salaried staff), (3) ordinary salaried employee, (4) skilled blue-collar worker, (5) unskilled blue-collar worker, (6) unspecified wage worker, (7) self-employed, (8) unemployed (receiving unemployment benefits and actively searching a job), (9) full-time student, (10) out of labour force (e.g., housewives) and (11) disability or early age pensioner. The ordinary salaried employee group is the reference category.

Gross annual income includes wages, pensions, unemployment benefits, social security benefits, and bank interest during the calendar year. It was categorized into quartiles according to its yearly 5-year age-sex distribution in the population.

Marital status includes married, cohabiting (living at the same address with a partner of opposite sex with an age difference less than 15 years), and single.

Parenthood status aims to capture family structure according to the age of children. We use dummy variables for parent of a child < 2 years, 2–3 years old, and 4–6 years old (the age of the youngest children), or having no young children.

Citizenship is measured as a dummy variable identifying Danish citizens.

The place of residence reflects one of three geographical areas: the capital area (the Copenhagen and Frederiksberg municipalities and its suburbs); large cities (>100,000 inhabitants); and others.

To control for the possibly confounding effect of health status, we include two more variables. The first is a binary variable indicating if a person had a sickness-related absence from work (> 3 consecutive weeks), and the second is a variable capturing the history of psychiatric hospitalization (never admitted, admitted within last one year, or admitted more than one year ago). Data on sickness-related job absence (recorded in previous year) is from the IDA Database, whereas psychiatric history information (at the time of suicide) was derived from the Danish Psychiatric Central Register.

Statistical Analysis

To analyze the effect of SES on male/female suicide mortality, we estimate conditional logistic regression models.[20] The *PHREG* procedure is implemented with the SAS statistical package version 8.0.[25] Because of the rarity of suicide and the method of sampling sex-age-matched controls, our coefficients—reported as odds ratios—can be interpreted as incidence rate ratios. 'Crude' odds ratios were derived from univariate analyses while controlling solely for the effect of age and calendar time through matching. In contrast, 'adjusted' odds ratios were derived from

the full model, which includes the SES proxies and the two health-related variables. In the full model, a likelihood ratio test was performed to examine the statistical strength of the interaction between sex and the SES/health variables in determining suicide risk.

RESULTS

During the period 1981–1997, we identified 15,648 individuals aged 18–65 who died by suicide in Denmark. **Table 1** shows the distribution of their SES characteristics. Compared with population controls, a higher proportion of both men and women who died by suicide had jobs with low skill requirements; were unemployed, not in the labor force, or recipients of age or disability pensions; or had a low income. They were more commonly single, with no young children, and residing in large urban areas.

We also report the sex-specific suicide risk associated with socioeconomic variables and health status and derived from conditional logistic regression analyses. We find that the association between occupation and labor market affiliation and suicide varied by sex (p<0.001). Compared with salaried employees, suicide risk was significantly higher for the unemployed, self-employed, full-time students, individuals out of the labor market, or pensioners. In all labor market groups, the risk of suicide decreases after controlling for other socioeconomic variables and health status, but for both sexes it remains significantly higher for the unemployed, or those receiving age/disability benefits. Among women, it remains higher for the self-employed. Unspecified wage workers, regardless of sex, were at a significantly elevated risk for suicide, even after controlling for other factors. In the unskilled blue-collar category, only males showed a significantly higher risk of suicide compared with their salaried counterparts. Men in managerial roles had significantly lower risk of suicide; while for women in similar positions, the risk became statistically insignificant in the full model.

Suicide risk increases progressively with decreasing income in both men and women. However, when controlling for additional factors, the relation between suicide risk and income appears to be U-shaped, with people in the lowest income quartile having the highest risk and those in the middle-income groups facing a risk level that is lower or equivalent to that of the highest (reference) income group. The general impact of income on suicide differs significantly by sex (sex interaction test: $p<0.001$). The elevated risk associated with low income is particularly prominent for men, while the reduced risk associated with a middle level income is stronger for women.

The effect of marital status does not vary by sex (sex interaction test: $p = 0.118$), but those who were single or cohabiting face higher risk.

Parenting a young child is protective against suicide: its effect is significantly stronger for women (sex interaction test: $p<0.001$) and it diminishes with the child's age. For men, the protective effect remains significant only for fathers of infants.

Regardless of gender, individuals in urban areas are at a higher risk. Furthermore, a higher degree of urbanicity of dwelling raises this risk. However, in the full model the excess risk disappears for women, and is reversed for men (sex interaction test: $p<0.001$).

Living in Denmark as a non-Danish citizen lowers the risk for suicide compared with counterparts with Danish citizenship. Nevertheless, adding further controls eliminates this effect, which remains significant only for men (sex interaction test: $p<0.001$).

DISCUSSION

This study demonstrates that the risk of suicide is strongly associated with a range of SES indicators, and that the association varies by sex even after controlling for these measures and for health status. Low economic status, reflected in low income, unskilled blue-collar work, unspecific wage work, and unemployment, tends to increase the risk of suicide more prominently for men than for women; marital status has a similar influence for both sexes, but the risk is significantly higher for the single; parenthood lowers the risk of suicide and the effect is stronger for women; living in a big city tends to raise the risk for women, but reduces it for men. Foreign citizens in Denmark face a lower risk of suicide compared with Danish citizens, but the result is driven by male immigrants.

Our finding of a positive gradient between male suicide risk and movement from high to low SES, especially by labour market status, is consistent with a number of other studies.[3,7,26,27] However, studies have generally been unable to control for the potentially confounding effect of mental illness, which is known to be causally associated with suicide,[28,29] and is also associated with lower SES and reduced labor market participation. Drawing on unique data sources, we account for the effect of mental or other illness that may be severe enough to cause signficant sickness-related absence from work, for mental illness requiring hospitalisation, and for a range of other SES variables, we confirm this causal association.

In particular, we find that low income is associated with a greater burden of risk for men than women, as is being an unspecified wage worker. Men in this group face a risk of suicide almost three-fold higher compared to wage employees. Jobs included in this category are normally spouse assistance or other unspecified assistant jobs, and are more likely to be part-time and temporary positions. They may also offer fewer opportunities for development of supportive

work relationships, and for many men work is an important source of social support. This finding is of interest because it cannot be accounted for by low income alone. It is consistent with findings such as those of the Whitehall studies which have shown that decreased job security and other forms of occupational stress lead to poorer mental health status.[30,31,32] A study from New Zealand suggests that the risk of suicide accumulates in younger men in the context of employment market change to a higher proportion of jobs of a part time, temporary nature, and with high unemployment rates,[33] whereas the present study shows that in the Danish setting, this excess vulnerability exists regardless of age.

Having a managerial position appears to 'protect' men but confers no advantage to women. The finding is consistent with previous evidence that exerting some control at the workplace is positively associated with male health status.[31,34] However, to our knowledge, this is the first study to demonstrate that the risk of suicide is not lower (and may even be higher) for women in managerial roles. In Denmark, employees are normally paid according to standard salary scales from the state or unions, meaning that women normally receive the same pay as men for the same job. Therefore, a possible explanation for this pattern is that women may experience more stress or role conflict when in a traditionally male-dominated role, and that this adversely affects their mental health and/or reduces their psychological resilience. An alternative explanation rests on the selection for personality traits such as assertiveness or independence to management positions, which could mean more reluctance to seek help when experiencing setbacks, distressing situations, or mental disorder.

Our results suggest that men are socially and psychologically more vulnerable than women to the effects of job position, labour market status, and income level.[35,36] The different roles and expectations of men and women in family and society may affect their risk of suicide. Although

economic stressors are common to both sexes, one could hypothesize that failure in living up to social, family, and own expectations may lead to greater loss of self-esteem or psychological distress in men than women, thus rendering men more vulnerable to suicidal behavior. On the other hand, it is possible that we are observing the uncontrolled effect of mental illness that did not result in hospitalisation or time off work. Although this is plausible given that men are less likely than women to seek help for psychological distress,[37,38] our findings also reflect the reality of the social distribution of increased risk of suicide.

Interestingly, once a range of SES indicators and health status are accounted for, there is no sex-specific effect of marital status on suicide risk. This finding is different from that in a previous Danish study,[3] probably because our analysis only focuses on subjects aged 18–65 whilst the previous one covered all ages. However, our finding of the progressively increased suicide risk along with being married, living with a partner, and being single, is consistent with previous studies, regardless of sex and age,[39] and supports Durkheim's theory of the protective effect of marriage on suicide.[1] Also, it is widely accepted that childbearing is a positive life event which may prevent people from ending their life.[1,40] The presence of a young child may increase parents' feelings of self-worth, possibly based on their perception of being needed. This may explain our finding that parents—especially mothers—are less likely to commit suicide, in line with previous findings.[35,39]

That suicide risk increases with the degree of urbanicity of dwelling in the crude analysis accords with previous studies for Western countries.[13,41,42] In the full model, this excess risk is attenuated but remains significant in women, and is reversed in men. This suggests that the gradient of urban-rural suicide could, to a large extent, be accounted for by the urban-rural disparities in other health or SES factors and, in particular, severe psychiatric disorders which may be more

prevalent among city dwellers.[43,44] Once the effects of those factors are controlled for, living in big cities may offer, for example, better job opportunities and career potential, which may benefit men more. Women may be more vulnerable in a competitive environment than their male counterparts. Such explanation may apply in particular to young and middle-aged adults, the socio-economically active part of the population.

Contrary to other reports,[41] the present study documents a generally lower risk for suicide among foreign citizens in Denmark, although this observation was confined to male immigrants only. Denmark is generally a non-immigrant country: only 5,45 percent of residents are foreign, and most of them are youth or middle-aged adults.[45] Immigrants come to Denmark normally because of a job offer, for schooling, to visit family, or as refugees. Our finding may thus largely reflect selection factors that determine who is able to come to Denmark and their reasons for staying. Men who immigrate to Denmark to work or for business may be more independent or have better social networks than immigrant women. The fact that a relatively large proportion of immigrants came from Islamic countries where suicide rates traditionally are low may also explain our findings.

Denmark's social economic environment is similar to that of other Scandinavian countries, and is also comparable to many Western European countries. However, one should be cautious when generalizing the results from this study to other countries with different socioeconomic environments, as our analysis has several limitations. For example, our measures of SES cover some, but not all, relevant aspects of an individual's location in the socioeconomic system, and individuals were assigned a social class based on their own socioeconomic status rather than their head of household's SES or through a dominance approach. Furthermore, this work does

not include socioeconomic factors that operate at the neighborhood or higher levels of social aggregation. Such improvements are left for future work.

Acknowledgements

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Table 1. **Distribution of study variables among suicide cases and population live controls as well as risk of suicide associated with social and economic status (SES) for men and women aged 18–65 years in Denmark**

SES Variables	Number (%)				Risk for suicide				Test of sex inter-action[§]
	Men		Women		Crude odds ratio (95 percent CI)[†]		Adjusted odds ratio (95 percent CI)[‡]		
	Cases (n=10 438)	Controls (n=208 760)	Cases (n=5 210)	Controls (n=104 200)	Men	Women	Men	Women	
Occupation and labor market status									
Salaried employee	791 (7.5)	23 166 (11.0)	732 (14.0)	24 609 (23.5)	1 reference	1 reference	1 reference	1 reference	X^2=115.4 , P<0.001
Top or high level manager	548 (5.2)	24 136 (11.5)	109 (2.1)	3 042 (2.9)	0.6 (0.6-0.7)[*]	1.2 (1.0-1.5)[#]	0.7 (0.6-0.8)[*]	1.1 (0.8-1.4)	
Low-level manager	590 (5.6)	23 061 (11.0)	367 (7.0)	10 412 (9.9)	0.7 (0.6-0.8)[*]	1.2 (1.1-1.4)[*]	0.8 (0.7-0.9)[*]	1.1 (0.9-1.2)	
Skilled blue-collar worker	1 053 (10.0)	33 321 (15.8)	58 (1.1)	1 853 (1.8)	0.9 (0.8-1.0)[#]	1.1 (0.8-1.4)	0.9 (0.8-1.0)[#]	1.1 (0.8-1.5)	
Unskilled blue-collar worker	1 488 (14.1)	33 279 (15.8)	478 (9.1)	17 533	1.3 (1.2-	1.0 (0.8-1.1)	1.2 (1.1-	0.9 (0.8-1.0)	

				(16.7)	1.4)*		1.3)*	
Unspecified wage worker	749 (7.1)	7 293 (3.5)	353 (6.7)	9 074 (8.7)	3.5 (3.1-3.9)*	1.5 (1.3-1.7)*	2.7 (2.4-3.1)*	1.6 (1.3-1.8)*
Self-employed	1 059 (10.1)	25 002 (11.9)	140 (2.7)	3 518 (3.4)	1.3 (1.1-1.4)*	1.5 (1.2-1.8)*	1.1 (0.9-1.2)	1.2 (1.0-1.5)*
Unemployed	1 126 (10.7)	13 806 (6.6)	372 (7.1)	6 614 (6.3)	2.4 (2.2-2.6)*	1.9 (1.7-2.2)*	1.3 (1.2-1.5)*	1.2 (1.0-1.4)#
Full-time student	210 (2.0)	3 796 (1.8)	98 (1.9)	1 583 (1.5)	2.1 (1.8-2.5)*	2.0 (1.5-2.6)*	1.0 (0.8-1.3)	1.1 (0.8-1.5)
Out of labor force	1 118 (10.6)	8 154 (3.9)	966 (18.4)	13 458 (12.8)	4.4 (4.0-4.9)*	3.0 (2.7-3.3)*	1.0 (0.8-1.1)	1.0 (0.8-1.2)
Age and disability pensioner	1 793 (17.0)	15 486 (7.4)	1 569 (29.9)	13 144 (12.5)	4.4 (4.1-4.9)*	6.7 (6.0-7.4)*	1.4 (1.2-1.5)*	1.9 (1.6-2.2)*
Gross income								
Highest income quartile	1 616 (15.5)	6 586 (3.2)	930 (17.8)	11 561 (11.1)	1 reference	1 reference	1 reference	1 reference	X^2=67.7, P<0.001
Second highest income quartile	3 961 (37.9)	125 233 (60.0)	818 (15.7)	21 517 (20.6)	1.9 (1.8-2.0)*	1.0 (0.9-1.1)	1.0 (0.9-1.0)	0.8 (0.7-0.9)*
Second lowest income quartile	2 867 (27.5)	51 658 (24.7)	1 661 (31.9)	44 641	3.0 (2.8-	1.9 (1.8-	0.8 (0.8-	0.7 (0.6-

				(42.8)	3.2)*	2.1)*	0.9)*	0.8)*	
Lowest income quartile	1 994 (19.1)	25 283 (12.1)	1 801 (34.6)	26 481 (25.4)	9.6 (8.9-10.2)*	2.3 (2.1-2.6)*	3.8 (3.4-4.2)*	1.7 (1.5-2.1)*	
Marital status									
Married	3 702 (35.5)	122 634 (58.7)	2 135 (41.0)	67 910 (65.2)	1 reference	1 reference	1 reference	1 reference	X^2=4.3, P=0.118
Cohabitating	990 (9.5)	24 089 (11.5)	426 (8.2)	8 937 (8.6)	1.6 (1.5-1.8)*	1.7 (1.5-1.9)*	1.3 (1.2-1.4)*	1.2 (1.1-1.4)*	
Single	5 746 (55.0)	62 037 (29.7)	2 649 (50.8)	27 353 (26.2)	3.7 (3.6-3.9)*	3.3 (3.1-3.5)*	1.8 (1.7-1.9)*	1.7 (1.5-1.8)*	
Parenthood									
No young child	9 150 (87.7)	172 785 (82.8)	4 868 (93.4)	91 678 (88.0)	1 reference	1 reference	1 reference	1 reference	
Child less than 2 years old	333 (3.3)	122 227 (5.9)	83 (1.6)	3 875 (3.7)	0.5 (0.5-0.6)*	0.4 (0.3-0.5)*	0.7 (0.6-0.8)*	0.4 (0.3-0.6)*	X^2=44.5, P<0.001
Child 2-3 years old	405 (3.9)	10 404 (5.0)	75 (1.4)	3 617 (3.5)	0.7 (0.7-0.8)*	0.4 (0.3-0.5)*	1.1 (0.9-1.2)	0.5 (0.4-0.7)*	
Child 4-6 years old	550 (5.3)	13 344 (6.4)	184 (3.5)	5 030 (4.8)	0.7 (0.7-0.8)*	0.6 (0.5-0.7)*	1.0 (0.9-1.1)	0.8 (0.7-0.9)#	

Place of residence									
Other than large city or capital area	6 523 (62.5)	137 373 (65.8)	2 919 (56.0)	67 712 (65.0)	1 reference	1 reference	1 reference	1 reference	X^2=30.6, P<0.001
Large city	1 122 (10.7)	23 894 (11.4)	652 (12.5)	11 831 (11.3)	1.0 (0.9-1.1)	1.3 (1.2-1.4)*	0.8 (0.8-0.9)*	1.2 (1.0-1.3)*	
Capital area	2 793 (26.8)	47 493 (22.7)	1 639 (31.5)	24 657 (23.7)	1.2 (1.2-1.3)*	1.5 (1.4-1.6)*	0.9 (0.9-1.0)*	1.1 (1.0-1.2)#	
Ethnicity									
Danish-citizenship	102 220 (97.9)	203 194 (97.3)	5 105 (98.0)	101 899 (97.8)	1 reference	1 reference	1 reference	1 reference	X^2=12.4, P<0.001
Non-Danish citizenship	218 (2.1)	5 566 (2.7)	105 (2.0)	2 311 (2.2)	0.8 (0.7-0.9)*	0.9 (0.7-1.1)	0.6 (0.5-0.7)*	1.1 (0.8-1.3)	

#: p<0.05; *: p<0.01.

†: Crude odds ratios were adjusted for sex, age, and calendar time through matching.

‡: Adjusted odds ratios were further adjusted for physical and mental health status and all variables in the table simultaneously.

§: The significance of the coefficient on the sex interaction variables was examined with the likelihood ratio test.