

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

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**Background:** Although many authors have investigated the impact of sex on the association between socio-economic status (SES) and suicide, a definite consensus has not yet emerged. Using Danish population registration data including 15 648 suicide deaths of individuals aged 18–65 year during 1981–97 and matched population controls, we investigate the associations of multiple SES factors with suicide risk and explore the sex-specific aspects of these associations. **Methods:** We use conditional logistic regression models to estimate the statistical relationship between SES, sex and suicide. **Results:** SES, proxied by low income, unskilled blue-collar work, non-specific 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 suicide risk for women but reduces it for men; residents with a foreign citizenship in Denmark have a lower risk of suicide compared with Danish citizens, but this protection is confined to male immigrants. **Conclusions:** Our results demonstrate that suicide risk is associated with a range of SES proxies but the strength and/or direction of the association can differ by sex. Risk assessment and, therefore, prevention approaches should take this into consideration.

**Keywords:** case–control study, Denmark, suicide, socio-economic status

## Introduction

Since Durkheim's seminal work,<sup>1</sup> the impact of socio-economic status (SES) on the risk of suicide has attracted much scholarly interest.<sup>2–14</sup> The link between SES and suicide is complex. Variation in SES implies a differential exposure to physical, psychological, environmental and occupational factors, and differences in access to healthcare, in the quality of life and in lifestyles.<sup>15</sup> Typical proxies for SES are variables that reflect social status and access to resources, such as income, education, marriage, employment and occupational status.<sup>3,5,7,9,16</sup> 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.<sup>17–19</sup> However, aggregate measures cannot accurately account for the impact of individual-level SES without risking the ecological fallacy. Men and women play different roles in the family and society, and this 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,<sup>3,7,8</sup> the results have been mixed, probably due to differences in the sample size, the nature of controls and the SES measures used.

In this study, we use a rich data set based on the Danish population longitudinal registers to estimate the impact of SES factors on both 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<sup>20</sup> based upon the entire population of Denmark. Data were drawn from four Danish longitudinal registers. The Danish Cause-of-Death Registry<sup>21</sup> contains dates and causes of all deaths in Denmark since 1970. The Integrated Database for Labour Market Research (IDA Database)<sup>22</sup> 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 its establishment in 1980. The Danish Psychiatric Central Register<sup>23</sup> covers all psychiatric facilities in Denmark and keeps computerized records of all personal contacts with psychiatric hospitals dating from 1969. Finally, the Danish Civil Registration System<sup>24</sup> contains unique personal identification numbers (known as CPR-numbers) for all residents of Denmark with their birth information and links to their 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% correct.<sup>24</sup> Each individual's personal identification was used to retrieve and link personal information from the various databases.

Deaths by suicide between 1981 and 1997 were retrieved from the Danish Cause-of-Death Registry, as coded according to the International Classification of Diseases (ICD) with E950–959 in ICD-8 before 1994, and X60–X84 in ICD-10 thereafter. Study cases were individuals aged 18–65 who lived in Denmark on 31 December in the year before their death from suicide. 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 male and 5210 female suicide deaths.

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Population controls were drawn from a 5% random subsample 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 socio-economic variables are occupation and labour market status, gross annual income, marital status, parenthood status, place of residence and citizenship status. The data were 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.<sup>22</sup> This was grouped into 11 mutually exclusive categories: (i) top or high-level manager (manager, superior salaried employee), (ii) low-level manager (head of salaried staff), (iii) ordinary salaried employee (staff with medium-level management of own work), (iv) skilled blue-collar worker, (v) unskilled blue-collar worker, (vi) unspecified wage worker (paid a wage for assisting spouse in farming or similar activity, or employee with no subject specification), (vii) self-employed, (viii) unemployed (receiving unemployment benefits and actively searching a job), (ix) full-time student, (x) out of labour force (e.g. housewives) and (xi) 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 was categorized according to the active living partnership as being married, cohabiting with a partner (living at the same address with a partner of opposite sex with an age difference <15 years) and living in a single status (never married, widowed, divorced or separated).

Parenthood status captured family composition according to the age of children who are under school age, i.e. 6-years old. We used dummy variables for parent of a child of age <2, 2–3 and 4–6 years (the age of the youngest child), or having no children under the age of 6.

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

Citizenship was measured as a dummy variable identifying Danish citizens.

To control for the potential confounding effect of health status, we included two more variables. The first was a binary variable indicating whether a person had a sickness-related absence from work (>3 consecutive weeks), and the second was a variable capturing the history of psychiatric hospitalization (never admitted, admitted within the previous year or admitted more than 1 year prior). Data on sickness-related job absence (recorded in previous year) were from the IDA Database, whereas psychiatric history information (at the time of suicide) was derived from the Danish Psychiatric Central Register.

### Statistical analysis

To investigate the effect of SES on male/female suicide mortality, we estimated conditional logistic regression models,<sup>20</sup> using the PHREG procedure within SAS statistical package version 8.0.<sup>25</sup> 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 included 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

We identified 15 648 individuals aged 18–65 years who died by suicide in Denmark during the period 1981–97. Table 1 shows the distribution of their SES characteristics. For both men and women, a higher proportion of cases were unemployed, on age and disability pensions, or otherwise out of the labour force. Cases were more commonly in the high and low income groups, single, with no children under the age of 6 years, Danish citizens and residing in the capital area.

Table 1 also shows the sex-specific suicide risk associated with socio-economic variables derived from the conditional logistic regression analyses. In general, we observed an increased crude odds ratio of suicide associated with socio-economic disadvantages. The associated risks were somewhat attenuated and in some cases even reversed in the direction when the data were adjusted for the effects of SES variables simultaneously and the two health indicators added, i.e. history of psychiatric hospital contact and sickness absence from job.

Occupation and labour-market affiliation had a strong impact on suicide risk. Compared with salaried employees, suicide risk was significantly higher for the unemployed, self-employed, full-time students, individuals out of the labour market and pensioners. In all labour-market groups, any elevated risk of suicide for men and women decreased after controlling for other socio-economic variables and health status. For men, compared with salaried employees, being in a management role or in skilled labour was protective against suicide, with this effect remaining after adjustment. The elevated risk of male suicide associated with self-employment, student and general out of labour force status reduced to the null following adjustment. Among women, the slight increase in risk associated with high status labour market roles disappeared following adjustment, as did the risk associated with student and out of labour force status. In contrast to men, there was no protective effect for women associated with any labour force status, and the elevated risk associated with self-employment remained following adjustment. In the unskilled blue-collar category, the significantly higher risk of male suicide compared with their salaried counterparts persisted after adjustment. Unspecified wage workers were at a significantly elevated risk for suicide, regardless of sex, even after controlling for other factors. Overall, the association between occupation and labour-market affiliation and suicide varied significantly by sex (sex interaction test:  $P < 0.001$ ).

Decreasing income progressively increased the unadjusted suicide risk for men and women, with a more pronounced effect for men. Controlling for additional factors yielded a U-shaped pattern of association, with men and women in the lowest income quartile having the highest risk and those in the middle-income groups facing a risk level lower or equivalent to that of the highest (reference) income group. The elevated risk associated with low income is particularly prominent for men. For women, having a middle level income was protective compared with having the highest and

**Table 1** Distribution of variables among cases and population live controls, and risk of suicide associated with social and economic status for men and women aged 18–65 years

SES variables	Number (%)		Risk for suicide				Test of sex interaction <sup>e</sup>
	Men		Crude odds ratio (95% CI) <sup>a</sup>		Adjusted odds ratio (95% CI) <sup>b</sup>		
	Cases (n = 10 438)	Controls (n = 208 760)	Men	Women	Men	Women	
<i>Occupation and labor market status</i>							
Salaried employee	791 (7.5)	23 166 (11.0)	732 (14.0)	24 609 (23.5)	1	1	X <sup>2</sup> = 115.4, P < 0.001
Top or high level manager	548 (5.2)	24 136 (11.5)	109 (2.1)	3042 (2.9)	0.6 (0.6–0.7)*	1.2 (1.0–1.5)*	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)*	1.1 (0.9–1.2)
Skilled blue-collar worker	1053 (10.0)	33 321 (15.8)	58 (1.1)	1853 (1.8)	0.9 (0.8–1.0)*	1.1 (0.8–1.0)*	1.1 (0.8–1.5)
Unskilled blue-collar worker	1488 (14.1)	33 279 (15.8)	478 (9.1)	17 533 (16.7)	1.3 (1.2–1.4)*	1.0 (0.8–1.1)	0.9 (0.8–1.0)
Unspecified wage worker	749 (7.1)	7 293 (3.5)	353 (6.7)	9074 (8.7)	3.5 (3.1–3.9)*	1.5 (1.3–1.7)*	1.6 (1.3–1.8)*
Self-employed	1059 (10.1)	25 002 (11.9)	140 (2.7)	518 (3.4)	1.3 (1.1–1.4)*	1.5 (1.2–1.8)*	1.2 (1.0–1.5)*
Unemployed	1126 (10.7)	13 806 (6.6)	372 (7.1)	6614 (6.3)	2.4 (2.2–2.6)*	1.9 (1.7–2.2)*	1.2 (1.0–1.4)*
Full-time student	210 (2.0)	3796 (1.8)	98 (1.9)	1583 (1.5)	2.1 (1.8–2.5)*	2.0 (1.5–2.6)*	1.1 (0.8–1.5)
Out of labor force	1118 (10.6)	8154 (3.9)	966 (18.4)	13 458 (12.8)	4.4 (4.0–4.9)*	3.0 (2.7–3.3)*	1.0 (0.8–1.2)
Age and disability pensioner	1793 (17.0)	15 486 (7.4)	1569 (29.9)	13 144 (12.5)	4.4 (4.1–4.9)*	6.7 (6.0–7.4)*	1.9 (1.6–2.2)*
<i>Gross income</i>							
Highest income quartile	1616 (15.5)	6 586 (3.2)	930 (17.8)	11 561 (11.1)	1	1	X <sup>2</sup> = 67.7, P < 0.001
Second highest income quartile	3961 (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)	0.8 (0.7–0.9)*
Second lowest income quartile	2867 (27.5)	51 658 (24.7)	1661 (31.9)	44 641 (42.8)	3.0 (2.8–3.2)*	1.9 (1.8–2.1)*	0.7 (0.6–0.8)*
Lowest income quartile	1994 (19.1)	25 283 (12.1)	1801 (34.6)	26 481 (25.4)	9.6 (8.9–10.2)*	2.3 (2.1–2.6)*	1.7 (1.5–2.1)*
<i>Marital status</i>							
Married	3702 (35.5)	122 634 (58.7)	2 135 (41.0)	67 910 (65.2)	1	1	X <sup>2</sup> = 4.3, P = 0.118
Cohabiting	990 (9.5)	24 089 (11.5)	46 (8.2)	8937 (8.6)	1.6 (1.5–1.8)*	1.7 (1.5–1.9)*	1.2 (1.1–1.4)*
Single	5746 (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)*
<i>Parenthood</i>							
No young child	9150 (87.7)	172 785 (82.8)	4 868 (93.4)	91 678 (88.0)	1	1	X <sup>2</sup> = 44.5, P < 0.001
Child less than 2 years old	333 (3.3)	122 227 (5.9)	83 (1.6)	3875 (3.7)	0.5 (0.5–0.6)*	0.4 (0.3–0.5)*	0.4 (0.3–0.6)*
Child 2–3 years old	405 (3.9)	10 404 (5.0)	75 (1.4)	3617 (3.5)	0.7 (0.7–0.8)*	0.4 (0.3–0.5)*	0.5 (0.4–0.7)*
Child 4–6 years old	550 (5.3)	13 344 (6.4)	184 (3.5)	5030 (4.8)	0.7 (0.7–0.8)*	0.6 (0.5–0.7)*	0.8 (0.7–0.9)*
<i>Place of residence</i>							
Other than large city or capital area	6523 (62.5)	137 373 (65.8)	2919 (56.0)	67 712 (65.0)	1	1	X <sup>2</sup> = 30.6, P < 0.001
Large city	1122 (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)*	1.2 (1.0–1.3)*
Capital area	2793 (26.8)	47 493 (22.7)	1639 (31.5)	24 657 (23.7)	1.2 (1.2–1.3)*	1.5 (1.4–1.6)*	1.1 (1.0–1.2)*
<i>Ethnicity</i>							
Danish citizenship	102 220 (97.9)	203 194 (97.3)	5105 (98.0)	101 899 (97.8)	1	1	X <sup>2</sup> = 12.4, P < 0.001
Non-Danish citizenship	218 (2.1)	5566 (2.7)	105 (2.0)	2311 (2.2)	0.8 (0.7–0.9)*	0.9 (0.7–1.1)	1.1 (0.8–1.3)

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

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

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

\*P < 0.01

#P < 0.05

lowest incomes. After controlling for health status and the other socio-economic variables, the general impact of income on suicide differed significantly by sex (sex interaction test:  $P < 0.001$ ).

Marital status was associated with suicide risk for both men and women. There was a risk gradient from married (reference) through cohabiting, to highest risk for men and women living in a single status. The greatly elevated uncontrolled risk for single men approached the lesser increased risk for single women in the fully adjusted model. The overall effect of marital status did not vary by sex (sex interaction test:  $P = 0.118$ ).

Parenting a child under the age of 6 years was protective against suicide, especially for women, when compared with the reference group (no child under the age of 6 years). In the adjusted model, the greatest protection was for women with infants up to 2-years old, with reduced protection as the child grows older. In contrast, for men, protection was only associated with having an infant up to 2-years of age. The protective effect of young children differed significantly by parental sex (sex interaction test:  $P < 0.001$ ).

In the unadjusted estimates, individuals in urban areas were at greater risk and living in an area with a higher degree of urban concentration elevated this risk. However, in the full model the excess risk reduced for women and was reversed for men (sex interaction test:  $P < 0.001$ ).

Living in Denmark as a non-Danish citizen lowered the male risk of suicide compared with that of people with Danish citizenship. However, the adjusted model increased this protective effect, which remained significant only for men (sex interaction test:  $P < 0.001$ ).

## Discussion

The strong association of a range of SES indicators with suicide vary by sex even after controlling for other SES factors and for physical and mental health status. Low SES, reflected by 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 people living in a single status. Parenthood with young children lowers the risk of suicide, and this effect is stronger for women. Living in a big city raises the risk for women but reduces it for men. Foreign citizens in Denmark face a lower risk of suicide compared with Danish citizens, but this result is attributable exclusively to male immigrants.

Key strengths of our study include the analysis of a range of SES indicators, enabling a detailed understanding of the influence of sex on suicide risk for different social groups, the use of a national data system with almost perfect linkage across databases and a large sample size. We used a robust approach to the case-control analysis: all comparisons were made within the same population, there is no reason to suspect differential error in measurement of the SES or confounding variables between cases and controls, and the population controls were randomly selected from a database containing the entire Danish population. We were able to control for mental illness and physical health status, the major confounders commonly not available from whole-population databases.

Limitations include the following: our measures of SES cover some, but not all, relevant aspects of an individual's location in the socio-economic system, and individuals were assigned a social class based on their own SES rather than that of their head of household. Furthermore, this work does not include socio-economic factors that operate at the neighbourhood or at higher levels of social aggregation. These limitations

impose a modest constraint on the interpretation of the findings, but they do not substantively undermine the internal validity of the study.

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.<sup>3,7,26,27</sup> However, most studies have been limited by the inability to control for the potentially confounding effect of mental illness, which is known to be causally associated with suicide<sup>28,29</sup> and is also associated with lower SES and reduced labour market participation. Drawing on unique data sources, we account for the effect of mental or other illness that may be severe enough to cause significant sickness-related absence from work, for mental illness requiring hospitalization and for a range of other SES variables, and we confirm this association.

In particular, we find that low income is associated with a greater burden of risk for men than for women, as is being an unspecified wage worker. Men in this group face a risk of suicide almost three times higher than that of 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 led to poorer mental health status.<sup>30-32</sup> A study from New Zealand suggests that during a time of economic restructuring with high unemployment rates and in which the proportion of part time, temporary jobs increased, the risk of suicide rose particularly in younger men.<sup>33</sup>

Having a managerial position appears to 'protect' men but confers no advantage on women. The finding is consistent with previous evidence that exerting some control at the workplace is positively associated with male health status.<sup>31,34</sup> 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. 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 in management positions, which could mean more reluctance to seek help when a woman experiences setbacks, distressing situations or mental disorder.

Our results suggest that men are socially and psychologically more affected by the effects of job position, labour market status and income level than women are.<sup>35,36</sup> 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 to live up to social, family and self-imposed expectations may lead to greater psychological distress or a greater loss of self-esteem in men than women, thus rendering men more vulnerable to suicidal behaviour. On the other hand, it is possible that we are observing the uncontrolled effect of mental illness which did not result in hospitalization or time off work. Although this is plausible given that men are less likely than women to seek help for psychological distress,<sup>37,38</sup> 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, the effect of marital status on

suicide risk is not significantly different by sex. This finding is different from that in a previous Danish study,<sup>3</sup> probably because our analysis only focuses on subjects aged 18–65 years whilst the previous one covered all ages. However, our finding that, regardless of sex, suicide risk differs depending on marital status (married, living with a partner, or being single) is consistent with previous studies<sup>39</sup> and supports Durkheim's theory of the protective effect of marriage against suicide.<sup>1</sup> It is widely accepted that child rearing is a positive life experience which may prevent people from ending their lives.<sup>1,40</sup> The presence of a young child may increase parents' feelings of self-worth, possibly due to their experience of being needed, and the presence of a dependent child may also increase the sense of obligation. This may explain our finding that parents—especially mothers—are less likely to die by suicide. This is in line with previous findings.<sup>35,39</sup>

Our observation of a higher crude odds ratio for suicide for residents living in a more urbanized area accords with previous studies from Western countries.<sup>13,41,42</sup> In the full model, however, 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 by severe psychiatric disorders which may be more prevalent among city dwellers.<sup>43,44</sup> Once the effects of those factors are controlled for, living in big cities may offer better job opportunities and career potential, for example, which may benefit men more. Women may be more vulnerable in a competitive environment than their male counterparts. Such an explanation may apply in particular to young and middle-aged adults, the socio-economically active part of the population.

Contrary to other reports,<sup>41</sup> the present study documents a generally lower risk for suicide among foreign citizens in Denmark, although this observation is confined to male immigrants only. Denmark is generally a country with low immigration: only 5.45% of residents are foreign, and most of them are youth or middle-aged adults.<sup>45</sup> 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 are able to come to Denmark and their reasons for staying. Men who immigrate to Denmark for work 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 similar to many Western European countries. However, one should be cautious when generalizing the results of this study to other countries with different socio-economic environments. Nevertheless, the present study demonstrates that suicide risk is associated with a range of SES proxies but the strength and/or direction of the association can differ by sex. These results suggest that risk assessment for suicide and other prevention approaches should take this into consideration. Perhaps the most immediate application of these findings would be in government, social agency and employer responses to the current economic crisis which is likely to be producing increased numbers of vulnerable men. As men are less likely to seek help when in psychological distress, proactive strategies such as assertive employee and social assistance programmes for those with threatened or actual job loss are essential. Such initiatives should focus on mental health and illness, and social well-being, as well as income support if they are to contribute to suicide prevention in the current economic climate.

## Acknowledgements

The authors would like to thank Catherine Cubbin, Camelia Minoiu and Jennifer Roberts for helpful comments and suggestions on earlier versions of this article.

*Conflicts of interest:* None declared.

## Key points

- This large population study provides robust evidence that suicide risk is associated with a range of socio-economic factors but the strength and/or direction of the association can differ by sex.
- Low SES, proxied by low income, unskilled blue-collar work, non-specific 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 with a stronger effect for women. Living in a large city raises suicide risk for women but reduces it for men.
- These results suggest that risk assessment for suicide and therefore prevention approaches should take them into consideration. This is particularly important for suicide prevention in the current economic climate.

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Received 16 January 2009, accepted 14 October 2009