

# Suicide and occupation: the impact of socio-economic, demographic and psychiatric differences

ESBEN AGERBO<sup>1\*</sup>, DAVID GUNNELL<sup>2</sup>, JENS PETER BONDE<sup>3</sup>,  
PREBEN BO MORTENSEN<sup>1</sup> AND MERETE NORDENTOFT<sup>4</sup>

<sup>1</sup> National Centre for Register-based Research, University of Aarhus, Aarhus C, Denmark; <sup>2</sup> Department of Social Medicine, University of Bristol, Bristol, UK; <sup>3</sup> Department of Occupational Medicine, Aarhus University Hospital, Aarhus C, Denmark; <sup>4</sup> Bispebjerg Hospital, Department of Psychiatry, Copenhagen NV, Denmark

## ABSTRACT

**Background.** To explore the risk of suicide associated with occupation while evaluating the impact of socio-economic, demographic and psychiatric differences.

**Method.** A nested case-control study with 3195 suicides and 63 900 matched controls. Information on causes of death, occupation, psychiatric admission, marital status and socio-economic factors was obtained from routine registers.

**Results.** Across the 55 occupations investigated, the risk of suicide ranged from 2.73 [95% confidence interval (CI) 1.77–4.22] among doctors to 0.44 (95% CI 0.27–0.72) among architects and engineers compared with primary school teachers. With the exception of doctors and nurses, most of the excess risk of suicide associated with particular occupations is explained by the social and economic characteristics of people in those occupations. Much, but not all, of the excess risk in doctors and nurses is due to their increased use of self-poisoning, a method for which they have the knowledge to use effectively. Occupation has little association with suicide among people who suffer from a psychiatric illness, except for doctors, where the excess risk is 3.62 ( $p=0.007$ ).

**Conclusions.** Most of the considerable variation in suicide risk across occupations is explained by socio-economic factors, except for doctors and nurses. Apart from in doctors, the risk of suicide has little association with occupation among people who suffer from a psychiatric illness. Restriction of access to lethal means is an important strategy in suicide prevention.

## INTRODUCTION

Several studies have found that members of some occupations are at greatly increased risk of suicide (Bedeian, 1982; Boxer *et al.* 1995; Kelly *et al.* 1995; Kposowa, 1999). Studies have reported an elevated risk for suicide among medical doctors (Schernhammer & Colditz, 2004), nurses (Hawton & Vislisel, 1999), veterinary surgeons (Mellanby, 2005), pharmacists (Kelly & Bunting, 1998), dentists (Alexander, 2001), farmers (Malmberg *et al.* 1999), police officers (Hem *et al.* 2001), social workers (Stack, 2004),

artists (Stack, 1996), craftsmen (Hamermesh & Soss, 1974), cooks (Stark *et al.* 2006), publicans (Kelly & Bunting, 1998), automobile mechanics (Schwartz, 1987), fishery, forestry and construction workers (Notkola *et al.* 1993; Liu & Waterbor, 1994), and more generally in low paying occupation such as labourers, semi-skilled and unskilled workers (Platt & Hawton, 2000; Stark *et al.* 2006). In part, the elevated risk of some occupational groups may reflect occupational stress or access to lethal means of suicide such as medicines or firearms. In others the risk may be due to economic factors, such as the transient nature of some occupations predisposing to periods of unemployment and low income. Some studies have reported a reduced

\* Address for correspondence: Esben Agerbo, M.Sc., National Centre for Register-based Research, University of Aarhus, Taasingegade 1, DK-8000 Aarhus C, Denmark.  
(Email: ea@ncrr.dk)

suicide risk among professionals (Lostao *et al.* 2006), clerical workers (Hamermesh & Soss, 1974; Kposowa, 1999) and military personnel (Rothberg *et al.* 1990).

Most previous studies of this issue have been limited in scope or methodology. For example, studies often lack information on persons at risk (denominator data) from the same source as the occupation at death (numerator data). For this reason, proportional mortality ratios have been used as the measure of risk in a number of publications (Kelly *et al.* 1995; Kelly & Bunting, 1998; Stark *et al.* 2006); this measure may distort suicide risk in occupations at increased or decreased risk of death from other causes (Rothman & Greenland, 1998). In addition, few studies have controlled for potentially confounding socio-economic and demographic factors (Kposowa, 1999). Finally, while suicide is often regarded as a concomitant of psychiatric illness (Maris, 2002), few, if any (Stack, 2001), studies have considered the association between occupation and suicide among people who suffer from a psychiatric disorder or the possible interplay with psychiatric illness. Furthermore, it is fairly common that studies have been confined to specific occupations and relatively few reports have systematically investigated the risk across several occupational groups.

The increased risk of suicide among medical professionals has been most extensively studied (Platt & Hawton, 2000; Schernhammer & Colditz, 2004; Schernhammer, 2005). As far as we are aware, no study has hitherto investigated the suicide risk among doctors who suffer from a psychiatric illness or investigated the possible mediating and confounding effects of psychiatric illness, socio-economic and demographic factors.

In this article, we aimed to answer the following three questions: (1) Are there differences in suicide rates across the broad range of occupation? (2) Are differences in suicide rates due to differences in psychiatric morbidity? (3) Are these differences explained by socio-economic and demographic factors?

## METHOD

### Source of data and population-based registers

Data were obtained by linking Danish population-based registers using the unique personal

identification number assigned to all persons living in Denmark and used across all registration systems (Malig, 1996). The Danish Medical Register on Vital Statistics contains dates and causes of all deaths in Denmark recorded from the Cause-of-Death Certificates since 1976 and for suicide since 1970 (Danish National Board of Health, 1992). Suicide was defined as ICD-8 (WHO, 1967) codes E950–E959 and ICD-10 (WHO, 1992) codes X60–X84. Undetermined deaths (open verdicts) were not included as this category might comprise accident victims and other non-suicidal deaths. ICD-9 has never been used in Denmark. Suicidal death by poisoning by medical compounds was defined as E950.0–E950.3 and X60–X64. The Integrated Database for Longitudinal Labour Market Research (IDA; Statistics Denmark, 1991) covers the entire population from 1980 onwards. It contains information on, for example, occupation since 1991, unemployment, marital status and income, and is updated annually by Statistics Denmark with information from administrative registers on individuals who were living in Denmark on 1 January. The Danish Psychiatric Central Register (DPCR) includes all admission and discharge dates and diagnoses according to the World Health Organization (WHO), 8th and 10th classification, and covers all psychiatric in-patient facilities in Denmark since 1969 (Munk-Jorgensen & Mortensen, 1997). There are no private psychiatric hospitals in Denmark, and all treatment is free of charge.

### Study population and statistical design

All subjects who died by suicide in the period 1991–1997 while aged 25–60 years and were therefore of working age were identified from the Danish Medical Register on Vital Statistics. Using a nested case–control design (Clayton & Hills, 1996), each person who died by suicide was matched to a random sample of 20 controls of the same gender who were born the same year and who were alive when the case died by suicide (King & Zeng, 2002). Cases and controls were only included if they were resident in Denmark throughout the two preceding years.

### Classification of occupations

Information on occupation according to the Danish version of the International

Classification of Occupations (DISCO-88) (ILO, 1990; Statistics Denmark, 1996) was obtained from IDA for the main occupation held by the subject the year prior to the index year. DISCO-88 is a pyramidal hierarchical nested four-digit occupational nomenclature that divides subjects into 10 major groups at the top level of aggregation; these are subdivided into 27 submajor groups, 111 minor groups, and 372 unit groups according to skill level and skill specialization (ILO, 1990; Statistics Denmark, 1996). To conduct a reliable inference (Altman & Royston, 2000), subjects were grouped, if possible, upwards in the hierarchy until there were more than 20 suicides in each occupational group. Since 1994, it is mandatory for employers with more than 10 employees to report occupational codes using DISCO-88. For employers with less than 10 employees, and prior to 1994, occupational reporting was based on occupational descriptions in text format and these have subsequently been converted to DISCO-88 codes. Statistics Denmark validates the DISCO codes against information on, for example, union membership, education and information from other routine registers, and therefore a person can be registered with an occupation while being unemployed. Any misclassification among suicides and controls will be non-differential (Rothman & Greenland, 1998) as they are matched on year of death and the occupational classification used in that year. However, the misclassification might vary between occupational groups and therefore bias our assessment of differences between occupations.

### **Socio-economic, demographic and psychiatric factors**

Information on the individual-level demographic and socio-economic factors was obtained from IDA and information on psychiatric admission was derived from the DPCR. The adjustment factors were: time since psychiatric hospital discharge (currently admitted, week, month, half-year, year, longer) and diagnoses (depression, schizophrenia, mania, alcohol, all others), employment status (fully employed, self-employed, unemployed, otherwise), marital status (married, cohabitating, single) and gross income in quartiles. In our adjusted models we initially controlled separately for psychiatric illness, income and employment status to

investigate whether the observed associations arose because of lower income and job insecurity in certain occupations or because some occupations might attract people with previous mental illness (e.g. elementary or unskilled occupations) or that certain occupations might increase the risk of psychiatric illness and this might lie on the causal pathway between occupation and suicide risk. Further details on these factors are published elsewhere (Agerbo, 2005*a, b*; Agerbo *et al.* 2006).

### **Data modelling**

The data were analysed using conditional logistic regression (King & Zeng, 2002) with each case forming a separate stratum. As the controls were selected randomly within the appropriate risk sets, the estimated measures of relative risk are called rate ratios (RRs) (King & Zeng, 2002). Primary education teaching professionals (primary school teachers) were chosen as reference because this occupation is relatively large, well-defined and universal. Wald tests were used to test for interactions between occupational group and gender, gender composition within occupations among controls, trend with age and year, and suicide methods (stratified by poisoning by medical compounds or by use of firearm *versus* other cause) (Lunn & McNeil, 1995). To avoid chance findings, only interactions that are significant at the 1% level are considered. Subsequently, data were stratified by whether the subjects had been admitted to a psychiatric hospital and odds ratios were calculated by unconditional logistic regression analysis. Analyses were performed using SAS version 9.1 (SAS Institute Inc., Cary, NC, USA).

## **RESULTS**

In total, 3195 suicides (898 females) and 63 900 controls were identified. The distribution of cases and controls and occupation specific RRs are shown in Table 1, the ratios are sorted in descending order of magnitude.

### **Suicide across the broad range of occupations**

The highest risk of suicide is among medical doctors, followed by subjects without occupation and nurses. Several low-paid occupations had raised suicide RRs, including elementary occupations (largely unskilled manual workers,

Table 1. Age- and sex-adjusted suicide rate ratios in all occupational groups estimated from the conditional logistic regression model

Occupation	DISCO-88	No. of cases/controls	RR (95% CI)
Medical doctors	2221	36/344	2.73 (1.77–4.22)
A residual group without occupation <sup>a</sup>	9999	6884/132 916	2.47 (1.87–3.28)
Nursing associate professionals	3231	40/530	2.04 (1.34–3.11)
Elementary occupations <sup>b</sup>	9	209/2804	1.99 (1.47–2.68)
Plant and machine operators and assemblers	8	43/627	1.84 (1.22–2.76)
Bricklayers and stonemasons	7122	26/388	1.76 (1.09–2.84)
Drivers and mobile-plant operators	83	36/542	1.75 (1.14–2.69)
Painters and related workers	7141	26/395	1.73 (1.07–2.79)
Cooks	5122	21/335	1.72 (1.03–2.88)
Construction and maintenance workers	9312	22/359	1.63 (0.98–2.70)
Market-oriented skilled agricultural and fishery workers	61	33/544	1.59 (1.02–2.47)
Plumbers and pipe fitters	7136	21/368	1.52 (0.91–2.54)
Carpenters and joiners	7124	56/993	1.49 (1.02–2.18)
Pre-primary education teaching associate professionals	3320	35/626	1.49 (0.97–2.29)
General managers of business services	1317	20/363	1.45 (0.86–2.45)
Sales and services elementary occupations	91	26/473	1.45 (0.90–2.33)
Life science and health associate professionals	32	29/552	1.41 (0.89–2.23)
Institution-based personal care workers	5132	87/1688	1.39 (0.99–1.96)
Machine operators and assemblers	82	57/1121	1.38 (0.95–2.01)
Motor-vehicle drivers	832	71/1370	1.35 (0.95–1.94)
Helpers and cleaners in offices, hotels and other establishments	9132	59/1182	1.35 (0.93–1.97)
Machine-tool setters and setter-operators	7223	33/649	1.34 (0.86–2.08)
Metal moulders, welders, sheet-metal workers, and related trades workers	721	25/508	1.32 (0.81–2.14)
Other office clerks	4190	61/1259	1.31 (0.90–1.89)
Home-based personal care workers	5133	22/471	1.27 (0.77–2.11)
Mail carriers and sorting clerks	4142	30/642	1.25 (0.80–1.97)
Precision, handicraft, printing and related trades workers	73	22/464	1.24 (0.75–2.06)
Electrical and electronic equipment mechanics and fitters	724	38/814	1.24 (0.81–1.89)
General managers in wholesale and retail trade	1314	40/856	1.24 (0.82–1.87)
Blacksmiths, tool-makers and related trades workers	722	32/698	1.22 (0.78–1.90)
Labourers in mining, construction, manufacturing and transport	93	30/687	1.18 (0.75–1.86)
Other associate professionals	34	29/656	1.17 (0.74–1.84)
Market-oriented crop and animal producers	6130	47/1064	1.17 (0.78–1.73)
Food and related products machine operators	827	22/519	1.15 (0.69–1.89)
Craft and related trades workers	7	54/1271	1.13 (0.77–1.65)
Physical and engineering science associate professionals	31	27/664	1.08 (0.68–1.73)
Clerks	4	70/1825	1.04 (0.73–1.48)
<b>Primary education teaching professionals (reference)</b>	<b>2331</b>	<b>57/1496</b>	<b>1</b>
Motor vehicle mechanics and fitters	7231	31/829	1.00 (0.64–1.56)
Other professionals	24	40/1066	0.99 (0.66–1.50)
Physical and engineering science technicians	311	47/1260	0.99 (0.67–1.47)
Teaching professionals	23	32/852	0.99 (0.63–1.53)
General managers	131	28/753	0.98 (0.62–1.55)
Secretaries	4115	43/1198	0.97 (0.65–1.46)
Administrative associate professionals	343	33/906	0.96 (0.62–1.49)
Extraction and building trades workers	71	25/712	0.94 (0.58–1.52)
Personal and protective services workers	51	50/1436	0.93 (0.63–1.37)
Business professionals	241	22/625	0.93 (0.56–1.53)
Professionals	2	30/899	0.89 (0.57–1.40)
Shop salespersons and demonstrators	5220	33/1138	0.79 (0.51–1.22)
Technicians and associate professionals	3	19/716	0.70 (0.42–1.19)
Corporate managers	12	40/1553	0.67 (0.44–1.01)
Finance and sales associate professionals	341	32/1452	0.59 (0.38–0.91)
Armed forces	0	8/438	0.51 (0.24–1.08)
Architects, engineers and related professionals	214	22/1324	0.44 (0.27–0.72)

DISCO-88, Danish version of the International Classification of Occupations; RR, rate ratio; CI, confidence interval.

<sup>a</sup> People with no registered occupation.

<sup>b</sup> Largely unskilled manual workers, for example domestic and related helpers, cleaners, launderers and manufacturing labourers (see Method section).

such as domestic and related helpers, cleaners, launderers and manufacturing labourers); plant and machine operators and assemblers; bricklayers and stonemasons; drivers and mobile-plant operators; painters and related workers; cooks; and carpenters and joiners. The lowest suicide risks are among (1) architects, engineers and related professionals; (2) armed forces; (3) finance and sales associate professionals (e.g. technical and commercial sales representatives); and (4) corporate managers. No gender or year interaction was found but suicide risk seems to increase more with age among finance and sales associate professionals ( $p=0.009$ ) and to decrease in the group without occupation ( $p=0.004$ ) compared with the general increase with age. A contextual effect associated with gender composition with occupation appeared as an interaction with gender: females working in male dominated occupations were at higher risk (RR 1.68, 95% CI 1.06–2.68) compared with females working in female-dominated occupations. The risk of suicide by poisoning by medical compounds was particularly pronounced among doctors (RR 11.12, 95% CI 5.98–20.66,  $p<0.0001$ ) and to a lesser extent among females, although this did not reach conventional levels of statistical significance (RR 2.72, 95% CI 1.48–4.99,  $p=0.23$ ). The suicide rate by firearms was increased only among farmers (market-oriented crop and animal producers) (RR 2.50, 95% CI 1.32–4.75,  $p=0.006$ ) and not among soldiers (RR 0.64, 95% CI 0.09–4.76). The risk of suicide was estimated in some selected occupations with less than 20 suicides: police officers (RR 0.85, 95% CI 0.43–1.68, number of cases/controls = 10/311; by firearms: RR 1.69, 95% CI 0.39–7.33), social workers (RR 2.07, 95% CI 1.06–4.03, number of cases/controls = 11/141), and waiters and bartenders (RR 1.84, 95% CI 0.92–3.69, number of cases/controls = 10/146). The numbers of cases (controls) among pharmacists, dentists, veterinary surgeons, psychologists, and artists were 3 (123), 4 (111), 0 (49), 4 (54) and 3 (30) respectively, thus a reliable risk estimate could not be obtained.

#### Adjustment for psychiatric, socio-economic and demographic factors

Table 2 presents suicide RRs before and after controlling for psychiatric admissions and

socio-economic indicators in the 20 highest and five lowest risk occupational groups. Except among doctors and nurses, the risks associated with occupations decreased markedly after adjustment for income and employment status. Considering RRs that changed by more than 10% (Greenland, 1989), the risks associated with occupation showed a tendency to increase after adjustment for psychiatric admission (Table 2, fifth column), with the exception of the residual group without occupation, elementary/unskilled occupations, cooks and sales and services elementary occupations. Generally, the risk of suicide in all occupational groups diminished in the final model, where we controlled for psychiatric admission, employment status, marital status and gross income (Table 2, last column). The only exception was medical doctors, where the risk further increased. The adjusted risks of suicide among doctors by medicines and other causes were 13.38 (95% CI 6.29–28.45) and 2.00 (95% CI 1.07–3.75) respectively and the analogous rates among nurses were 3.26 (95% CI 1.59–6.67) and 1.93 (95% CI 1.09–3.41).

#### Suicide risks across occupations among the (never) psychiatrically admitted individuals

Approximately 47.5% of individuals who died by suicide and 5.1% of the controls had been psychiatric in-patients. Table 3 shows the risk of suicide in the 10 highest and five lowest occupational groups stratified by psychiatric disorder. Among individuals who have been admitted with a psychiatric disorder, only moderate differences in suicide risk are observed between the various occupations ( $p_{\text{heterogeneity}}=0.05$ ); the notable exception is medical doctors, who are at almost fourfold greater risk than other occupations. Among individuals who have never been admitted, the suicide risk in a specific occupation is generally slightly larger or similar in magnitude to the analogous risk in the unstratified analysis (Table 2, last column) with the possible exception of nurses, where the risk, although statistically indistinguishable, is approximately 50% higher ( $p_{\text{heterogeneity}}<0.0001$ ).

#### DISCUSSION

This study reveals that the risk of suicide varies considerably across occupational groups. Such findings might raise awareness of suicide risk in

Table 2. Suicide, 20 highest and five lowest occupational rate ratios with 95% confidence intervals

Occupation	DISCO-88	RR (95% CI) <sup>a</sup>	RR adjusted for income and employment status	RR adjusted for psychiatric admission	RR adjusted for psychiatric admission, income, employment and marital status
Medical doctors	2221	2.73 (1.77–4.22)	3.31 (2.12–5.18)	3.03 (1.83–5.02)	3.40 (2.04–5.67)
A residual group without occupation	9999	2.47 (1.87–3.28)	0.88 (0.66–1.17)	1.71 (1.24–2.36)	1.06 (0.77–1.48)
Nursing associate professionals	3231	2.04 (1.34–3.11)	2.11 (1.38–3.22)	2.30 (1.42–3.74)	2.28 (1.40–3.72)
Elementary occupations (largely unskilled manual workers)	9	1.99 (1.47–2.68)	0.92 (0.68–1.26)	1.72 (1.22–2.43)	1.15 (0.81–1.63)
Plant and machine operators and assemblers	8	1.84 (1.22–2.76)	1.38 (0.91–2.10)	2.47 (1.58–3.86)	1.99 (1.27–3.12)
Bricklayers and stonemasons	7122	1.76 (1.09–2.84)	0.96 (0.59–1.57)	2.11 (1.25–3.56)	1.44 (0.85–2.45)
Drivers and mobile-plant operators	83	1.75 (1.14–2.69)	1.31 (0.85–2.03)	2.12 (1.32–3.43)	1.77 (1.10–2.85)
Painters and related workers	7141	1.73 (1.07–2.79)	0.96 (0.59–1.56)	1.75 (1.02–2.99)	1.25 (0.72–2.14)
Cooks	5122	1.72 (1.03–2.88)	0.97 (0.57–1.64)	1.58 (0.87–2.86)	1.15 (0.63–2.09)
Construction and maintenance workers	9312	1.63 (0.98–2.70)	0.97 (0.58–1.62)	1.59 (0.89–2.85)	1.15 (0.64–2.07)
Market-oriented skilled agricultural and fishery workers	61	1.59 (1.02–2.47)	1.02 (0.65–1.60)	1.57 (0.96–2.58)	1.17 (0.71–1.93)
Plumbers and pipe fitters	7136	1.52 (0.91–2.54)	1.00 (0.59–1.68)	1.57 (0.88–2.79)	1.23 (0.69–2.21)
Carpenters and joiners	7124	1.49 (1.02–2.18)	0.97 (0.66–1.43)	1.65 (1.08–2.53)	1.28 (0.83–1.97)
Pre-primary education teaching associate professionals	3320	1.49 (0.97–2.29)	1.13 (0.73–1.75)	1.67 (1.02–2.74)	1.40 (0.85–2.29)
General managers of business services	1317	1.45 (0.86–2.45)	1.14 (0.67–1.95)	1.78 (1.00–3.17)	1.38 (0.77–2.49)
Sales and services elementary occupations	91	1.45 (0.90–2.33)	0.87 (0.54–1.41)	1.16 (0.67–2.01)	0.83 (0.47–1.46)
Life science and health associate professionals	32	1.41 (0.89–2.23)	1.21 (0.76–1.93)	1.53 (0.91–2.58)	1.43 (0.85–2.41)
Institution-based personal care workers	5132	1.39 (0.99–1.96)	0.98 (0.69–1.38)	1.34 (0.91–1.97)	1.07 (0.72–1.58)
Machine operators and assemblers	82	1.38 (0.95–2.01)	0.90 (0.61–1.32)	1.50 (0.99–2.29)	1.15 (0.75–1.76)
Motor-vehicle drivers	832	1.35 (0.95–1.94)	1.00 (0.69–1.44)	1.49 (1.00–2.22)	1.22 (0.81–1.82)
<b>Primary education teaching professionals (reference)</b>	<b>2331</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>
Technicians and associate professionals	3	0.70 (0.42–1.19)	0.56 (0.33–0.96)	0.66 (0.37–1.18)	0.56 (0.31–1.02)
Corporate managers	12	0.67 (0.44–1.01)	0.79 (0.52–1.19)	0.99 (0.63–1.55)	1.12 (0.71–1.76)
Finance and sales associate professionals	341	0.59 (0.38–0.91)	0.58 (0.37–0.90)	0.84 (0.52–1.36)	0.83 (0.52–1.35)
Armed forces	0	0.51 (0.24–1.08)	0.47 (0.22–1.01)	0.88 (0.41–1.89)	0.84 (0.39–1.81)
Architects, engineers and related professionals	214	0.44 (0.27–0.72)	0.43 (0.26–0.70)	0.57 (0.33–0.97)	0.52 (0.30–0.89)

DISCO-88, Danish version of the International Classification of Occupations; RR, rate ratio; CI, confidence interval.

<sup>a</sup> Adjusted for age, gender and year.

certain occupations and aid our understanding of the aetiology of suicide by prompting further investigation of reasons for an occupational group's elevated risk. Compared to primary school teachers, the suicide rate is more than 50% higher among doctors, nurses, people in elementary/unskilled occupations, plant and machine operators and assemblers, bricklayers, drivers, painters, cooks, construction and maintenance workers, agricultural and fishery workers, plumbers, carpenters, social workers, waiters and bartenders, and in the group without occupation. The risk of suicide is low in certain occupations, including architects, engineers, armed forces, finance and sales associate professionals and corporate managers. The suicide risk decreased in all occupations after adjustment for psychiatric admission, employment status, marital status and gross income,

with the exception of medical doctors and perhaps nurses, where the rate increased further. The most important determinants of occupational differences in suicide risk, as indicated by the reduction in risks in adjusted models (Table 2), appeared to be income and employment status. A similar result, however, is not seen among people who never have been admitted with a psychiatric disorder. Among people who have previously been admitted with psychiatric disorders, modest associations between suicide and occupation are observed except for doctors, who are at almost fourfold greater risk.

#### Epidemiological considerations: mediation, confounding and selection

A limitation of our analysis is that we cannot determine whether elevated suicide risks

Table 3. Suicide, 10 highest and five lowest occupational rate ratios stratified by admission to psychiatric hospital

Occupation	Previously admitted to a psychiatric hospital		Never admitted to a psychiatric hospital	
	No. of cases/controls	Adjusted RR (95% CI) <sup>a</sup>	No. of cases/controls	Adjusted RR (95% CI) <sup>a</sup>
Medical doctors	19/9	3.62 (1.43–9.15)	17/335	3.03 (1.59–5.79)
A residual group without occupation	566/1201	0.71 (0.45–1.13)	502/15 395	1.20 (0.79–1.83)
Nursing associate professionals	18/18	1.31 (0.59–2.91)	22/512	3.47 (1.91–6.29)
Elementary occupations	108/248	0.76 (0.46–1.26)	101/2556	1.16 (0.73–1.84)
Plant and machine operators and assemblers	9/21	0.78 (0.32–1.94)	34/606	2.24 (1.31–3.83)
Bricklayers and stonemasons	7/23	0.61 (0.23–1.59)	19/365	1.64 (0.88–3.06)
Drivers and mobile-plant operators	14/18	1.69 (0.74–3.90)	22/524	1.62 (0.89–2.93)
Painters and related workers	10/26	0.75 (0.32–1.78)	16/369	1.43 (0.75–2.74)
Cooks	13/17	1.08 (0.46–2.53)	8/318	1.02 (0.45–2.30)
Construction and maintenance workers	8/18	0.80 (0.31–2.07)	14/341	1.38 (0.70–2.71)
<b>Primary education teaching professionals (Reference)</b>	<b>33/61</b>	<b>1</b>	<b>24/1435</b>	<b>1</b>
Technicians and associate professionals	11/45	0.41 (0.19–0.91)	8/671	0.62 (0.28–1.39)
Corporate managers	11/25	0.96 (0.41–2.24)	29/1528	1.14 (0.66–1.98)
Finance and sales associate professionals	14/16	1.78 (0.76–4.18)	18/1436	0.66 (0.36–1.23)
Armed forces	0/4	— <sup>b</sup>	8/434	0.89 (0.40–2.01)
Architects, engineers and related professionals	11/32	0.68 (0.30–1.54)	11/1292	0.42 (0.20–0.86)

RR, Rate ratio; CI, confidence interval.

<sup>a</sup> Adjusted for age, gender, year, income, employment and marital status.<sup>b</sup> No cases are exposed.

associated with particular occupations arise as a result of the characteristics of the jobs, the people who take up the jobs or a combination of the two. Several circumstances may elevate risk in a specific occupation. First, access to, and specialist knowledge of, lethal means of suicide, such as medicines among doctors and nurses or firearms among farmers, police officers and soldiers, might be contributing factors. This is supported by the elevated risks of method-specific suicide in some of these groups in our analyses. Second, an elevated risk could partly reflect occupational stress and economic factors, such as recurrent or persistent unemployment spells and low income, or that psychiatric illness is more common in certain jobs (Wieclaw *et al.* 2005). In this study, we adjusted for psychiatric admission, employment status, marital status and gross income although it is not certain that these factors merely confound the association between suicide and occupation or lie on its causal pathway. It is plausible that these factors also act as intermediate conditions at different times, and therefore constitute time-dependent confounders (Robins *et al.* 2000). For example, doctors are at higher risk of being admitted with an affective disorder (e.g. depression) (Wieclaw *et al.* 2005),

which suggests that these psychiatric illnesses lie on the causal pathway between occupation and suicide, but affective illnesses also tend to occur later in life. Third, the healthy worker effect (Li & Sung, 1999), which characterizes the two-sided selection of healthy people into occupation and the exclusion of the unhealthy from the workforce, should be kept in mind when interpreting the results concerning the group without occupation and elementary/unskilled occupations, where the excess risk might partly, if not almost entirely, be caused by unemployment, lower income, higher incidences of singleness and psychiatric illness. Fourth, it is possible that people at increased risk of suicide are attracted to particular occupations. For example, some studies have shown that publicans are at increased suicide risk (Kelly & Bunting, 1998); it is possible that people at risk of alcoholism, a known risk factor for suicide, are attracted to occupations where alcohol is freely available.

### Psychiatric, socio-economic and demographic factors

Apart from people working in elementary/unskilled occupations and those not registered with an occupation, a suppressor effect

(MacKinnon *et al.* 2000) is found for most occupations as the suicide risk increased after adjustment for psychiatric admission. This indicates that levels of psychiatric admission are lower in these occupations than they are among teachers (Wieclaw *et al.* 2005). It is plausible that people who suffer from a psychiatric illness are more likely to have unskilled occupations or no occupation. In keeping with the social drift hypothesis (Kreitman *et al.* 1991; Tohen *et al.* 2000), it is likely that these people drift into unemployment or an unskilled job from the occupations where the suppression effect is seen. In all occupations, except among doctors, the risk of suicide showed a tendency to decrease after further adjustment for employment status, marital status and gross income, which, in keeping with previous studies (Kposowa, 1999; Stack, 2001), suggests that these factors account for some of the differentials in suicide risk. Although these factors account for some of the variation, it is possible that other factors, such as internal occupational stress (Stack, 2001), could account for the risk excess observed in some occupations. A skewed gender composition could be an internal stressor, as the results suggest that females (males) who are working in a male- (female)-dominated occupation are at increased risk of suicide. The additional risk increase among doctors after adjustment might be caused by doctors being less exposed to, for example, lower income, singleness and unemployment.

### Psychiatrically hospitalized individuals

Except for medical doctors, among individuals who have been hospitalized with a psychiatric disorder, only moderate disparities in suicide risks are observed across the various occupations; thus occupation has little association with suicide among individuals who suffer from a psychiatric illness. A straightforward conjecture is that psychiatric illness lies on the causal pathway between occupation and suicide; or, in keeping with a past study on suicide and unemployment (Agerbo, 2003, 2005*a*), that occupational inequalities are less important once a person suffers from a psychiatric illness. However, there are relatively few exposed cases in each occupational group, and the statistical power is limited and perhaps not sufficient to distinguish the suicide risks, which are also

rather limited in magnitude. This pattern, however, differs among doctors, who are at particular high risk of suicide when they have been admitted with psychiatric disorder. Anecdotal reports suggest that if doctors are treated, the treatment may be compromised because of collegial relationships and deference from the treating clinician, who may give more freedom to the doctor-patient to control the therapy and to self-medicate (Center *et al.* 2003). In keeping with a study on suicide in richer people with a psychiatric illness (Agerbo *et al.* 2001), doctors might feel more stigmatized and have a higher loss of self-esteem than other people with psychiatric illnesses.

### The never psychiatrically hospitalized individuals

In the section of the population who have never been admitted with a psychiatric disorder, the adjusted occupational risk of suicide tends to be slightly higher, or similar in magnitude, when compared with the general population. This is not too surprising because of the rarity of psychiatric illness in the general population. Perhaps nurses are an exception as their risk of suicide is considerably higher, which could be due to unobserved psychiatric illness. However, nurses are at increased risk of being admitted with a psychiatric disorder (Wieclaw *et al.* 2006), and an odds ratio is always larger than the corresponding risk ratio (Newman, 2001). A priori expectations suggest that the largest aberration should be found in the group without occupation, as this group has a particularly high risk of admission (Agerbo *et al.* 2004; Wieclaw *et al.* 2005).

### Availability of means for suicide

Restriction of access to means of suicide, such as lethal medicines or firearms, has been suggested as an important strategy for suicide prevention (Hawton, 2005). In this connection, we found a particularly high risk of suicide by firearms among farmers and perhaps among police officers, as well as by medicines among doctors and nurses despite an excess risk of suicide by other means among doctors and nurses. By contrast, in keeping with previous findings (Hem *et al.* 2001), the risk of suicide by firearm is not increased among soldiers and might therefore indicate a healthy soldier effect (Bross & Bross, 1987).



## ACKNOWLEDGEMENTS

This study was supported financially by the Stanley Medical Research Institute. Psychiatric epidemiological research at the National Centre for Register-based Research is in part funded through a collaborative agreement with the Centre for Basic Psychiatric Research, Psychiatric Hospital in Aarhus, Denmark.

## DECLARATION OF INTEREST

None.

## REFERENCES

- Agerbo, E. (2003). Unemployment and suicide. *Journal of Epidemiology and Community Health* **57**, 560–561.
- Agerbo, E. (2005a). Effect of psychiatric illness and labour market status on suicide: a healthy worker effect? *Journal of Epidemiology and Community Health* **59**, 598–602.
- Agerbo, E. (2005b). Midlife suicide risk, partner's psychiatric illness, spouse and child bereavement by suicide or other modes of death: a gender specific study. *Journal of Epidemiology and Community Health* **59**, 407–412.
- Agerbo, E., Byrne Eaton, W. W. & Mortensen, P. B. (2004). Marital and labor market status in the long run in schizophrenia. *Archives of General Psychiatry* **61**, 28–33.
- Agerbo, E., Mortensen, P. B., Eriksson, T., Qin, P. & Westergaard-Nielsen, N. (2001). Risk of suicide in relation to income level in people admitted to hospital with mental illness: nested case-control study. *British Medical Journal* **322**, 334–335.
- Agerbo, E., Qin, P. & Mortensen, P. B. (2006). Psychiatric illness, socioeconomic status, and marital status in people committing suicide: a matched case-sibling-control study. *Journal of Epidemiology and Community Health* **60**, 776–781.
- Alexander, R. E. (2001). Stress-related suicide by dentists and other health care workers. Fact or folklore? *Journal of the American Dental Association* **132**, 786–794.
- Altman, D. G. & Royston, P. (2000). What do we mean by validating a prognostic model? *Statistics in Medicine* **19**, 453–473.
- Bedeian, A. G. (1982). Suicide and occupation: a review. *Journal of Vocational Behavior* **21**, 206–223.
- Boxer, P. A., Burnett, C. & Swanson, N. (1995). Suicide and occupation: a review of the literature. *Journal of Occupational and Environmental Medicine* **37**, 442–452.
- Bross, I. D. & Bross, N. S. (1987). Do atomic veterans have excess cancer? New results correcting for the healthy soldier bias. *American Journal of Epidemiology* **126**, 1042–1050.
- Center, C., Davis, M., Detre, T., Ford, D. E., Hansbrough, W., Hendin, H., Laszlo, J., Litts, D. A., Mann, J., Mansky, P. A., Michels, R., Miles, S. H., Proujansky, R., Reynolds III, C. F. & Silverman, M. M. (2003). Confronting depression and suicide in physicians: a consensus statement. *Journal of the American Medical Association* **289**, 3161–3166.
- Clayton, D. & Hills, M. (1996). *Statistical Models in Epidemiology*. Oxford University Press: Oxford.
- Danish National Board of Health (1992). *Causes of Death in Denmark 1990* [in Danish]. Danish National Board of Health: Copenhagen.
- Greenland, S. (1989). Modeling and variable selection in epidemiologic analysis. *American Journal of Public Health* **79**, 340–349.
- Hamermesh, D. S. & Soss, N. M. (1974). An economic theory of suicide. *Journal of Political Economy* **82**, 83–98.
- Hawton, K. (2005). Restriction of access to methods of suicide as a means of suicide prevention. In *Prevention and Treatment of Suicidal Behaviour: From Science to Practice* (ed. K. Hawton), pp. 279–291. Oxford University Press: Oxford.
- Hawton, K. & Vislisel, L. (1999). Suicide in nurses. *Suicide and Life-threatening Behavior* **29**, 86–95.
- Hem, E., Berg, A. M. & Ekeberg, A. O. (2001). Suicide in police – a critical review. *Suicide and Life-threatening Behavior* **31**, 224–233.
- ILO (1990). *International Standard Classification of Occupations: ISCO-88*. International Labor Office: Geneva.
- Kelly, S. & Bunting, J. (1998). Trends in suicide in England and Wales, 1982–96. *Population Trends* **92**, 29–41.
- Kelly, S., Charlton, J. & Jenkins, R. (1995). Suicide deaths in England and Wales, 1982–92: the contribution of occupation and geography. *Population Trends* **80**, 16–25.
- King, G. & Zeng, L. (2002). Estimating risk and rate levels, ratios and differences in case-control studies. *Statistics in Medicine* **21**, 1409–1427.
- Kposowa, A. J. (1999). Suicide mortality in the United States: differentials by industrial and occupational groups. *American Journal of Industrial Medicine* **36**, 645–652.
- Kreitman, N., Carstairs, V. & Duffy, J. (1991). Association of age and social class with suicide among men in Great Britain. *Journal of Epidemiology and Community Health* **45**, 195–202.
- Li, C. Y. & Sung, F. C. (1999). A review of the healthy worker effect in occupational epidemiology. *Occupational Medicine (Oxford, England)* **49**, 225–229.
- Liu, T. & Waterbor, J. W. (1994). Comparison of suicide rates among industrial groups. *American Journal of Industrial Medicine* **25**, 197–203.
- Lostao, L., Joiner Jr., T. E., Lester, D., Regidor, E., Atach, P. & Sandin, B. (2006). Social inequalities in suicide mortality: Spain and France, 1980–1982 and 1988–1990. *Suicide and Life-threatening Behavior* **36**, 113–119.
- Lunn, M. & McNeil, D. (1995). Applying Cox regression to competing risks. *Biometrics* **51**, 524–532.
- MacKinnon, D. P., Krull, J. L. & Lockwood, C. M. (2000). Equivalence of the mediation, confounding and suppression effect. *Prevention Science* **1**, 173–181.
- Malig, C. (1996). *The Civil Registration System in Denmark*. IIVRS Technical Paper no. 66. International Institute for Vital Registration and Statistics: Bethesda, MD, USA.
- Malmberg, A., Simkin, S. & Hawton, K. (1999). Suicide in farmers. *British Journal of Psychiatry* **175**, 103–105.
- Maris, R. W. (2002). Suicide. *Lancet* **360**, 319–326.
- Mellanby, R. J. (2005). Incidence of suicide in the veterinary profession in England and Wales. *The Veterinary Record* **157**, 415–417.
- Munk-Jorgensen, P. & Mortensen, P. B. (1997). The Danish Psychiatric Central Register. *Danish Medical Bulletin* **44**, 82–84.
- Newman, S. C. (2001). *Biostatistical Methods in Epidemiology*. John Wiley & Sons: New York.
- Notkola, V. J., Martikainen, P. & Leino, P. I. (1993). Time trends in mortality in forestry and construction workers in Finland 1970–85 and impact of adjustment for socioeconomic variables. *Journal of Epidemiology and Community Health* **47**, 186–191.
- Platt, S. & Hawton, K. (2000). Suicidal behaviour and the labour market. In *The International Handbook of Suicide and Attempted Suicide* (ed. K. Hawton and K. van Heeringen), pp. 309–384. John Wiley & Sons: New York.
- Robins, J. M., Hernan, M. A. & Brumback, B. (2000). Marginal structural models and causal inference in epidemiology. *Epidemiology* **11**, 550–560.
- Rothberg, J. M., Bartone, P. T., Holloway, H. C. & Marlowe, D. H. (1990). Life and death in the US Army. In *Corpore sano*. *Journal of the American Medical Association* **264**, 2241–2244.
- Rothman, K. J. & Greenland, S. (1998). *Modern Epidemiology*. Lippincott Williams & Wilkins: Philadelphia.
- Schernhammer, E. (2005). Taking their own lives – the high rate of physician suicide. *New England Journal of Medicine* **352**, 2473–2476.

- Schernhammer, E. S. & Colditz, G. A. (2004). Suicide rates among physicians: a quantitative and gender assessment (meta-analysis). *American Journal of Psychiatry* **161**, 2295–2302.
- Schwartz, E. (1987). Proportionate mortality ratio analysis of automobile mechanics and gasoline service station workers in New Hampshire. *American Journal of Industrial Medicine* **12**, 91–99.
- Stack, S. (1996). Gender and suicide risk among artists: a multivariate analysis. *Suicide and Life-threatening Behavior* **26**, 374–379.
- Stack, S. (2001). Occupation and suicide. *Social Science Quarterly* **82**, 384–396.
- Stack, S. (2004). Suicide among social workers: a research note. *Archives of Suicide Research* **8**, 379–388.
- Stark, C., Belbin, A., Hopkins, P., Gibbs, D., Hay, A. & Gunnell, D. (2006). Male suicide and occupation in Scotland. *Health Statistics Quarterly* **29**, 26–29.
- Statistics Denmark (1991). *The Integrated Database for Longitudinal Labour Market Research* [in Danish]. Statistics Denmark Press: Copenhagen.
- Statistics Denmark (1996). DISCO-88. *Statistics Denmark's Standard Classification of Occupations*. Statistics Denmark: Copenhagen.
- Tohen, M., Bromet, E., Murphy, J. M. & Tsuang, M. T. (2000). Psychiatric epidemiology. *Harvard Review of Psychiatry* **8**, 111–125.
- WHO (1967). *Manual of the International Classification of Diseases (ICD-8)*. World Health Organization: Geneva.
- WHO (1992). *The ICD-10 Classification of Mental and Behavioral Disorders*. World Health Organization: Geneva.
- Wieclaw, J., Agerbo, E., Mortensen, P. B. & Bonde, J. P. (2005). Occupational risk of affective and stress-related disorders in the Danish workforce. *Scandinavian Journal of Work, Environment and Health* **31**, 343–351.
- Wieclaw, J., Agerbo, E., Mortensen, P. B. & Bonde, J. P. (2006). Risk of affective and stress related disorders among employees in human service professions. *Occupational and Environmental Medicine* **63**, 314–319.