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# Mortality differences between self-employed and paid employees: a 5-year follow-up study of the working population in Sweden

Susanna Toivanen,<sup>1</sup> Rosane Härter Griep,<sup>1,2</sup> Christin Mellner,<sup>3</sup> Stig Vinberg,<sup>4</sup> Sandra Eloranta<sup>5</sup>

<sup>1</sup>Centre for Health Equity Studies, Stockholm University/ Karolinska Institutet, Stockholm, Sweden

<sup>2</sup>Laboratory of Health and Environment Education, Oswaldo Cruz Institute, Oswaldo Cruz Foundation (Fiocruz), Rio de Janeiro, Brazil

<sup>3</sup>Department of Psychology, Stockholm University, Stockholm, Sweden

<sup>4</sup>Department of Health Sciences, Mid Sweden University, Östersund, Sweden

<sup>5</sup>Scandinavian Development Services, Stockholm, Sweden

## Correspondence to

Dr Susanna Toivanen, Centre for Health Equity Studies, CHES, Stockholm University/ Karolinska Institutet, SE-106 91 Stockholm 10691, Sweden; susanna.toivanen@ches.su.se

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## ABSTRACT

**Objectives** Analyse mortality differences between self-employed and paid employees with a focus on industrial sector, educational level and gender using Swedish register data.

**Methods** A cohort of the total working population (4 776 135 individuals; 7.2% self-employed; 18–100 years of age at baseline 2003) in Sweden with a 5-year follow-up (2004–2008) for all-cause and cause-specific mortality (57 743 deaths). Self-employed individuals were categorised as sole proprietors or limited liability company (LLC) owners according to their enterprise's legal form. Cox proportional hazards models were applied to compare mortality rates between sole proprietors, LLC owners and paid employees, adjusted for sociodemographic confounders.

**Results** Mortality from cardiovascular diseases was 16% lower and from suicide 26% lower among LLC owners than among paid employees, adjusted for confounders. Within the industrial category, all-cause mortality was 13–15% lower among sole proprietors and LLC owners compared with employees in manufacturing and mining (MM) as well as personal and cultural services (PCS), and 11–20% higher in sole proprietors in trade, transport and communication and the welfare industry (W). A significant three-way interaction indicated 17–23% lower all-cause mortality among male LLC owners in MM and female sole proprietors in PCS, and 50% higher mortality in female sole proprietors in W than in employees in the same industries.

**Conclusions** Mortality differences between self-employed individuals and paid employees vary by the legal form of self-employment, across industries, and by gender. Differences in work environment exposures and working conditions, varying market competition across industries and gender segregation in the labour market are potential mechanisms underlying these findings.

## INTRODUCTION

Approximately 14% of the European workforce consists of self-employed individuals.<sup>1</sup> Encouraging self-employment has become a priority in contemporary economies worldwide, as it is argued to boost growth and enhance business.<sup>1–2</sup> However, less is known about the health effects, as the self-employed are still a neglected group in the international occupational safety and health research.<sup>3</sup> On the one hand, individuals who become

## What this paper adds

- ▶ Analysing the Total Population Register data, the present study shows that mortality differences between the self-employed and paid employees vary by the legal structure of self-employment (sole proprietor or limited liability company owner), across industries and by gender.
- ▶ Generally, mortality is lower among those self-employed who run a limited liability company than among paid employees.
- ▶ However, among those self-employed operating as sole proprietors, mortality is higher in trade and transportation and in the welfare industry than in paid employees in the same industries.
- ▶ Regarding gender differences, women sole proprietors in the welfare industry, but not men, have a 50% higher mortality than paid employees in the same industry.
- ▶ The results provide valuable information for policymakers by indicating industries with higher mortality among the self-employed than paid employees. If self-employment is to be encouraged, the impact of the legal structure of self-employment on health needs to be highlighted.

self-employed report increased job satisfaction, but they also report more exhaustion than when they were ordinary employees.<sup>4</sup> On the other hand, entering self-employment may be stressful and was found to be associated with being prescribed tranquillisers, both among the entrepreneurs themselves and their spouses.<sup>5</sup> It has recently been suggested that self-employment could even be detrimental to one's health.<sup>6</sup> Whether the self-employed have better health than paid employees is still unclear.

Most previous studies of health differences between the self-employed and employees, some of which we briefly summarise below, have focused on morbidity outcomes.<sup>3 7–17</sup> Studies of mortality differences between the two occupational groups are scarce. Mortality comparisons give important information on a group level, and a group suffering from premature mortality has an evident health disadvantage that reduces worker productivity.<sup>18–26</sup> Therefore, mortality data are

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particularly useful for studying health differences between distinct groups of people in the labour market, such as self-employed and organisationally employed workers in the same industries.

In many countries, sole proprietorship and limited liability company (LLC) are the main legal structures of self-employment that a person can choose for registering a business at the tax authority. Both legal forms can be registered by one person, who can employ other persons. While a sole proprietor is personally responsible for all financial transactions, an LLC provides the business owner with protection from legal debt or obligation that arises in business operations. Previous research shows that legal form is associated with mortality among the self-employed so that mortality is lower among LLC owners than among sole proprietors.<sup>19</sup>

### Morbidity differences between the self-employed and employees

On the basis of the data from the European Social Survey, a cross-sectional study that adjusted for work environment factors reported poorer well-being among self-employed men than among male employees, but no difference in well-being was found between self-employed women and their organisationally employed counterparts.<sup>7</sup> Poorer self-rated health was reported among the self-employed as compared with employees in private companies.<sup>8</sup> One study reported worse physical health among self-employed women than among female employees, and in general, self-employment was associated with few mental health benefits.<sup>14</sup> Other studies have found no difference in mental health between the self-employed and employees,<sup>4 12</sup> although high overall burnout and emotional exhaustion were reported among self-employed individuals.<sup>17</sup> In a follow-up study, the health status of self-employed women was worse than that of wage earners.<sup>27</sup>

Studies investigating how health varies across individuals who transition from employment to self-employment have generally concluded that selection of comparatively healthier and perhaps more satisfied individuals into self-employment is the main reason for health differences between self-employed individuals and employees.<sup>4 6</sup>

Self-employed individuals were found to be as healthy as wage-earners; they were more likely to engage in healthy behaviours and did not experience a greater barrier to access to care.<sup>9</sup> Better health among self-employed workers than employees has been reported in cross-sectional studies based on national representative samples.<sup>9 11</sup> Entrepreneurs reported better health in terms of lower overall somatic and mental morbidity, and somatoform disorders, lower blood pressure and prevalence of hypertension, as well as higher well-being and more favourable health behaviours than employees.<sup>11</sup> Thus, both worse and better health have been reported in self-employed compared with organisationally employed individuals and, to the best of our knowledge, no comprehensive literature reviews are available.

### Mortality differences between occupational groups

Several studies of occupational injury fatality rates have reported higher fatality among the self-employed than among paid employees in various industries.<sup>28–30</sup> Regarding mortality differences by occupational class, the self-employed are occasionally excluded from the analysis, yet some studies include them as a specific occupational group.<sup>20–24</sup> For instance, a study from the late 1960s in Sweden showed higher all-cause mortality and mortality from cardiovascular diseases (CVD) among self-

employed men and women than among other occupational classes.<sup>24</sup> However, studies from the 1990s in Sweden have shown a somewhat different picture, in that CVD-specific mortality was lower among self-employed women,<sup>23</sup> but mortality from myocardial infarction remained higher among self-employed men than among non-manual male workers.<sup>22</sup> In general, farmers tend to have lower all-cause mortality and cause-specific mortality from CVD<sup>24</sup> and cancer<sup>20</sup> than other occupational groups. In Denmark, cancer mortality was highest among women with high educational level and both self-employed and salaried employees, but similar results were not found among men.<sup>20</sup> Higher all-cause mortality was reported among self-employed professionals than among professionals employed in government and production in the USA.<sup>21</sup> In Japan, no differences in all-cause mortality or mortality from ischaemic heart disease were found between employed and self-employed workers, but self-employed men had lower mortality from cerebrovascular disease than employed men. Among middle-aged women in Japan, those who were self-employed had higher mortality than employed women working full time.<sup>18</sup> Mortality among the self-employed varied across industries in Sweden, and mortality from CVD was higher in trade, transport and communication (TC), and mortality from neoplasm was higher in manufacturing and mining (MM) compared with agriculture.<sup>19</sup>

To summarise, whether self-employed individuals are generally healthier than those who are organisationally employed is still an unanswered research question. Most previous studies have focused on morbidity outcomes, and studies of mortality differences between the two occupational groups are scarce. Previous studies have shown that several factors, such as gender, educational level, previous health status, the legal form of self-employed persons' enterprise as well as industry, could influence the mortality risk. However, to the best of our knowledge, no previous study has considered these factors simultaneously. Therefore, using Total Population Register data, the aim of this study is to explore mortality differences between the self-employed and organisationally employed persons. Specific research questions investigate (1) whether there are differences in all-cause mortality and mortality from the most common causes of death between the self-employed and employees in the Swedish working population; (2) whether the legal form of self-employment influences mortality differences between the occupational groups; (3) whether the mortality differences between the self-employed and employees remain when adjusted for sociodemographic factors; (4) whether the mortality differences between the self-employed and employees vary across industries or by educational level and (5) whether there are any gender differences in the associations above.

### MATERIALS AND METHODS

We analysed data from the Swedish Work and Mortality Database (WMD) maintained at the Centre for Health Equity Studies, Stockholm University/Karolinska Institutet. The WMD comprises multiple-linked data from Swedish population registers provided by Statistics Sweden and the National Board of Health and Welfare, and it includes all individuals living in Sweden in 1980 or 1990, and born before 1986. The present analyses used data from the Total Population Register, the Longitudinal Database on Education, Income and Employment (LOUISE), the Hospital Discharge Register and the Cause of Death Register. Record linkages were possible using the 10-digit personal identity number, which was replaced by a serial number by the authorities to ensure anonymity. Ethical

permission (number 583 02-481) was granted by the Regional Ethics Committee in Stockholm.

### Study population and follow-up

All people who were gainfully employed either as self-employed or organisationally employed in 2003 in Sweden were included ( $N=4\,776\,135$ ; 7.2% self-employed). The proportion of women was 48.5% of the total working population, and the age range was between 18 and 100 years. The proportion of individuals <65 years of age was 96.6% among organisationally employed persons and 91.3% among the self-employed. The cohort was followed for all-cause mortality and mortality from specific diseases (cardiovascular, neoplasms and suicide) by record linkage to the Cause of Death Register during 2004–2008. Each individual was considered at risk from the beginning of the follow-up (1 January 2004) to the date of death, death from other cause (in analyses on specific causes of death) or the end of the follow-up (31 December 2008). There were 57 743 deaths during the follow-up period (10.9% among the self-employed). The crude all-cause mortality rates per 10 000 person-years were 17.4 (95% CI 17.1 to 17.6) and 29.3 (95% CI 29.0 to 29.6) for female and male organisationally employed persons, respectively. For the self-employed, the corresponding rates were 29.3 (95% CI 27.8 to 30.8) and 44.1 (95% CI 42.9 to 45.3).

### Measurement of occupational group

In the data, a person's occupational group is stated as (1) organisationally employed (paid employees) (2) self-employed and (3) self-employed as a LLC owner. In this study, employees and both groups of self-employed were selected. Self-employment can take a number of legal forms,<sup>31</sup> the two most common in Sweden being sole proprietors and LLC owners.<sup>19</sup> The group of self-employed includes mainly sole proprietors and a few other legal forms, the common feature being that the self-employed are personally responsible for all financial transactions in contrast to LLC owners, where the enterprise carries the financial risks. Sociodemographic differences between the two groups of self-employed individuals are reported in detail elsewhere.<sup>19</sup> In short, LLC owners are slightly older, and a larger proportion of them have tertiary education as compared with sole proprietors.<sup>19</sup>

### Measurement of mortality

Mortality was defined as (1) all-cause mortality (International Classification of Diseases, 10th Revision (ICD-10) all chapters) and as mortality from the most common causes of death, (2) CVD (ICD-10 Chapter IX, ICD-10-IX), (3) neoplasms (ICD-10-II) and (4) suicide (ICD-10-X60–X84 intentional self-harm).<sup>32</sup>

### Measurement of potential confounders

Age at entry to the study was included as a categorical variable (<50, 50–59, 60–69, and >70) in the statistical analyses. There are fewer self-employed women than men, and women and men work largely in different industrial sectors in a gender-segregated labour market. Owing to the very low share of women in some industrial sectors, as well as few deaths among these women, the main analysis was performed for women and men together and adjusted for gender. However, interaction effects between gender, industrial sector and educational level, respectively, were formally tested in separate analyses. Educational level was categorised into four groups: primary, secondary, tertiary and unknown education. Family structure was

preferred to marital status, as it also contains information on cohabiting individuals with or without children. Family structure was categorised into five groups: single (living alone), single with children, cohabiting (married or cohabiting), cohabiting with children or unknown. Number of children was grouped into small children (ages 0–6) and older children (ages 7–17). In an attempt to control for potential health-related selection, health status before the baseline was measured in terms of the Charlson Comorbidity Index using data from the Hospital Discharge Register.<sup>33</sup> Conditions included in the index cover a large variety of somatic diseases, for example, CVD, diabetes, tumours and AIDS. The index was calculated from ICD-10 codes available in the data from the period 1999–2003. Since only a limited time period is included, and only diagnoses from inpatient care were included, the absolute values of the scores may be underestimated. It is, however, reasonable to assume that the scores provide a useful approximation of previous health status, and that the potential misclassification of the score is non-differential between self-employed and organisationally employed individuals. Since the size of a company may influence workers' safety and health, enterprise size was categorised into solo (1 worker), micro (2–10 workers), small or medium-sized enterprises (SME, >10 and <250 workers) or unknown. Industrial sectors were classified using the Swedish Standard Industrial Classification (2002), which corresponds to NACE Rev. 1.1 (European Union level) and ISIC Rev. 3 (world level).<sup>34,35</sup> The highest aggregate level identified by an alphabetical code was used to collapse industries into eight categories: agriculture, forestry and fishing (AFF); MM; construction (C); TC; financial intermediation and business activities (FB); personal and cultural services (PCS); education; human health and social care; the industries of education, health and social care, public administration, and energy, water and waste management were collapsed in to the welfare sector (W) and sector not specified (NS).

### Statistical analyses

Relative risks of mortality (all-cause, CVD, neoplasms and suicide) for the self-employed and employees, compared with the general Swedish population for 2003–2007, were estimated as standardised mortality ratios (SMRs). SMRs were calculated by industrial sector as a ratio of observed to expected number of deaths. The cohort was stratified by gender and 5-year age groups, and follow-up time in person-years for each stratum was recorded. The expected number of deaths was calculated by multiplying the stratum-specific person-years in the cohort with the corresponding mortality in the general population. Ninety-five per cent CIs were computed under the assumption that the observed number of cases followed a Poisson distribution.<sup>36</sup>

Cox regression was used to study the association between occupational groups and mortality (the organisationally employed were used as the reference category). In all analyses, time since entry into the cohort was used as the time scale. Four different outcomes were considered: all-cause mortality, cause-specific CVD, neoplasm and suicide mortality.

Regression models were sequentially adjusted for potential confounding factors and effect modification. Model 1A–D included adjustment for age at entry into the cohort, gender and industrial sector, according to the SNI 2002 classification. Model 2A–D were additionally adjusted for education level, family structure, number of children, previous health status and enterprise size. Individuals with unknown education level were

not included in model 2A–D. The latter models are referred to as the fully adjusted models.

To study whether the effect of occupational group was modified by industrial sector and/or education level, two-way interaction terms between occupational group and the two variables, respectively, were added to the fully adjusted models (models 3A–D and 4A–D). The effects of occupational group on mortality are presented within each level of the modifying factors. The statistical significance of the interaction effects was calculated using likelihood ratio tests.

If there was evidence of statistically significant two-way interaction effects in models 3A–D and 4A–D, we further checked for three-way interaction effects between gender, occupational group and industrial sector, as well as gender, occupational group and education level. In situations when the three-way interaction effects were statistically significant, models of types 3 and 4 were fitted separately for men and women.

The proportional hazards assumption was tested formally using the Schoenfeld residuals from each Cox model, respectively. A significance level of 5% was used to determine statistical significance.

## RESULTS

Compared with employees, the self-employed are older, a smaller proportion of them have tertiary educational level and their health is slightly poorer as measured by the Charlson Comorbidity Index (tables 1 and 2). The proportion of women is 50% among employees and 30% among the self-employed, and the proportion varies across industries. The largest proportion of the self-employed is found in TC (22.5%) and the smallest in W (4.45%), and for employees the largest proportions operate in W (35.7%) and the smallest in AFF (0.96%; tables 1 and 2).

### Standardised mortality rate ratios

The age and gender SMRs were <1 for the self-employed and employees, indicating that their relative mortality risk was lower compared with the Swedish general population (table 3). Overall, the SMRs were closer to 1 among employees than among the self-employed, demonstrating that employees are more similar to the general population with regard to mortality. However, the self-employed in AFF and in TC were an exception, as their CVD-specific mortality was higher than that of the employees. In both occupational groups, the SMRs varied across industries.

### Mortality differences between the self-employed and organisationally employed

The significant overall effect of occupational group on all-cause mortality and mortality from CVD and suicide ( $p < 0.001$ ) indicated that there are differences in mortality between the self-employed and employees (table 4, model 1A–D). In fully adjusted regression models, mortality from CVD (HR 0.84 (95% CI 0.75 to 0.94)) and suicide (HR 0.74 (95% CI 0.56 to 0.97)) was significantly lower among LLC owners than among employees (table 4, model 2A–D).

### Interaction analyses

Interaction analyses show that the effect of occupational group was modified by industrial sector for all-cause mortality ( $p = 0.002$ ) and mortality from CVD ( $p < 0.005$ ), but not for mortality from neoplasm ( $p = 0.21$ ) or suicide ( $p = 0.11$ ; table 3, model 3A–D). Compared with employees, all-cause mortality was lower among LLC owners in MM (HR 0.87 (95% CI 0.77

to 0.99)), and among sole proprietors in PCS (HR 0.85 (95% CI 0.75 to 0.96)), as well as in the NS sector (HR 0.87 (95% CI 0.79 to 0.96)). All-cause mortality was higher among sole proprietors in TC (HR 1.11 (95% CI 1.02 to 1.2)) and in the welfare sector (W; HR 1.20 (95% CI 1.02 to 1.42)) than among employees. Mortality from CVD was lower among LLC owners in MM (HR 0.72 (95% CI 0.56 to 0.94)), FB (HR 0.69 (95% CI 0.54 to 0.89)) and PCS (HR 0.50 (95% CI 0.27 to 0.93)), and among sole proprietors in PCS (HR 0.74 (95% CI 0.56 to 0.98)) and NS (HR 0.82 (95% CI 0.68 to 0.98)). CVD-specific mortality was higher among sole proprietors in TC (HR 1.19 (95% CI 1.02 to 1.39)) than among employees in the same industry.

### Gender differences

Since the two-way interaction between occupational group and industrial level was significant (table 3, model 3A–B), a three-way interaction analysis was conducted between occupational group, industrial sector and gender (figure 1). For all-cause mortality, a significant interaction effect was found. Compared with employees, lower mortality was found among self-employed men, but not among women, operating as LLC owners in MM (HR 0.83 (95% CI 0.72 to 0.96)) or as sole proprietors in NS (HR 0.82 (95% CI 0.73 to 0.92)). Self-employed women, but not men, operating as sole proprietors in PCS had lower mortality (HR 0.77 (95% CI 0.64 to 0.94)) and those in W had higher mortality (HR 1.5 (95% CI 1.22 to 1.89)) than employees in the same industries.

## DISCUSSION

This 5-year follow-up study of the total working population in Sweden investigated mortality differences between self-employed persons and paid employees. In general, the relative risk of mortality was lower in the self-employed than in the employees analysed in terms of SMRs. Yet, mortality varied by the legal form of self-employment, across industries and between men and women. Mortality from CVD and suicide was lower among the self-employed operating as LLC owners than among paid employees, and the difference persisted when adjusted for gender and industry, as well as other sociodemographic factors. When analysing industry-specific mortality, both LLC owners and sole proprietors had lower mortality than employees in some industries: MM, FB and PCS. Higher all-cause mortality among the self-employed than among employees was found among sole proprietors in trade and transport and in the welfare industry, and CVD-specific mortality was higher also in trade and transport. Regarding gender differences, mortality was lower among male LLC owners than among employees in MM and among female sole proprietors in PCS. Mortality was higher among female sole proprietors in the welfare industry compared with employees in the same industry. Regarding the effect of educational level on mortality differences between the self-employed and paid employees, this study did not find any significant associations.

### Present findings in relation to previous studies

Previous research has shown that mortality among the self-employed differs by the legal form of self-employment, such that mortality was higher among the self-employed operating as sole proprietors than among limited partners.<sup>19</sup> In this study, mortality was generally lower among LLC owners than among regular employees, yet in some industries mortality was higher among sole proprietors than among employees.

**Table 1** Baseline characteristics for self-employed persons in Sweden 2003 across industrial sectors

	All	AFF	MM	C	TC	FB	PCS	W	NS
Total N (%)	321 274 (100)	41 951 (13)	28 049 (9)	38 385 (12)	72 277 (22)	60 574 (19)	37 913 (12)	14 295 (4)	27 830 (9)
Age*	49.40 [12.02]	51.67 [11]	50.16 [11.2]	48.47 [10.8]	49.38 [11]	49.41 [12.1]	44.09 [11.7]	51.02 [10.3]	52.96 [16.1]
Sex									
Female	95 363 (30)	8595 (20)	6747 (24)	3311 (9)	18 543 (26)	18 789 (31)	21 196 (56)	8215 (57)	9967 (36)
Male	225 911 (70)	33 356 (80)	21 302 (76)	35 074 (91)	53 734 (74)	41 785 (69)	16 717 (44)	6080 (43)	17 863 (64)
Education									
Primary	82 721 (26)	15 392 (37)	8175 (29)	12 647 (33)	23 606 (33)	6438 (11)	8684 (23)	871 (6)	6908 (25)
Secondary	158 428 (49)	21 848 (52)	15 214 (54)	23 063 (60)	37 948 (53)	23 727 (39)	21 500 (57)	3565 (25)	11 563 (42)
Tertiary	73 749 (23)	4469 (10)	4254 (15)	2443 (6)	9807 (13)	29 540 (49)	7212 (19)	9754 (68)	6270 (22)
Unknown	6376 (2)	242 (1)	406 (2)	232 (1)	916 (1)	869 (1)	517 (1)	105 (1)	3089 (11)
Family									
Living alone	73 984 (23)	7293 (18)	5833 (21)	8429 (22)	15 917 (22)	15 580 (26)	10 193 (27)	3236 (23)	7503 (27)
Lone parent	18 312 (6)	2509 (6)	1203 (4)	1868 (5)	3533 (5)	3227 (5)	3127 (8)	1189 (8)	1656 (6)
Cohabiting parent	145 296 (45)	21 102 (50)	12 786 (46)	18 217 (47)	33 195 (46)	25 343 (42)	17 880 (47)	6393 (45)	10 380 (37)
Cohabiting	83 681 (26)	11 047 (26)	8227 (29)	9871 (26)	19 631 (27)	16 424 (27)	6713 (18)	3477 (24)	8291 (30)
Unknown	1 (0)	0 (0)	0 (0)	0 (0)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Children*									
Ages 0–6	0.20 [0.5]	0.16 [0.5]	0.17 [0.5]	0.20 [0.5]	0.19 [0.5]	0.20 [0.5]	0.30 [0.6]	0.16 [0.5]	0.18 [0.5]
Ages 7–17	0.50 [0.9]	0.55 [0.9]	0.51 [0.9]	0.55 [0.9]	0.52 [0.9]	0.44 [0.8]	0.54 [0.9]	0.56 [0.9]	0.39 [0.8]
Enterprise legal form									
Sole proprietorship	211 465 (66)	37 785 (90)	11 943 (43)	22 009 (57)	37 336 (52)	34 658 (57)	31 051 (82)	9081 (64)	27 602 (99)
Limited liability	109 809 (34)	4166 (10)	16 106 (57)	16 376 (43)	34 941 (48)	25 916 (43)	6862 (18)	5214 (36)	228 (1)
Enterprise size									
Solo	179 538 (56)	26 043 (62)	10 458 (37)	20 328 (53)	31 076 (43)	36 550 (60)	25 374 (67)	8483 (59)	21 226 (76)
Micro	102 904 (32)	12 303 (29)	11 698 (42)	13 931 (36)	32 509 (45)	17 050 (28)	10 382 (27)	4236 (30)	795 (3)
SME	19 736 (6)	308 (1)	4771 (17)	3112 (8)	6161 (9)	3146 (5)	1195 (3)	1001 (7)	42 (0.2)
Unknown	19 096 (6)	3297 (8)	1122 (4)	1014 (3)	2531 (3)	3828 (7)	962 (3)	575 (4)	5767 (20.8)
Charlson Comorbidity Index									
None	307 766 (95.8)	40 076 (95.8)	26 844 (95.8)	37 002 (96.4)	69 306 (95.8)	58 072 (95.8)	36 823 (97)	13 742 (96)	25 901 (93)
Mild	12 823 (4)	1782 (4)	1146 (4)	1332 (3.5)	2817 (4)	2378 (4)	1037 (2.9)	522 (3.8)	1809 (6.6)
Severe	685 (0.2)	93 (0.2)	59 (0.2)	51 (0.1)	154 (0.2)	124 (0.2)	53 (0.1)	31 (0.2)	120 (0.4)

Reported as number (%) if not otherwise stated.

Industrial sector: AFF, MM, C, TC, FB, PCS, W and NS.

\*Age and number of children: average with the SD in square brackets.

AFF, agriculture, forestry and fishing; C, construction; FB, financial intermediation and business activities; MM, manufacturing and mining; NS, not specified; PCS, personal and cultural services; SME, small or medium-sized enterprises; TC, trade, transport and communication; W, welfare including education and research, health and social care, public administration, and energy, water and waste management.

**Table 2** Baseline characteristics for employees in Sweden 2003 across industrial sectors

	All	AFF	MM	C	TC	FB	PCS	W	NS
Total N (%)	4 454 861 (100)	42 733 (1)	785 324 (18)	217 166 (5)	792 807 (18)	593 539 (13)	356 216 (8)	1 588 629 (36)	78 447 (2)
Age*	41.7 [13.7]	40.4 [15.3]	41.7 [12.7]	41.3 [13.1]	39.1 [13.6]	41.3 [14.1]	39.5 [16.39]	43.7 [12.9]	46.1 [18.6]
Sex									
Female	2 222 346 (50)	10 821 (25)	208 495 (27)	17 632 (8)	323 048 (41)	261 618 (44)	195 530 (55)	1 163 370 (73)	41 832 (53)
Male	2 232 515 (50)	31 912 (75)	576 829 (73)	199 534 (92)	469 759 (59)	331 921 (56)	160 686 (45)	425 259 (27)	36 615 (47)
Education									
Primary	737 060 (17)	12 336 (29)	181 764 (23)	49 623 (23)	164 233 (21)	85 953 (14)	76 173 (22)	147 336 (9)	19 642 (25)
Secondary	2 187 053 (49)	22 898 (54)	423 595 (54)	143 397 (66)	466 382 (59)	267 258 (45)	171 680 (48)	659 001 (42)	32 842 (42)
Tertiary	1 490 319 (33)	6962 (16)	175 643 (22)	23 440 (11)	158 283 (20)	230 128 (39)	99 711 (28)	774 542 (49)	21 610 (28)
Unknown	40 429 (1)	537 (1)	43.22 (1)	706 (0)	3909 (0)	10 200 (2)	8652 (2)	7750 (0)	4353 (5)
Family									
Living alone	1 446 765 (33)	13 394 (31)	265 473 (34)	71 368 (33)	279 841 (35)	211 110 (36)	131 096 (37)	448 479 (28)	26 004 (33)
Lone parent	412 147 (9)	3827 (9)	56 972 (7)	14 457 (6)	70 962 (9)	49 406 (8)	39 320 (11)	168 117 (11)	9086 (12)
Cohabiting parent	1 868 910 (42)	19 309 (45)	341 682 (44)	97 146 (45)	333 477 (42)	238 126 (40)	130 864 (37)	683 641 (43)	24 665 (31)
Cohabiting	727 023 (16)	6203 (15)	121 195 (15)	34 194 (16)	108 520 (14)	94 895 (16)	54 935 (15)	288 389 (18)	18 692 (24)
Unknown	16 (0)	0 (0)	2 (0)	1 (0)	7 (0)	2 (0)	1 (0)	3 (0)	0 (0)
Children*									
Ages 0–6	0.2 [0.5]	0.2 [0.5]	0.2 [0.6]	0.2 [0.6]	0.2 [0.6]	0.2 [0.6]	0.2 [0.5]	0.2 [0.5]	0.1 [0.5]
Ages 7–17	0.5 [0.8]	0.5 [0.8]	0.5 [0.8]	0.5 [0.8]	0.4 [0.8]	0.4 [0.8]	0.4 [0.8]	0.5 [0.9]	0.4 [0.8]
Enterprise size									
Solo	74 089 (2)	3368 (8)	4233 (1)	4071 (2)	15 306 (2)	24 720 (4)	16 158 (5)	4856 (0)	1377 (2)
Micro	631 906 (14)	20 823 (49)	56 785 (7)	49 064 (23)	193 225 (24)	110 660 (19)	102 779 (29)	95 964 (6)	2606 (3)
SME	3 395 154 (76)	15 525 (36)	711 227 (90)	133 783 (62)	567 977 (72)	399 968 (67)	206 272 (57)	1 358 565 (86)	1837 (2)
Unknown	353 712 (8)	3017 (7)	13 079 (2)	30 248 (14)	16 299 (2)	58 191 (10)	31 007 (9)	129 244 (8)	72 627 (93)
Charlson Comorbidity Index									
None	4 326 714 (96.9)	41 630 (96.9)	763 574 (96.9)	211 687 (97.9)	576 293 (97.9)	773 955 (96.9)	344 213 (96.8)	1 541 541 (96.9)	73 821 (93.7)
Mild	122 472 (3)	1057 (3)	20 795 (3)	5260 (2)	16 419 (2)	18 063 (3)	11 391 (3)	45 131 (3)	4356 (6)
Severe	5675 (0.1)	46 (0.1)	955 (0.1)	219 (0.1)	827 (0.1)	789 (0.1)	612 (0.2)	1957 (0.1)	270 (0.3)

Reported as number (%) if not otherwise stated.

Industrial sector: AFF, MM, C, TC, FB, PCS, W and NS.

\*Age and number of children: average with the SD in square brackets.

AFF, agriculture, forestry and fishing; C, construction; FB, financial intermediation and business activities; MM, manufacturing and mining; NS, not specified; PCS, personal and cultural services; SME, small or medium-sized enterprises; TC, trade, transport and communication; W, welfare including education and research, health and social care, public administration, and energy, water and waste management.

**Table 3** Number of deaths and age and gender SMRs, and 95% CI for all-cause mortality and mortality from CVD\*, neoplasm\* and suicide\* for self-employed persons and employees in Sweden (2004–2008)

	Self-employed			Employees		
	Observed	SMR	(95% CI)	Observed	SMR	(95% CI)
<b>All-cause mortality</b>						
All	6295	0.64	(0.62 to 0.66)	51 448	0.69	(0.69 to 0.70)
AFF	842	0.61	(0.57 to 0.65)	541	0.62	(0.57 to 0.67)
MM	582	0.69	(0.64 to 0.75)	9459	0.77	(0.75 to 0.78)
C	587	0.61	(0.56 to 0.66)	2421	0.68	(0.65 to 0.71)
TC	1313	0.67	(0.64 to 0.71)	7522	0.71	(0.69 to 0.72)
FB	1012	0.56	(0.52 to 0.59)	7602	0.66	(0.64 to 0.67)
PCS	394	0.64	(0.58 to 0.71)	5241	0.69	(0.67 to 0.70)
W	247	0.67	(0.59 to 0.75)	16 140	0.66	(0.65 to 0.68)
NS	1318	0.69	(0.66 to 0.73)	2522	0.77	(0.74 to 0.80)
<b>CVD*</b>						
All	1874	0.58	(0.56 to 0.61)	12 939	0.63	(0.62 to 0.64)
AFF	252	0.57	(0.50 to 0.64)	152	0.55	(0.46 to 0.64)
MM	167	0.62	(0.53 to 0.72)	2617	0.76	(0.73 to 0.79)
C	151	0.51	(0.43 to 0.59)	615	0.61	(0.56 to 0.66)
TC	406	0.67	(0.61 to 0.74)	1808	0.64	(0.61 to 0.67)
FB	249	0.43	(0.38 to 0.49)	2162	0.60	(0.57 to 0.62)
PCS	81	0.51	(0.40 to 0.63)	1549	0.63	(0.59 to 0.66)
W	53	0.51	(0.38 to 0.66)	3216	0.55	(0.53 to 0.57)
NS	515	0.68	(0.62 to 0.74)	820	0.69	(0.65 to 0.74)
<b>Neoplasm*</b>						
All	2838	0.81	(0.78 to 0.84)	24 439	0.87	(0.86 to 0.88)
AFF	373	0.72	(0.65 to 0.80)	209	0.71	(0.61 to 0.81)
MM	258	0.85	(0.75 to 0.96)	3954	0.92	(0.89 to 0.95)
C	286	0.84	(0.75 to 0.94)	1030	0.87	(0.82 to 0.93)
TC	598	0.84	(0.77 to 0.91)	3486	0.90	(0.87 to 0.93)
FB	514	0.77	(0.70 to 0.84)	3514	0.87	(0.84 to 0.90)
PCS	212	0.86	(0.75 to 0.99)	2296	0.86	(0.83 to 0.90)
W	139	0.90	(0.76 to 1.06)	8918	0.84	(0.82 to 0.85)
NS	458	0.83	(0.75 to 0.91)	1032	0.93	(0.87 to 0.98)
<b>Suicide*</b>						
All	232	0.73	(0.64 to 0.84)	2632	0.76	(0.73 to 0.79)
AFF	49	1.09	(0.81 to 1.44)	42	1.09	(0.78 to 1.47)
MM	19	0.66	(0.39 to 1.02)	621	0.86	(0.79 to 0.93)
C	32	0.74	(0.51 to 1.05)	177	0.80	(0.68 to 0.92)
TC	55	0.75	(0.56 to 0.97)	494	0.77	(0.71 to 0.84)
FB	35	0.60	(0.42 to 0.83)	303	0.64	(0.57 to 0.72)
PCS	12	0.41	(0.21 to 0.72)	187	0.74	(0.64 to 0.85)
W	12	1.01	(0.52 to 1.77)	751	0.72	(0.67 to 0.77)
NS	18	0.69	(0.41 to 1.09)	57	0.96	(0.73 to 1.25)

Industrial sector: AFF, MM, C, TC, FB, PCS, W and NS.

\*CVD: diseases of the circulatory system mortality ICD-10-IX; neoplasm: neoplasm mortality ICD-10-II; suicide: suicide mortality ICD-10-X60-X84.

AFF, agriculture, forestry and fishing; C, construction; CVD, cardiovascular diseases; FB, financial intermediation and business activities; ICD-10, International Classification of Diseases, 10th Revision; MM, manufacturing and mining; NS, not specified; PCS, personal and cultural services; SMR, standardised mortality ratio; TC, trade, transport and communication; W, welfare.

Previous studies have also revealed differences in mortality from CVD, neoplasm and suicide among the self-employed,<sup>19</sup> and between the self-employed and other occupational groups.<sup>20–24</sup> When expanding the present analyses to investigate differences in mortality from CVD, neoplasm and suicide, LLC owners had significantly lower mortality from CVD and suicide than employees, but no significant differences were seen regarding mortality from neoplasm. One potential explanation for lower mortality among LLC owners could be that they have more control over their working life than paid employees do, which has been associated with less work stress and, consequently, lower risk for CVD<sup>37–38</sup> and suicide.<sup>39</sup>

Mortality was generally lower among LLC owners than among regular employees, yet in some industries mortality was higher among sole proprietors than among employees. Previous research has shown that mortality among the self-employed differs by the legal form of self-employment, such that mortality was higher among the self-employed operating as sole proprietors than among limited partners. Thus, while confirming some previous findings,<sup>19</sup> the present results also highlight that sole proprietors in trade and transport and in the welfare industry are vulnerable labour market groups compared with paid employees as regards increased mortality risk. It is plausible that the working conditions, including income, of sole proprietors are more stressful

**Table 4** HR and 95% CIs for all-cause mortality, and mortality from CVD, neoplasm and suicide, by occupational group, adjusted for covariates (2003, follow-up for mortality 2004–2008) for self-employed persons and employees in Sweden

	A: All-cause		B: CVD		C: Neoplasm		D: Suicide	
	Limited liability HR* (95% CI)	Sole proprietor HR (95% CI)	Limited liability HR (95% CI)	Sole proprietor HR (95% CI)	Limited liability HR (95% CI)	Sole proprietor HR (95% CI)	Limited liability HR (95% CI)	Sole proprietor HR (95% CI)
<i>Model 1†</i>	0.89 (0.84 to 0.94)	0.99 (0.95 to 1.03)	0.78 (0.7 to 0.86)	0.97 (0.9 to 1.04)	0.96 (0.9 to 1.03)	1.05 (1 to 1.11)	0.69 (0.53 to 0.9)	1.09 (0.92 to 1.29)
p Value	<0.01		<0.01		0.10		<0.01	
<i>Model 2‡</i>	0.95 (0.9 to 1.00)	1.00 (0.95 to 1.05)	0.84 (0.75 to 0.94)	0.96 (0.88 to 1.04)	0.99 (0.92 to 1.07)	1.04 (0.97 to 1.11)	0.74 (0.56 to 0.97)	1.09 (0.86 to 1.37)
p Value	0.19		<0.01		0.46		0.04	
<i>Model 3§</i>								
Industrial sector								
Agriculture, forestry and fishing	1.00 (0.75 to 1.33)	1.06 (0.94 to 1.2)	0.91 (0.5 to 1.64)	1.08 (0.86 to 1.36)	1.32 (0.9 to 1.94)	1.10 (0.92 to 1.33)	0.28 (0.04 to 2.02)	1.25 (0.8 to 1.96)
Manufacturing and mining	0.87 (0.77 to 0.99)	1.10 (0.96 to 1.25)	0.72 (0.56 to 0.94)	1.00 (0.79 to 1.28)	0.89 (0.74 to 1.07)	1.21 (1.00 to 1.45)	0.53 (0.25 to 1.12)	0.84 (0.43 to 1.67)
Construction	1.01 (0.88 to 1.15)	0.96 (0.85 to 1.09)	0.97 (0.75 to 1.27)	0.89 (0.7 to 1.12)	0.98 (0.81 to 1.19)	1.11 (0.93 to 1.32)	0.73 (0.37 to 1.43)	1.15 (0.71 to 1.85)
Trade, transport and communication	0.97 (0.89 to 1.06)	1.11 (1.02 to 1.2)	1.00 (0.84 to 1.19)	1.19 (1.02 to 1.39)	1.01 (0.89 to 1.15)	1.04 (0.92 to 1.18)	0.62 (0.37 to 1.05)	1.35 (0.94 to 1.94)
Financial intermediation and business activities	0.93 (0.83 to 1.04)	1.00 (0.91 to 1.09)	0.69 (0.54 to 0.89)	0.91 (0.75 to 1.09)	0.96 (0.82 to 1.12)	1.01 (0.89 to 1.15)	0.94 (0.54 to 1.65)	1.1 (0.69 to 1.78)
Personal and cultural services	1.00 (0.8 to 1.24)	0.85 (0.75 to 0.96)	0.50 (0.27 to 0.93)	0.74 (0.56 to 0.98)	1.30 (0.97 to 1.74)	0.93 (0.78 to 1.11)	0.76 (0.24 to 2.37)	0.6 (0.3 to 1.2)
Welfare	1.06 (0.84 to 1.33)	1.20 (1.02 to 1.42)	1.10 (0.69 to 1.75)	0.99 (0.68 to 1.44)	0.92 (0.66 to 1.29)	1.33 (1.08 to 1.65)	2.02 (0.9 to 4.54)	1.26 (0.55 to 2.86)
Not specified	1.20 (0.57 to 2.51)	0.87 (0.79 to 0.96)	NA	0.82 (0.68 to 0.98)	1.66 (0.62 to 4.45)	0.94 (0.81 to 1.09)	6.22 (0.85 to 45.21)	0.83 (0.45 to 1.52)
p for interaction	0.002		0.005		0.11		0.21	
<i>Model 4¶</i>								
Education level								
Primary	0.90 (0.83 to 0.98)	0.99 (0.93 to 1.06)	0.83 (0.7 to 0.98)	0.97 (0.86 to 1.08)	0.98 (0.87 to 1.1)	1.05 (0.96 to 1.15)	0.58 (0.34 to 0.97)	0.98 (0.71 to 1.34)
Secondary	0.94 (0.87 to 1.02)	1.00 (0.94 to 1.06)	0.77 (0.65 to 0.91)	0.95 (0.84 to 1.07)	0.99 (0.88 to 1.1)	1.02 (0.94 to 1.12)	0.64 (0.42 to 0.97)	1.16 (0.87 to 1.54)
Tertiary	1.10 (0.98 to 1.23)	1.02 (0.93 to 1.12)	1.05 (0.83 to 1.33)	0.96 (0.8 to 1.15)	1.01 (0.86 to 1.19)	1.04 (0.92 to 1.18)	1.32 (0.81 to 2.16)	1.18 (0.76 to 1.83)
p for interaction	0.09		0.36		0.99		0.13	

\*The reference group in all analyses is employees.

†Adjusted for time in study (in years), age at baseline, gender and industrial sector.

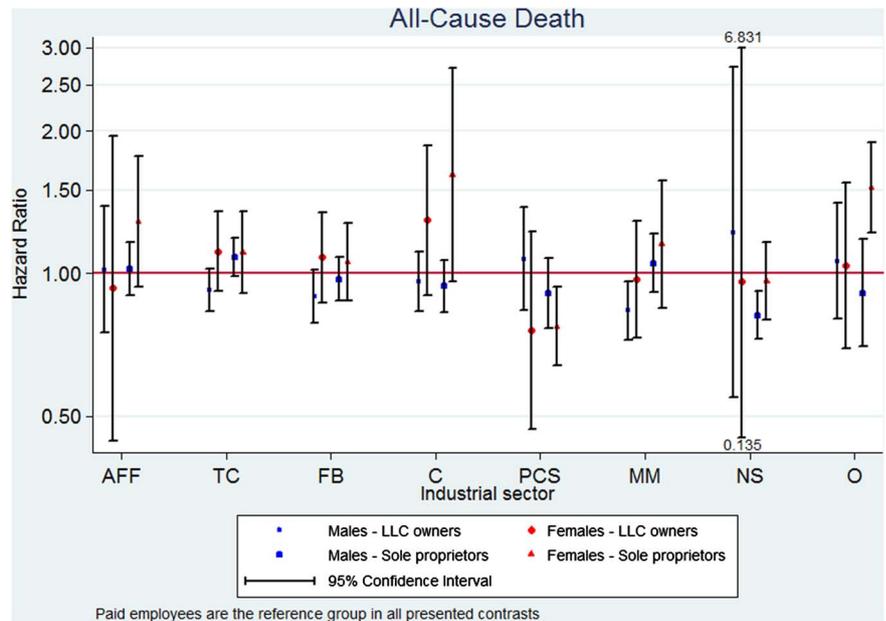
‡Additionally adjusted for education level, number of children and family structure, Charlson Comorbidity Index, enterprise size.

§Additionally adjusted for an interaction between industrial sector and occupational group.

¶Model 2 additionally adjusted for an interaction between education and occupational group.

CVD, cardiovascular diseases; NA, not applicable.

**Figure 1** Gender and occupational group specific HRs and 95% CIs for all-cause mortality by industrial sector, adjusted for covariates (2003, follow-up for mortality 2004–2008) for self-employed and paid employees in Sweden. Industrial sector: AFF, agriculture, forestry and fishing; C, construction; FB, financial intermediation and business activities; MM, manufacturing and mining; NS, not specified; PCS, personal and cultural services; TC, trade, transport and communication; W, welfare including education and research, health and social care, public administration, and energy, water and waste management.



and unstable than those of paid employees, particularly in the trade and transport and welfare industries. Competition in these industries may be harder than in other industries, and sole proprietors in the welfare industry may be dependent on a few main customers, a situation that could increase their vulnerability.

Regarding gender differences, all-cause mortality was lower among male LLC owners in MM and among female sole proprietors in PCS than among paid employees. All-cause mortality was higher among female sole proprietors in the welfare industry compared with employees in the same industry. PCS and welfare are the industries in which most self-employed women operate in Sweden. It is plausible that the working conditions are extremely different in these industries, and therefore further investigations are warranted. Previous studies from Japan have revealed lower mortality from cerebrovascular disease among self-employed men compared with employed men, adjusted for a number of biomedical risk factors for CVD, but not for industries or legal form of self-employment.<sup>25</sup> Among women in Japan, self-employment was associated with increased risk for all-cause mortality compared with employment among women working full time.<sup>18</sup> However, whether this was valid for women in different industries or differed by the legal form of self-employment among women was not in focus.

### Possible mechanisms and implications for policymakers

Differences in work environment exposures and working conditions between the self-employed and paid employees, varying market competition across different industries, and gender segregation in the labour market are potential mechanisms underlying the mortality differences between the self-employed and paid employees found in this study. The self-employed are still a neglected group in the international occupational safety and health research, and more knowledge is needed about the health effects of self-employment,<sup>3</sup> particularly as encouraging self-employment seems to have become a priority in contemporary economies worldwide in order to boost growth and enhance business.<sup>1 2</sup> It is plausible that self-employment may increase as a consequence of changing working life and global competition, ageing populations and the need to integrate refugees and vulnerable groups into the labour market. Thus, it is important to monitor working conditions among the self-employed, as some

industries may be more detrimental than others to the health and well-being of this group.

### Study strengths and limitations

While some previous studies have shown that the self-employed have better health than other occupational groups,<sup>40</sup> there has been a tendency to lump the self-employed in one category based on business ownership. As a consequence, the group of self-employed includes people with very different qualifications, experiences and life chances. The present findings thus progress the research literature in several ways. First, analyses are based on register data on the total working population including the self-employed and employees with various occupations, which make the results valid for all working women and men in Sweden regardless of occupation. The findings may be generalisable to other similar populations elsewhere. Second, the self-employed were classified as sole proprietors or LLC owners according to the main legal forms of self-employment, a condition that has not typically been considered in previous studies and that revealed important mortality differences between the self-employed and employees in this study. Third, industrial sectors were classified according to international standards.<sup>35</sup> Fourth, we used mortality data from the Cause of Death Register to compare the self-employed and employees. In order to compare health between the self-employed and paid employees, mortality is a more objective measure than self-reported health outcomes, which is the measure mainly used in previous studies. Fifth, in an attempt to control for health selection, we adjusted for previous health status in terms of the Charlson Comorbidity Index.<sup>33</sup> However, population registers do not generally include information on health behaviours or work environment factors, which would have been relevant in this study to minimise the risk that the associations observed are subject to residual confounding. Moreover, owing to the large number of statistical tests performed, the results from the three-way interaction analyses should be considered as exploratory findings until verified in future research.

### CONCLUSIONS

This study provided new prospective findings indicating that mortality differences between self-employed individuals and

paid employees vary by the legal form of self-employment, gender and across industries. Even if mortality is generally lower among the self-employed than among the paid employees, our results indicate higher mortality among the self-employed in a few industries, particularly among self-employed women in the welfare industry. Further work is required to examine the associations in different settings, preferably using individual-level data, and adjusting for the legal form of self-employment, work environment factors and other working and living conditions. Gender-specific analyses are warranted, as the impact of self-employment on health differs for women and men in a gender-segregated labour market.

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