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## Late-life suicidal behaviours among new users of antidepressants: A prospective population-based study of sociodemographic and gender factors in those aged 75 and above

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3 **1 Late-life suicidal behaviours among new users of antidepressants:**  
4 **2 A prospective population-based study of sociodemographic and**  
5 **3 gender factors in those aged 75 and above**  
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## 2 **ABSTRACT**

### 3 **Objective**

4 To investigate sociodemographic and gender factors associated with suicide and suicide  
5 attempts among new users of antidepressants aged 75 and above.

### 6 **Design**

7 Register-based cohort study.

### 8 **Setting**

9 National population-based cohort of Swedish residents aged  $\geq 75$  years.

### 10 **Participants**

11 185 225 patients who initiated antidepressant medication between January 1, 2007 and  
12 December 31, 2013 were followed until December 31, 2014.

### 13 **Main outcome measures**

14 Suicide and suicide attempts. Fine and Gray regression models were used to analyse the  
15 sociodemographic factors (age, country of birth, marital status, education level, last  
16 occupation, income and social allowance) associated with suicidal behaviours in the entire  
17 cohort and by gender.

### 18 **Results**

19 During follow-up, 295 suicides and 654 suicide attempts occurred. Adjusted sub-hazard ratios  
20 (aSHRs) for suicide were lower among older age groups (aSHR 0.73, 95% confidence interval  
21 0.53-0.99 for those 85-89 years; and 0.53, 0.33 to 0.86 for those  $\geq 90$  years). A similar pattern  
22 was observed for suicide attempts. Suicide attempts were more common among those born in  
23 foreign countries (1.58, 1.16 to 2.15 for those born in another Nordic country; and 1.43, 1.06  
24 to 1.93 for those born in non-Nordic countries). In the gender-stratified analyses, being single  
25 or divorced, and born in another Nordic country was associated with higher risk of suicide  
26 among men. Educational and occupational history and being born in a non-Nordic country  
27 influenced risk of suicidal behaviours in women.

### 28 **Conclusion**

29 Suicidal behaviours occurred more commonly among new users who were “younger” old  
30 adults and those with foreign background, suggesting that those groups might require greater  
31 support when initiating antidepressant therapy. Our findings suggest the need for gender-  
32 specific, multifaceted approaches to the prevention of suicidal behaviours in late-life.

### 33 **Keywords**

34 Antidepressants, Suicide, Sociodemographic factors, Pharmacoepidemiology, Aged, Cohort  
35 study

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## STRENGTHS AND LIMITATIONS OF THIS STUDY

- This is the first prospective cohort study to focus on the sociodemographic factors associated with suicidal behaviours among the oldest adults who initiated an antidepressant therapy.
- The study is based on a national population-based cohort with no exclusion criteria, minimizing the risk of selection bias. Moreover, there is no recall bias as national registers were used to define the sociodemographic factors and potential confounders.
- Only suicide attempts that have been registered in hospitals or specialised outpatient services can be captured with our study design.
- Research is needed in other settings as socioeconomic conditions, availability of healthcare, and cultural differences may have an impact on suicidal behaviours in late-life.

## 1 INTRODUCTION

2 High suicide rates are observed in older adults in many countries.<sup>1</sup> The most common  
3 contributing factor to the development of self-harm behaviours in late-life is the presence of  
4 clinically significant depressive symptoms.<sup>2</sup> Therefore, most suicide prevention strategies  
5 have focused on increasing the detection of depression and optimising its management.<sup>3</sup>  
6 However, the long-term benefits and sustainability of such programmes remains uncertain.<sup>4 5</sup>  
7 While suicide rates are particularly high in older adult males,<sup>6</sup> prevention programs appear to  
8 be more successful in women than in men.<sup>4</sup>

9 One possible explanation of the limited success of depression-focused interventions in  
10 reducing the prevalence of suicidal behaviours in late-life is that these behaviours have a  
11 multifactorial aetiology. Untargeted factors such as loneliness, limited social support, and  
12 financial concerns may drive the association between depression and suicidal behaviours.<sup>7 8 9</sup>

13 The role of social factors in late-life suicidal behaviours is relatively little studied. Despite  
14 broad inclusion criteria, a recent systematic review identified only 16 studies with a focus on  
15 social factors in late-life suicidal behaviours.<sup>8</sup> Few of these involved persons in their upper  
16 seventies, eighties and nineties, which is the segment of the population with particularly high  
17 rates of suicide.<sup>10</sup> Results from studies focusing on “younger” older adults (under 75 years)  
18 cannot be extrapolated to older persons. Risk factors have been shown to differ with age in  
19 both clinical and population-based cohorts of older adults.<sup>11 12</sup>

20 Better recognition and management of factors associated with suicidal behaviours is an  
21 important target for the prevention of suicide in the oldest population, especially in the  
22 context of depression. The objective of this study was therefore to investigate the association  
23 between sociodemographic factors and risk of fatal and non-fatal suicidal behaviours in a  
24 national population-based cohort of Swedish adults aged  $\geq 75$  years who initiated  
25 antidepressant therapy.

26

## 1 **METHODS**

### 2 **Study population and data sources**

3 We conducted a population-based cohort study among all Swedish residents aged  $\geq 75$  years  
4 who filled at least one antidepressant prescription between January 1, 2007 and December 31,  
5 2013 and had not filled any antidepressant prescription in the preceding 12 months. The date  
6 of the first filled prescription represented the index date. These individuals were followed  
7 from their index date until December 31, 2014 or until migration or death. Data on dispensed  
8 antidepressant medications (defined by the Anatomic Therapeutic Code ATC-N06A) was  
9 obtained from the Swedish Prescribed Drug Register held at the National Board of Health and  
10 Welfare.<sup>13</sup> The register includes purchased prescribed drugs for outpatients, residential care  
11 and nursing homes. Sociodemographic data were collected, by record linkage, from the  
12 longitudinal integration database for health insurance and labour market studies (LISA) and  
13 the Total Population Register, held by Statistics Sweden. Persons residing in nursing homes  
14 were identified by data from the care and social services from the National Board of Health  
15 and Welfare.

### 16 **Outcome measure**

17 The study outcomes were the occurrence of suicide or suicide attempt, identified from the  
18 Cause of Death Register, and from the National Patient Register, respectively. Both registers  
19 are held by the National Board of Health and Welfare. The outcome measures were coded  
20 according to International Classification of Disease (ICD)-10: Intentional self-harm (X60-  
21 X84), harm of undetermined intent (Y10-Y34), and sequelae of intentional self-harm and of  
22 events of undetermined intent (Y87.0 and Y87.2).

### 23 **Sociodemographic factors**

24 We collected sociodemographic data as recorded during the year preceding the index date.  
25 Participants' characteristics included: sex, age group (75-79, 80-84, 85-89, and  $\geq 90$  years),  
26 and number of household members (1, 2, and 3 or more). We grouped marital status into four  
27 categories: single, married, divorced, and widow/widower. Country of birth was grouped into  
28 three categories: Sweden, Nordic countries, and other. The highest attained level of education  
29 was categorised into mandatory, secondary, and higher education. We categorised the last  
30 registered type of occupation as: upper white-collar; lower white-collar; blue-collar and  
31 others. The latter category included armed forces, farmers, market gardeners, forestry  
32 workers, and related occupations. Annual income was categorized in tertiles. We also

1 considered whether individuals had received social allowance during the year preceding the  
2 index date.

### 3 **Healthcare facility**

4 We categorised the healthcare facility that issued the index prescription according to the type  
5 of care: primary, specialised ambulatory care, hospital, home care, and other. Spheres of  
6 activity were characterised as: primary care, psychiatry, geriatrics, emergency, internal  
7 medicine, neurology, palliative, home care, convalescent and day care, and other.

### 8 **Statistical analysis**

9 We used the Fine and Gray proportional hazard model<sup>14</sup> to identify factors associated with  
10 suicide and suicide attempt. Independent sociodemographic variables included in the model  
11 were: sex, age, marital status, country of birth, level of education and occupational category.

12 We also considered the type of the healthcare facility where the index prescription was issued.

13 We adjusted the regression model for residence in nursing home during the year preceding the  
14 index date as a general marker of frailty. As attempted suicide is a strong predictor of future  
15 suicidal behaviours, models were also adjusted for suicide attempt during the year prior to  
16 initiation of antidepressant therapy. The number of household members was not included in  
17 the regression model because of its association with the marital status. A very small  
18 proportion of individuals had social allowance (0.4%). This variable was not included in the  
19 regression models. We analysed the data for the entire study population as well as for men  
20 and women separately. Data analyses were performed by SAS version 9.4 (SAS Institute Inc,  
21 NC, USA).

22 The study was approved by the Regional Ethical Review Board in Gothenburg (no: 111-15) in  
23 accordance with national regulations.

### 24 **Patient and public involvement**

25 No patients were recruited for this study as it was based solely on national register data. No  
26 patients were directly involved in setting the research question or the study measures, and  
27 none were asked to advise on interpretation or writing up of results. The study questions were  
28 inspired by our research works involving the experiences of older patients hospitalized in  
29 connection with self-harm and close relatives of old persons who died by suicide,<sup>11 15</sup> as well  
30 as our ongoing focus group study on older men and women's experiences of being depressed  
31 and being in treatment for depression. Our research is carried out within the AgeCap Center, a



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1 multidisciplinary research center on aging, and results will be disseminated to the older adult  
2 community through our AgeCap newsletter, and other public activities. Results will also be  
3 disseminated to health and social service professionals who work with older adults through  
4 our group's regional and national educational activities for service providers.  
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## 1 RESULTS

2 Table 1 includes the baseline sociodemographic characteristics of the 185 225 persons who  
 3 initiated antidepressant treatment. The mean age was 83.4 years (range 75-110 years). Almost  
 4 two-thirds were women. Sixty percent lived alone. Most were born in Sweden and few  
 5 received social allowance during the year preceding the initiation of their antidepressant  
 6 therapy. Suicide attempts were uncommon during that period.

7 **Table 1. Baseline characteristics of new users of antidepressants aged 75 and above**  
 8 **(N=185 225)**

Characteristics	N (%)
<b>Sex</b>	
women	117 606 (63.5)
<b>Age group (years)</b>	
75-79	53 126 (28.7)
80-84	56 223 (30.4)
85-89	47 678 (25.7)
≥ 90	28 198 (15.2)
<b>Number of household members*</b>	
1	110 500 (59.7)
2	721 60 (39.0)
>2	2537 (1.4)
<b>Marital status</b>	
Widow/widower	79 703 (43.0)
Married	73 059 (39.4)
Divorced	21 619 (11.7)
Single	10 816 (5.8)
<b>Country of birth</b>	
Sweden	167 586 (90.5)
Nordic countries (except Sweden)	8 488 (4.6)
Non-Nordic countries	9 151 (4.9)
<b>Highest level of education</b>	
Mandatory school	108 573 (58.6)
Secondary school	42 298 (22.8)
Post-secondary or higher	34 354 (18.5)
<b>Last occupation</b>	
Upper white collar worker	36 826 (19.9)
Lower white collar worker	23 622 (12.8)
Blue collar worker	91 932 (49.6)
Other	4 518 (2.4)
Unknown	28 327 (15.3)
<b>Annual income (Swedish Crowns)*</b>	
Tertile 1	≤ 113 656
Tertile 2	113 6567 – 140 717
Tertile3	≥ 140 718
<b>Nursing home residence</b>	34 268 (18.5)
<b>Previous suicide attempt*</b>	763 (0.4)

9 \*During one year preceding the initiation of the antidepressant therapy

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1 Over two-thirds received their index prescription in a primary care setting (table 2). Fewer  
2 than one out of twelve initiated their antidepressant therapy within psychiatric services.

3 **Table 2. Characteristics of healthcare facility issuing the index antidepressant**  
4 **prescription for new users of antidepressants aged 75 and above (N=185 225)**

Characteristics	N (%)	Suicide (N=295)	Attempted suicide (N=654)
<b>Type of care</b>			
Primary/ambulatory care	99 338 (53.6)	169	327
Specialized outpatient care	56 966 (30.8)	86	204
Inpatient care	21 813 (11.8)	32	89
Other	6 925 (3.7)	8	34
Missing	183 (0.1)	0	2
<b>Sphere of activity</b>			
Primary care	125 183 (67.6)	198	386
Internal medicine	18 316 (9.9)	23	64
Geriatric care	9 616 (5.2)	8	29
Psychiatry care	9 363 (6.9)	18	37
Neurology	1 815 (1.0)	2	6
Home care	1 206 (0.7)	0	5
Oncology	908 (0.5)	0	0
Emergency care	968 (0.5)	2	6
Intensive care	628 (0.3)	0	0
Convalescent/Day care	236 (0.1)	0	0
Palliative care	270 (0.1)	0	0
Other	12 533 (6.8)	44	121
Missing	183 (0.1)	0	2

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1 The median length of follow-up was 2.6 (interquartile range 1.2–4.6) years. Overall, 90 681  
2 persons (48.7%) died during follow-up. Suicide was the cause of death for 295 individuals  
3 (199 men and 96 women), corresponding to an incidence rate of 50 per 100,000 person-years  
4 for the total study population. In total 654 persons (300 men and 354 women) attempted  
5 suicide, yielding an incidence rate of 117 per 100,000 person-years for the total study  
6 population.

7 Table 3 shows that the adjusted sub-hazard ratio (aSHR) for suicidal behaviours was  
8 significantly higher among men for both suicide (aSHR 3.56, 95% CI 2.67 to 4.73), and  
9 suicide attempt (1.41, 95% CI 1.17 to 1.68). A lower risk of suicide was observed among  
10 antidepressant new users aged 85 years and over compared to those aged 75-79 years. A  
11 similar result was observed for suicide attempts. We found a higher risk of suicide attempts  
12 among those born outside of Sweden: (1.58, 95% CI 1.16 to 2.15) for those born in another  
13 Nordic country, and for those born in non-Nordic countries (1.43, 95% CI 1.06 to 1.93). The  
14 risk of suicide was higher among those who were single (1.81, 95% CI 1.21 to 2.70) or  
15 divorced (1.43, 95% CI 1.02 to 2.01) compared to those who were married when initiating  
16 their antidepressant therapy. The level of education impacted differentially on fatal and non-  
17 fatal suicidal behaviours. The risk of suicide was lower among those with secondary  
18 education compared to those with mandatory education only (0.71, 95% CI 0.51 to 0.99),  
19 while the risk of suicide attempt was higher (1.60, 95% CI 1.27 to 2.01) among those with a  
20 higher education. Neither income nor occupational history were associated with suicidal  
21 behaviours. The risks of both fatal and non-fatal suicidal behaviours were lower among those  
22 who lived in nursing homes when initiating their antidepressant therapy. No association was  
23 found between the type of healthcare facility where antidepressant treatment was initiated and  
24 suicidal behaviours.

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1 **Table 3. Factors associated with suicide and suicide attempt among new users of**  
 2 **antidepressants aged 75 and above (N=185 015)\***

Variable	Suicide n=295		Suicide attempt n=654	
	Crude SHR (95% CI)	Adjusted SHR** (95% CI)	Crude SHR (95% CI)	Adjusted SHR** (95% CI)
<b>Men</b>	4.18 (3.26-5.36)	3.56 (2.67-4.73)	1.70 (1.46-1.99)	1.41 (1.17-1.68)
<b>Age group (years)</b>				
75-79	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
80-84	0.74 (0.56-0.97)	0.80 (0.60-1.05)	0.78 (0.65-0.94)	0.83 (0.69-1.00)
85-89	0.61 (0.45-0.82)	0.73 (0.53-0.99)	0.66 (0.54-0.81)	0.75 (0.61-0.94)
≥90	0.36 (0.23-0.56)	0.53 (0.33-0.86)	0.42 (0.32-0.57)	0.58 (0.43-0.79)
<b>Country of birth</b>				
Sweden	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Nordic countries (except Sweden)	1.46 (0.94-2.28)	1.38 (0.87-2.21)	1.62 (1.21-2.17)	1.58 (1.16-2.15)
Non-Nordic countries	0.60 (0.30-1.21)	0.64 (0.31-1.30)	1.57 (1.15-2.13)	1.43 (1.06-1.93)
<b>Marital status</b>				
Married	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Single	1.42 (0.96-2.10)	1.81 (1.21-2.70)	0.73 (0.51-1.05)	0.90 (0.62-1.30)
Widow/Widower	0.50 (0.38-0.66)	1.00 (0.74-1.35)	0.76 (0.64-0.90)	1.09 (0.90-1.33)
Divorced	1.08 (0.77-1.50)	1.43 (1.02-2.01)	0.92 (0.72-1.18)	1.02 (0.79-1.31)
<b>Highest level of education</b>				
Mandatory (≤ 9 years)	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Secondary	0.72 (0.52-0.99)	0.71 (0.51-0.99)	1.05 (0.86-1.28)	0.99 (0.81-1.22)
Higher education	1.59 (1.22-2.07)	1.14 (0.81-1.59)	1.86 (1.55-2.22)	1.60 (1.27-2.01)
<b>Last registered occupation</b>				
Upper white collar	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Lower white collar	0.60 (0.40-0.90)	1.04 (0.67-1.61)	0.81 (0.63-1.05)	1.19 (0.90-1.57)
Blue collar	0.64 (0.49-0.84)	0.83 (0.59-1.17)	0.66 (0.55-0.80)	0.98 (0.78-1.24)
<b>Annual income</b>				
Tertile 1	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Tertile 2	1.17 (0.87-1.57)	0.90 (0.66-1.21)	1.15 (0.94-1.39)	1.08 (0.88-1.33)
Tertile 3	1.49 (1.12-1.97)	0.77 (0.55-1.07)	1.40 (1.16-1.69)	1.01 (0.80-1.27)
<b>Nursing home residence</b>	0.21 (0.11-0.43)	0.25 (0.12-0.52)	0.17 (0.10-0.29)	0.21 (0.13-0.36)
<b>Type of the healthcare facility issuing the index prescription</b>				
Primary care	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Specialised ambulatory. care	0.99 (0.77-1.28)	0.95 (0.74-1.23)	1.09 (0.92-1.30)	1.10 (0.92-1.31)
Inpatient care	0.92 (0.63-1.33)	0.71 (0.49-1.03)	1.21 (0.96-1.54)	1.07 (0.84-1.35)
Other	0.67 (0.33-1.35)	0.64 (0.31-1.29)	1.41 (0.99-2.00)	1.36 (0.95-1.93)

3 \*Due to partially missing data, 210 persons were excluded from the regression analysis

4 \*\*Adjusted for age, sex, suicide attempt within one year preceding the index date, country of birth, marital  
 5 status, nursing home residence, highest level of education, last registered occupation, annual income, type of  
 6 facility issuing the index medication.

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3 1 Differences unfolded in the gender stratified analyses (Table 4). In men, the risk of suicide  
4 2 was lower among the oldest (0.45, 95% CI 0.24 to 0.85). This risk was however higher among  
5 3 those who were single (1.81, 95% CI 1.13 to 2.89) or divorced (1.58, 95% CI 1.06 to 2.36).  
6 4 Such differences were not found among women. Women who had a lower white-collar or a  
7 5 blue-collar occupation before retirement had lower risk of suicide compared to those with  
8 6 upper white-collar positions.  
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1 **Table 4. Factors associated with suicide among new users of antidepressants aged 75 and**  
 2 **above stratified by gender (N=185 015)\***

Variable	Men, suicide n=199 N = 67 539		Women, suicide n=96 N = 117 476	
	Crude SHR (95% CI)	Adjusted SHR* (95% CI)	Crude SHR (95% CI)	Adjusted SHR* (95% CI)
<b>Age group (years)</b>				
75-79	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
80-84	0.88 (0.63-1.22)	0.90 (0.64-1.25)	0.57 (0.34-0.91)	0.62 (0.37-1.03)
85-89	0.75 (0.52-1.08)	0.80 (0.55-1.16)	0.48 (0.28-0.82)	0.62 (0.35-1.11)
≥90	0.38 (0.20-0.72)	0.45 (0.24-0.85)	0.43 (0.22-0.83)	0.65 (0.30-1.41)
<b>Country of birth</b>				
Sweden	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Nordic countries (except Sweden)	1.40 (0.79-2.45)	1.24 (0.68-2.27)	1.71 (0.83-3.53)	1.70 (0.80-3.60)
Non-Nordic countries	0.56 (0.21-1.51)	0.52 (0.19-1.42)	0.84 (0.31-2.29)	0.84 (0.30-2.33)
<b>Marital status</b>				
Married	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Single	1.67 (1.06-2.65)	1.81 (1.13-2.89)	1.27 (0.59-2.74)	1.46 (0.65-3.26)
Widow/Widower	0.92 (0.64-1.32)	1.15 (0.79-1.65)	0.57 (0.36-0.91)	0.75 (0.44-1.29)
Divorced	1.52 (1.02-2.27)	1.58 (1.06-2.36)	0.96 (0.52-1.78)	1.02 (0.53-1.94)
<b>Highest level of education</b>				
Mandatory (≤ 9 years)	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Secondary	0.71 (0.46-1.09)	0.71 (0.46-1.10)	0.85 (0.51-1.41)	0.68 (0.40-1.17)
Higher education	1.17 (0.86-1.59)	1.30 (0.88-1.91)	1.47 (0.87-2.50)	0.66 (0.34-1.28)
<b>Last registered occupation</b>				
Upper white collar	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Lower white collar	1.22 (0.70-2.12)	1.37 (0.78-2.42)	0.55 (0.30-1.01)	0.50 (0.26-0.96)
Blue collar	1.02 (0.74-1.41)	1.14 (0.76-1.70)	0.40 (0.24-0.65)	0.35 (0.20-0.61)
<b>Annual income</b>				
Tertile 1	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Tertile 2	0.82 (0.55-1.21)	0.80 (0.54-1.18)	1.05 (0.67-1.66)	1.09 (0.67-1.78)
Tertile 3	0.81 (0.56-1.16)	0.74 (0.49-1.11)	1.00 (0.60-1.69)	0.82 (0.45-1.49)
<b>Nursing home residence</b>	0.23 (0.09-0.56)	0.24 (0.10-0.59)	0.23 (0.07-0.72)	0.28 (0.08-0.94)
<b>Type of the healthcare facility issuing the index prescription</b>				
Primary care	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Specialised ambulatory care	0.93 (0.68-1.27)	0.93 (0.68-1.27)	0.99 (0.63-1.55)	0.99 (0.63-1.56)
Inpatient care	0.75 (0.48-1.17)	0.68 (0.44-1.05)	0.90 (0.45-1.83)	0.81 (0.40-1.65)
Other	0.47 (0.17-1.29)	0.47 (0.17-1.27)	1.02 (0.37-2.82)	1.01 (0.37-2.80)

3 \*Due to partially missing data, 210 persons were excluded from the regression analysis

4 \*\*Adjusted for age, sex, suicide attempt, country of birth, marital status, nursing home residence, highest level  
 5 of education, last registered occupation, annual income, type of facility issuing the index medication.

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3 1 Regarding factors associated with suicide attempt (Table 5), for women a lower risk was  
4 2 observed for those aged 90 and above. Suicide attempts were more common among men born  
5 3 in another Nordic country (1.59, 95% CI 1.02 to 2.46), and women born outside of Nordic  
6 4 countries (1.65, 95% CI 1.12 to 2.41). Women with the highest education level had a higher  
7 5 risk of suicide attempt (1.98, 95% CI 1.43 to 2.75).  
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1 **Table 5. Factors associated with suicide attempt among new users of antidepressants**  
 2 **aged 75 and above stratified by gender (N=185 015)\***

Variable	Men, suicide attempt n=300 N = 67 539		Women, suicide attempt n=354 N = 117 476	
	Crude SHR (95% CI)	Adjusted SHR** (95% CI)	Crude SHR (95% CI)	Adjusted SHR** (95% CI)
<b>Age group (years)</b>				
75-79	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
80-84	0.84 (0.64-1.11)	0.87 (0.66-1.15)	0.74 (0.58-0.96)	0.81 (0.62-1.04)
85-89	0.70 (0.51-0.95)	0.76 (0.55-1.06)	0.65 (0.49-0.85)	0.76 (0.56-1.02)
≥90	0.58 (0.38-0.89)	0.73 (0.48-1.13)	0.36 (0.24-0.54)	0.50 (0.33-0.77)
<b>Country of birth</b>				
Sweden	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Nordic countries (except Sweden)	1.72 (1.13-2.64)	1.59 (1.02-2.46)	1.57 (1.05-2.34)	1.32 (0.87-2.00)
Non-Nordic countries	1.47 (0.87-2.47)	1.46 (0.86-2.47)	1.72 (1.17-2.51)	1.65 (1.12-2.41)
<b>Marital status</b>				
Married	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Single	0.78 (0.47-1.28)	0.96 (0.58-1.59)	0.71 (0.42-1.22)	0.81 (0.47-1.39)
Widow/Widower	1.00 (0.75-1.31)	1.22 (0.92-1.62)	0.77 (0.61-0.98)	1.02 (0.78-1.34)
Divorced	1.04 (0.72-1.49)	1.06 (0.74-1.54)	0.92 (0.65-1.30)	0.94 (0.65-1.34)
<b>Highest level of education</b>				
Mandatory (≤ 9 years)	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Secondary	0.97 (0.70-1.35)	0.92 (0.66-1.28)	1.14 (0.88-1.47)	1.03 (0.79-1.35)
Higher education	1.49 (1.16-1.91)	1.32 (0.98-1.80)	2.08 (1.60-2.70)	1.98 (1.43-2.75)
<b>Last registered occupation</b>				
Upper white collar	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Lower white collar	0.81 (0.50-1.32)	0.95 (0.58-1.57)	0.92 (0.66-1.29)	1.31 (0.91-1.90)
Blue collar	0.75 (0.58-0.97)	0.98 (0.72-1.32)	0.66 (0.49-0.88)	1.03 (0.72-1.46)
<b>Annual income</b>				
Tertile 1	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Tertile 2	1.12 (0.78-1.62)	1.14 (0.78-1.67)	1.09 (0.86-1.39)	1.11 (0.86-1.44)
Tertile 3	1.38 (0.99-1.93)	1.23 (0.85-1.79)	1.11 (0.85-1.46)	0.88 (0.64-1.22)
<b>Nursing home residence</b>				
Primary care	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Specialised ambulatory care	0.93 (0.68-1.27)	1.31 (1.01-1.69)	0.91 (0.72-1.17)	0.94 (0.74-1.20)
Inpatient care	0.75 (0.48-1.17)	1.15 (0.83-1.62)	1.08 (0.77-1.53)	1.01 (0.72-1.42)
Other	0.47 (0.17-1.29)	1.14 (0.63-2.06)	1.54 (0.99-2.39)	1.52 (0.97-2.36)

3 \*Due to partially missing data, 210 persons were excluded from the regression analysis.

4 \*\*Adjusted for age, sex, suicide attempt, country of birth, marital status, nursing home residence, highest level  
 5 of education, last registered occupation, annual income, type of facility issuing the index medication.

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## 1 DISCUSSION

2 Higher risks of fatal and non-fatal suicidal behaviours were observed among the “younger”  
3 older adults (75-79 years), and suicide attempts were more common among new users of  
4 antidepressants born in a foreign country. In the gender-stratified analyses, being single or  
5 divorced was associated with elevated risk of suicide among men, but not among women.  
6 Educational and occupational history influenced risk of suicidal behaviours in women only.

7 We found lower risk of suicidal behaviour among those aged  $\geq 85$  years compared to those  
8 aged 75-79 years old. This was somewhat unexpected as higher rates of suicide are observed  
9 in those aged 85+ in the general population. We could identify no previous studies focusing  
10 on new users of antidepressants for comparison. Our population of new users of  
11 antidepressant may differ from their peers in the general population since late-life depression  
12 is associated with vascular, neuroanatomic, and inflammatory risk factors, as well as anxiety,  
13 dementia and sleep disorders.<sup>16</sup> However, we could not compare the medical characteristics of  
14 our population with all Swedish residents aged  $\geq 75$  years since these data were not available  
15 in our dataset. After the age of 85, a large proportion of the population has dementia,<sup>17</sup> one of  
16 the few psychiatric diagnoses not related to elevated suicide risk.<sup>18</sup> Also, it must be  
17 remembered that the very old in this study represent a survival population. Nonagenarians and  
18 centenarians alive today have benefited from a number of factors that have contributed to  
19 prolonged life expectancy, such as healthier lifestyle, better health conditions and caretaking.  
20 All this may have a positive effect on their quality of life and thus on the suicide rate in the  
21 oldest age groups.

22 Our result regarding higher risk of suicide attempts among foreign-born older adults extends  
23 the findings of mixed-age studies conducted in Sweden and other Western countries.<sup>19-21</sup> The  
24 higher risk of suicide attempt among those born in other Nordic countries may in part be  
25 related to the fact that high suicide attempt rates are observed in immigrants from Finland,  
26 who constituted a large proportion of immigrants, compared to the native Swedish  
27 population.<sup>22 23</sup> The authors of a recent meta-analysis reported substantial continuity between  
28 the suicide rates in the country of birth and those of the country of immigration.<sup>24</sup> Cultural  
29 factors including attitudes to suicide and lifestyle may also play a role for the higher suicide  
30 rates among Nordic-born immigrants. We have previously shown increased risk of both fatal  
31 and non-fatal suicidal behaviours in older adults with alcohol use disorders,<sup>25</sup> and differential  
32 rates of alcohol consumption may be a partial explanation.<sup>26</sup> The higher risk of suicide  
33 attempt among those born in non-Nordic countries may be explained by life conditions that

1 we were unable to capture in our study, such as refugee status, post-traumatic stress,  
2 migration experience, and an experience of being distanced from Swedish society.<sup>27</sup> Social  
3 isolation in terms of limited social network, language limitation and sparse contact with  
4 family members may also be relevant to explain elevated rates of suicidal behaviour among  
5 the oldest adults born in non-Nordic countries. However, the gender-difference in the  
6 association between the country of birth and suicidal behaviours warrants more research to  
7 better elucidate this association.

8 In our gender-stratified analysis, being single or divorced had significant effect on suicide risk  
9 among men but not among women. While we could find no study focusing on depressed older  
10 adults for comparison, one partial explanation of our findings may be that depressed old men  
11 living alone may be more prone to social isolation than their female counterparts.<sup>28</sup> Another  
12 issue might be men's unwillingness to seek mental health services,<sup>29</sup> and living alone  
13 probably reduces their motivation to seek care. Further, it has been shown that old men with  
14 disability have a shorter life expectancy than their women counterparts.<sup>30 31</sup> Partner loss was  
15 not associated with suicidal behaviour in our study. One Danish cohort study found increased  
16 risk for suicide among the oldest widowed, especially among men.<sup>32</sup> However, the study  
17 included only deaths of partners that occurred during a 5-year observation period. It may  
18 therefore not be relevant to compare the findings of the two studies.

19 The higher risk of suicidal behaviours among women with higher education and those who  
20 have had positions requiring more advanced qualifications is a new finding. Most previous  
21 research on socio-economic status and suicidal behaviours in late-life have overlooked the  
22 gender dimension and gender-stratified studies have yielded disparate results.<sup>8 33 34</sup> Our  
23 results support the need for a life-course approach to better understand and prevent late-life  
24 suicidal behaviours.<sup>16</sup> A large prospective cohort study with over 50 years of follow-up and a  
25 wide range of life course measures and job characteristics has found that women in leadership  
26 positions at time of retirement were significantly more exposed to job-related stressors than  
27 lower status women and men in both positions.<sup>35</sup> Women who had higher education and  
28 leadership positions have often experienced a work environment highly dominated by men,  
29 and as such might have experienced higher demands for excellent work performances. These  
30 demands combined with a possible tendency to adapt to ideals that traditionally have been  
31 associated with men and masculinity might put these women in a more vulnerable situation.  
32 For example, they might feel that they are better off dead than having compromised autonomy  
33 and they might have reduced social networks to manage the demanding work situations.

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3 1 Despite the social advantages that women with higher socio-economic status may have had,  
4 2 the gendered macro- and meso-level social contexts may have limited the extent to which  
5 3 women in higher-status positions have derived psychological benefits from their socio-  
6 4 economic situation.<sup>35 36</sup>  
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10 5 New users of antidepressants who resided in nursing homes had lower risks of both fatal and  
11 6 non-fatal suicidal behaviours compared to their peers living in the community. A partial  
12 7 explanation might be that nursing home staff are more able to monitor older adults who are on  
13 8 treatment for depression.<sup>37</sup> Being in a nursing home provides the older adults with a social  
14 9 network, which may reduce feelings of loneliness. Further, many of the new users of  
15 10 antidepressants residing in nursing homes might have been prescribed antidepressants for  
16 11 behavioural symptoms of dementia, rather than for depression.<sup>18</sup>  
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20 12 The sociodemographic factors associated with fatal or non-fatal suicidal behaviours in new  
21 13 users of antidepressants in our study (e.g. male sex, level of education, occupational history in  
22 14 women, and country of birth) seem less susceptible to a reverse causality. Therefore, the  
23 15 interpretation of our results should take into account the underlying assumption that the  
24 16 associations between the exposures and suicidal behaviours are unidirectional. However,  
25 17 more research is needed on possible mechanisms and mediators influencing these  
26 18 associations.  
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### 34 19 **Strengths and limitations**

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36 20 The use of national population-based data means that there are no exclusion criteria. This  
37 21 minimizes the risk of selection bias that may potentially result from the sole use of hospital-  
38 22 based data. Our study was sufficiently large to explore the association of numerous  
39 23 sociodemographic variables with fatal and non-fatal suicidal behaviours. Register-based  
40 24 studies on suicidal behaviours rely on collection of data from many different hospitals and  
41 25 variations in data validity can occur. An important limitation is that only suicide attempts that  
42 26 have been registered in hospitals or specialised outpatient services can be captured with our  
43 27 study design. Despite the wide range of covariates included in the analyses, information on  
44 28 other potential confounders such as health behaviours including alcohol consumption was not  
45 29 available. Gender-stratified analyses should be interpreted with caution due to the low number  
46 30 of suicides, especially among women and therefore low power.  
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54 31 One strength of our research is the investigation of suicidal behaviours in 5-year age bands  
55 32 after the age of 75 years. This is particularly relevant due to the aging of populations  
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1 worldwide. A previous study found that suicide rates slightly increased again in the 100 years  
2 age-band.<sup>38</sup> Due to the low number of centenarians in our study, we could not investigate the  
3 risk of suicidal behaviours in this age group.

4 We had access to information about the initiation of antidepressants to define our population  
5 but we acknowledge that using this method is not the same as using structured clinical  
6 interviews or diagnostic criteria to define depression, and we therefore do not rule out an  
7 indication bias or a residual confounding. Antidepressants are prescribed not only for the  
8 treatment of depression but also for anxiety disorders and obsessive compulsive disorder as  
9 well as behavioural symptoms of dementia. Furthermore, being married does not inform about  
10 the actual support received from the partner, and it is possible that age-related changes that  
11 affect one or both partners can burden the relationship. Therefore, it seems possible that some  
12 of the observed associations of the marital status and suicidal behaviours could be explained,  
13 at least in part, by unmeasured factors. Another limitation is that, when considering findings  
14 related to immigrant status, we did not have information about the date of immigration, which  
15 may have influenced degree of acculturation and assimilation to the hosting country,<sup>39</sup> which  
16 in turn could impact on suicidal behaviours.

### 17 **Implications**

18 While our findings cannot be extrapolated to older adults not taking antidepressants, or long-  
19 term users of these drugs, they offer clues to the prevention of suicidal behaviours in persons  
20 recently identified as depressed and in need of treatment. Our findings highlight the need for  
21 gender-specific, multifaceted approaches to the prevention of suicidal behaviours in late-life.  
22 The identification and treatment of late-life depression remains an important target for suicide  
23 prevention in our oldest adults, but the current findings highlight the need for new initiatives  
24 that go beyond the healthcare sphere.

25 Research is needed in other settings as socio-economic conditions, availability of healthcare,  
26 and cultural differences may have an impact on risk of both fatal and non-fatal suicidal  
27 behaviours in late-life.

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1 **Authors' contributorship:** KH conceived and designed the study, helped acquire the data, helped  
2 with data analysis and interpretation of results, drafted the article, and had the final approval for  
3 submission. KAS conceived and designed the study, helped acquire the data, helped with data  
4 analysis, revised the article for content, and gave the final approval for submission. GH helped with  
5 interpretation of results, revised the article for content, and gave the final approval for submission. IS  
6 helped with interpretation of results, revised the article for content, and gave the final approval for  
7 submission. SG performed data analysis, revised the article for content, and gave the final approval  
8 for submission. MW is the primary investigator of the project. She conceived and designed the study,  
9 helped acquire the data, helped with interpretation of results, revised the article for content, and gave  
10 the final approval for submission. All authors had full access to all of the data (including statistical  
11 reports and tables) and can take responsibility for the integrity of the data and the accuracy of the data  
12 analysis. KH is the guarantor.

13 **Competing interests:** All authors have completed the ICMJE uniform disclosure form at  
14 [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf), and declare financial support from the Swedish Research Council,  
15 the Swedish Research Council for Health, Working Life and Welfare, ALF, and the Söderström-  
16 König Foundation for the submitted work; no financial relationships with any organisations that  
17 might have an interest in the submitted work in the previous three years; no other relationships or  
18 activities that could appear to have influenced the submitted work. Karolina Andersson Sundell is  
19 employed by AstraZeneca. However, the views expressed in this study are her own and not those of  
20 AstraZeneca.

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25 Hospital (ALF).

26 **Data sharing:** No additional data available.

27 **Ethical approval:** This study was approved by the Regional Ethical Review Board in Gothenburg  
28 (No: 111-15).

29 **Transparency:** The first author (KH) affirms that the manuscript is an honest, accurate, and  
30 transparent account of the study being reported; that no important aspects of the study have been

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1 omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been  
2 explained.

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STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Reported on page #
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	Title: Page 1, line 2, Abstract: Page 2, line 6
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Page 4, line 11
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 4, line 22
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	Page 5, line 3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 5, line 3
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	Page 5, line 5
		(b) For matched studies, give matching criteria and number of exposed and unexposed	NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Exposures: Page 5, line 8
			Outcomes: Page 5, line 16
			Confounders: Page 6, line 13
Data sources/measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Page 6, lines 9 and 17
Bias	9	Describe any efforts to address potential sources of bias	Page 17, line 17
Study size	10	Explain how the study size was arrived at	NA: population-based study
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 6, line 1
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Page 6, line 8
		(b) Describe any methods used to examine subgroups and interactions	Page 6, line 19 (gender-stratified analyses)
		(c) Explain how missing data were addressed	Page 10, line 3
		(d) If applicable, explain how loss to follow-up was addressed	NA
		(e) Describe any sensitivity analyses	NA
<b>Results</b>			

1	Participants	13	(a) Report numbers of individuals at each stage of study— eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	NA
2			(b) Give reasons for non-participation at each stage	NA
3			(c) Consider use of a flow diagram	NA
4	Descriptive data	14	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Page 7, line 2 and Table 1
5			(b) Indicate number of participants with missing data for each variable of interest	Table 1, Table 2
6			(c) Summarise follow-up time (eg, average and total amount)	Page 10, line 1
7	Outcome data	15	Report numbers of outcome events or summary measures over time	Page 10, lines 2 and 4
8	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Page 10, line 6 and Table 3
9			(b) Report category boundaries when continuous variables were categorized	NA
10			(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
11	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Page 12, line 1 and Table 4. Page 14, line 1 and Table 5
12	<b>Discussion</b>			
13	Key results	18	Summarise key results with reference to study objectives	Page 16, line 2
14	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Page 18, line 22
15	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Page 16, line 7
16	Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 16, line 10. Page 19, line 22
17	<b>Other information</b>			
18	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Page 20, line 20

# BMJ Open

## Late-life suicidal behaviours among new users of antidepressants: A prospective population-based study of sociodemographic and gender factors in those aged 75 and above

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Keywords:	pharmacoepidemiology, Antidepressants, Suicide, Aged, Cohort stud, Sociodemographic factors

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3 **1 Late-life suicidal behaviours among new users of antidepressants:**  
4 **2 A prospective population-based study of sociodemographic and**  
5 **3 gender factors in those aged 75 and above**  
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## 2 ABSTRACT

### 3 Objective

4 To investigate sociodemographic and gender factors associated with suicide and suicide  
5 attempts among new users of antidepressants aged 75 and above.

### 6 Design

7 Register-based cohort study.

### 8 Setting

9 National population-based cohort of Swedish residents aged  $\geq 75$  years.

### 10 Participants

11 185 225 patients who initiated antidepressant medication between January 1, 2007 and  
12 December 31, 2013 were followed until December 31, 2014.

### 13 Main outcome measures

14 Suicide and suicide attempts. Fine and Gray regression models were used to analyse the  
15 sociodemographic factors (age, country of birth, marital status, education level, last  
16 occupation, income and social allowance) associated with suicidal behaviours in the entire  
17 cohort and by gender.

### 18 Results

19 During follow-up, 295 suicides and 654 suicide attempts occurred. Adjusted sub-hazard ratios  
20 (aSHRs) for suicide were lower among older age groups (aSHR 0.73, 95% confidence interval  
21 0.53-0.99 for those 85-89 years; and 0.53, 0.33 to 0.86 for those  $\geq 90$  years). A similar pattern  
22 was observed for suicide attempts. Suicide attempts were more common among those born in  
23 foreign countries (1.58, 1.16 to 2.15 for those born in another Nordic country; and 1.43, 1.06  
24 to 1.93 for those born in non-Nordic countries). In the gender-stratified analyses, being single  
25 or divorced, and born in another Nordic country was associated with higher risk of suicide  
26 among men. Educational and occupational history and being born in a non-Nordic country  
27 influenced risk of suicidal behaviours in women.

### 28 Conclusion

29 Suicidal behaviours occurred more commonly among new users who were “younger” old  
30 adults and those with foreign background, suggesting that those groups might require greater  
31 support when initiating antidepressant therapy. Our findings suggest the need for gender-  
32 specific, multifaceted approaches to the prevention of suicidal behaviours in late-life.

### 33 Keywords

34 Antidepressants, Suicide, Sociodemographic factors, Pharmacoepidemiology, Aged, Cohort  
35 study

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## STRENGTHS AND LIMITATIONS OF THIS STUDY

- This is the first prospective cohort study to focus on the sociodemographic factors associated with suicidal behaviours among the oldest adults who initiated an antidepressant therapy.
- The study is based on a national population-based cohort with no exclusion criteria, minimizing the risk of selection bias. Moreover, there is no recall bias as national registers were used to define the sociodemographic factors and potential confounders.
- Only suicide attempts that have been registered in hospitals or specialised outpatient services can be captured with our study design.
- Research is needed in other settings as socioeconomic conditions, availability of healthcare, and cultural differences may have an impact on suicidal behaviours in late-life.

## 1 INTRODUCTION

2 High suicide rates are observed in older adults in many countries.<sup>1</sup> The most common  
3 contributing factor to the development of self-harm behaviours in late-life is the presence of  
4 clinically significant depressive symptoms.<sup>2</sup> Therefore, most suicide prevention strategies  
5 have focused on increasing the detection of depression and optimising its management.<sup>3</sup>  
6 However, the long-term benefits and sustainability of such programmes remains uncertain.<sup>4 5</sup>  
7 While suicide rates are particularly high in older adult males,<sup>6</sup> prevention programs appear to  
8 be more successful in women than in men.<sup>4</sup>

9 One possible explanation of the limited success of depression-focused interventions in  
10 reducing the prevalence of suicidal behaviours in late-life is that these behaviours have a  
11 multifactorial aetiology. Untargeted factors such as loneliness, limited social support, and  
12 financial concerns may drive the association between depression and suicidal behaviours.<sup>7 8 9</sup>

13 The role of social factors in late-life suicidal behaviours is relatively little studied. Despite  
14 broad inclusion criteria, a recent systematic review identified only 16 studies with a focus on  
15 social factors in late-life suicidal behaviours.<sup>8</sup> Few of these involved persons in their upper  
16 seventies, eighties and nineties, which is the segment of the population with particularly high  
17 rates of suicide.<sup>10</sup> Results from studies focusing on “younger” older adults (under 75 years)  
18 cannot be extrapolated to older persons. Risk factors have been shown to differ with age in  
19 both clinical and population-based cohorts of older adults.<sup>11 12</sup>

20 Better recognition and management of factors associated with suicidal behaviours is an  
21 important target for the prevention of suicide in the oldest population, especially in the  
22 context of depression. Given that antidepressants are commonly prescribed for depression,<sup>13-15</sup>  
23 their use may be considered as a proxy for depressive disorders. The objective of this study  
24 was therefore to investigate the association between sociodemographic factors and risk of  
25 fatal and non-fatal suicidal behaviours in a national population-based cohort of Swedish  
26 adults aged  $\geq 75$  years who initiated antidepressant therapy.

27

## 1 METHODS

### 2 Study population and data sources

3 We conducted a population-based cohort study among all Swedish residents aged  $\geq 75$  years  
4 who filled at least one antidepressant prescription between January 1, 2007 and December 31,  
5 2013 and had not filled any antidepressant prescription in the preceding 12 months. The date  
6 of the first filled prescription represented the index date. These individuals (N= 185 225,  
7 mean age: 83.4 years, age range: 75-110 years) were followed from their index date until  
8 December 31, 2014 or until migration or death. Data on dispensed antidepressant medications  
9 (defined by the Anatomic Therapeutic Code ATC-N06A) was obtained from the Swedish  
10 Prescribed Drug Register held at the National Board of Health and Welfare.<sup>16</sup> The register  
11 includes purchased prescribed drugs for outpatients, residential care and nursing homes.  
12 Sociodemographic data were collected, by record linkage, from the longitudinal integration  
13 database for health insurance and labour market studies (LISA) and the Total Population  
14 Register, held by Statistics Sweden. Persons residing in nursing homes were identified by data  
15 from the care and social services from the National Board of Health and Welfare.

### 16 Outcome measure

17 The study outcomes were the occurrence of suicide or suicide attempt, identified from the  
18 Cause of Death Register, and from the National Patient Register, respectively. Both registers  
19 are held by the National Board of Health and Welfare. The outcome measures were coded  
20 according to International Classification of Disease (ICD)-10: Intentional self-harm (X60-  
21 X84), harm of undetermined intent (Y10-Y34), and sequelae of intentional self-harm and of  
22 events of undetermined intent (Y87.0 and Y87.2).

### 23 Sociodemographic factors

24 We collected sociodemographic data as recorded during the year preceding the index date.  
25 Participants' characteristics included: sex, age group (75-79, 80-84, 85-89, and  $\geq 90$  years),  
26 and number of household members (1, 2, and 3 or more). We grouped marital status into four  
27 categories: single, married, divorced, and widow/widower. Country of birth was grouped into  
28 three categories: Sweden, Nordic countries, and other. The highest attained level of education  
29 was categorised into mandatory, secondary, and higher education. We categorised the last  
30 registered type of occupation as: upper white-collar; lower white-collar; blue-collar and  
31 others. The latter category included armed forces, farmers, market gardeners, forestry  
32 workers, and related occupations. Annual income was categorized in tertiles. We also

1 considered whether individuals had received social allowance during the year preceding the  
2 index date.

### 3 **Healthcare facility**

4 We categorised the healthcare facility that issued the index prescription according to the type  
5 of care: primary, specialised ambulatory care, hospital, home care, and other. Spheres of  
6 activity were characterised as: primary care, psychiatry, geriatrics, emergency, internal  
7 medicine, neurology, palliative, home care, convalescent and day care, and other.

### 8 **Statistical analysis**

9 We used the Fine and Gray proportional hazard model<sup>17</sup> to identify factors associated with  
10 suicide and suicide attempt. Independent sociodemographic variables included in the model  
11 were: sex, age, marital status, country of birth, level of education and occupational category.

12 We also considered the type of the healthcare facility where the index prescription was issued.

13 We adjusted the regression model for residence in nursing home during the year preceding the  
14 index date as a general marker of frailty. As attempted suicide is a strong predictor of future  
15 suicidal behaviours, models were also adjusted for suicide attempt during the year prior to  
16 initiation of antidepressant therapy. The number of household members was not included in  
17 the regression model because of its association with the marital status. A very small  
18 proportion of individuals had social allowance (0.4%). This variable was not included in the  
19 regression models. We analysed the data for the entire study population as well as for men  
20 and women separately. Data analyses were performed by SAS version 9.4 (SAS Institute Inc,  
21 NC, USA).

22 The study was approved by the Regional Ethical Review Board in Gothenburg (no: 111-15) in  
23 accordance with national regulations.

### 24 **Patient and public involvement**

25 No patients were recruited for this study as it was based solely on national register data. No  
26 patients were directly involved in setting the research question or the study measures, and  
27 none were asked to advise on interpretation or writing up of results. The study questions were  
28 inspired by our research interviews with close relatives of older adults who died by suicide,<sup>11</sup>  
29 and with older patients hospitalized in connection with self-harm,<sup>18</sup> as well as our ongoing  
30 focus group study on older men and women's experiences of being depressed and being in  
31 treatment for depression. Our research is carried out within the AgeCap Center, a

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1 multidisciplinary research center on aging, and results will be disseminated to the older adult  
2 community through our AgeCap newsletter, and other public activities. Results will also be  
3 disseminated to health and social service professionals who work with older adults through  
4 our group's regional and national educational activities for service providers.  
5

For peer review only

## 1 RESULTS

2 Table 1 includes the baseline sociodemographic characteristics of the Almost two-thirds were  
3 women. Sixty percent lived alone. Most were born in Sweden and few received social  
4 allowance during the year preceding the initiation of their antidepressant therapy.

5 **Table 1. Baseline characteristics of new users of antidepressants aged 75 and above**  
6 **(N=185 225)**

Characteristics	N (%)
<b>Sex</b>	
women	117 606 (63.5)
<b>Age group (years)</b>	
75-79	53 126 (28.7)
80-84	56 223 (30.4)
85-89	47 678 (25.7)
≥ 90	28 198 (15.2)
<b>Number of household members*</b>	
1	110 500 (59.7)
2	721 60 (39.0)
>2	2537 (1.4)
<b>Marital status</b>	
Widow/widower	79 703 (43.0)
Married	73 059 (39.4)
Divorced	21 619 (11.7)
Single	10 816 (5.8)
<b>Country of birth</b>	
Sweden	167 586 (90.5)
Nordic countries (except Sweden)	8 488 (4.6)
Non-Nordic countries	9 151 (4.9)
<b>Highest level of education</b>	
Mandatory school	108 573 (58.6)
Secondary school	42 298 (22.8)
Post-secondary or higher	34 354 (18.5)
<b>Last occupation</b>	
Upper white collar worker	36 826 (19.9)
Lower white collar worker	23 622 (12.8)
Blue collar worker	91 932 (49.6)
Other	4 518 (2.4)
Unknown	28 327 (15.3)
<b>Annual income (Swedish Crowns)*</b>	
Tertile 1	≤ 113 656
Tertile 2	113 6567 – 140 717
Tertile3	≥ 140 718
<b>Nursing home residence</b>	34 268 (18.5)
<b>Social allowance*</b>	741 (0.4)

7 \*During one year preceding the initiation of the antidepressant therapy

8

1 As previously reported,<sup>19</sup> half of the cohort had a prescription for citalopram, and one fifth  
 2 were on mirtazapine. Over two-thirds received their index prescription in a primary care  
 3 setting (table 2). Fewer than one out of twelve initiated their antidepressant therapy within  
 4 psychiatric services.

5 **Table 2. Characteristics of healthcare facility issuing the index antidepressant**  
 6 **prescription for new users of antidepressants aged 75 and above (N=185 225)**

Characteristics	N (%)	Suicide (N=295)	Attempted suicide (N=654)
<b>Type of care</b>			
Primary/ambulatory care	99 338 (53.6)	169	327
Specialized outpatient care	56 966 (30.8)	86	204
Inpatient care	21 813 (11.8)	32	89
Other	6 925 (3.7)	8	34
Missing	183 (0.1)	0	2
<b>Sphere of activity</b>			
Primary care	125 183 (67.6)	198	386
Internal medicine	18 316 (9.9)	23	64
Geriatric care	9 616 (5.2)	8	29
Psychiatry care	9 363 (6.9)	18	37
Neurology	1 815 (1.0)	2	6
Home care	1 206 (0.7)	0	5
Oncology	908 (0.5)	0	0
Emergency care	968 (0.5)	2	6
Intensive care	628 (0.3)	0	0
Convalescent/Day care	236 (0.1)	0	0
Palliative care	270 (0.1)	0	0
Other	12 533 (6.8)	44	121
Missing	183 (0.1)	0	2

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1 Suicide was the cause of death for 295 individuals (199 men and 96 women), corresponding  
2 to an incidence rate of 50 per 100,000 person-years for the total study population. As  
3 previously reported,<sup>19</sup> hanging was the most common method in men; poisoning was the  
4 dominant method among women. Suicide methods are shown by sex in online supplementary  
5 appendix 1. In total 654 persons (300 men and 354 women) attempted suicide, yielding an  
6 incidence rate of 117 per 100,000 person-years for the total study population.

7 Table 3 shows that the adjusted sub-hazard ratio (aSHR) for suicidal behaviours was  
8 significantly higher among men for both suicide (aSHR 3.56, 95% CI 2.67 to 4.73), and  
9 suicide attempt (1.41, 95% CI 1.17 to 1.68). A lower risk of suicide was observed among  
10 antidepressant new users aged 85 years and over compared to those aged 75-79 years. A  
11 similar result was observed for suicide attempts. We found a higher risk of suicide attempts  
12 among those born outside of Sweden: (1.58, 95% CI 1.16 to 2.15) for those born in another  
13 Nordic country, and for those born in non-Nordic countries (1.43, 95% CI 1.06 to 1.93). The  
14 risk of suicide was higher among those who were single (1.81, 95% CI 1.21 to 2.70) or  
15 divorced (1.43, 95% CI 1.02 to 2.01) compared to those who were married when initiating  
16 their antidepressant therapy. The level of education impacted differentially on fatal and non-  
17 fatal suicidal behaviours. The risk of suicide was lower among those with secondary  
18 education compared to those with mandatory education only (0.71, 95% CI 0.51 to 0.99),  
19 while the risk of suicide attempt was higher (1.60, 95% CI 1.27 to 2.01) among those with a  
20 higher education. Neither income nor occupational history were associated with suicidal  
21 behaviours. The risks of both fatal and non-fatal suicidal behaviours were lower among those  
22 who lived in nursing homes when initiating their antidepressant therapy. No association was  
23 found between the type of healthcare facility where antidepressant treatment was initiated and  
24 suicidal behaviours.

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1 **Table 3. Factors associated with suicide and suicide attempt among new users of**  
 2 **antidepressants aged 75 and above (N=185 015)\***

Variable	Suicide n=295		Suicide attempt n=654	
	Crude SHR (95% CI)	Adjusted SHR** (95% CI)	Crude SHR (95% CI)	Adjusted SHR** (95% CI)
<b>Men</b>	4.18 (3.26-5.36)	3.56 (2.67-4.73)	1.70 (1.46-1.99)	1.41 (1.17-1.68)
<b>Age group (years)</b>				
75-79	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
80-84	0.74 (0.56-0.97)	0.80 (0.60-1.05)	0.78 (0.65-0.94)	0.83 (0.69-1.00)
85-89	0.61 (0.45-0.82)	0.73 (0.53-0.99)	0.66 (0.54-0.81)	0.75 (0.61-0.94)
≥90	0.36 (0.23-0.56)	0.53 (0.33-0.86)	0.42 (0.32-0.57)	0.58 (0.43-0.79)
<b>Country of birth</b>				
Sweden	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Nordic countries (except Sweden)	1.46 (0.94-2.28)	1.38 (0.87-2.21)	1.62 (1.21-2.17)	1.58 (1.16-2.15)
Non-Nordic countries	0.60 (0.30-1.21)	0.64 (0.31-1.30)	1.57 (1.15-2.13)	1.43 (1.06-1.93)
<b>Marital status</b>				
Married	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Single	1.42 (0.96-2.10)	1.81 (1.21-2.70)	0.73 (0.51-1.05)	0.90 (0.62-1.30)
Widow/Widower	0.50 (0.38-0.66)	1.00 (0.74-1.35)	0.76 (0.64-0.90)	1.09 (0.90-1.33)
Divorced	1.08 (0.77-1.50)	1.43 (1.02-2.01)	0.92 (0.72-1.18)	1.02 (0.79-1.31)
<b>Highest level of education</b>				
Mandatory (≤ 9 years)	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Secondary	0.72 (0.52-0.99)	0.71 (0.51-0.99)	1.05 (0.86-1.28)	0.99 (0.81-1.22)
Higher education	1.59 (1.22-2.07)	1.14 (0.81-1.59)	1.86 (1.55-2.22)	1.60 (1.27-2.01)
<b>Last registered occupation</b>				
Upper white collar	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Lower white collar	0.60 (0.40-0.90)	1.04 (0.67-1.61)	0.81 (0.63-1.05)	1.19 (0.90-1.57)
Blue collar	0.64 (0.49-0.84)	0.83 (0.59-1.17)	0.66 (0.55-0.80)	0.98 (0.78-1.24)
<b>Annual income</b>				
Tertile 1	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Tertile 2	1.17 (0.87-1.57)	0.90 (0.66-1.21)	1.15 (0.94-1.39)	1.08 (0.88-1.33)
Tertile 3	1.49 (1.12-1.97)	0.77 (0.55-1.07)	1.40 (1.16-1.69)	1.01 (0.80-1.27)
<b>Nursing home residence</b>	0.21 (0.11-0.43)	0.25 (0.12-0.52)	0.17 (0.10-0.29)	0.21 (0.13-0.36)
<b>Type of the healthcare facility issuing the index prescription</b>				
Primary care	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Specialised ambulatory. care	0.99 (0.77-1.28)	0.95 (0.74-1.23)	1.09 (0.92-1.30)	1.10 (0.92-1.31)
Inpatient care	0.92 (0.63-1.33)	0.71 (0.49-1.03)	1.21 (0.96-1.54)	1.07 (0.84-1.35)
Other	0.67 (0.33-1.35)	0.64 (0.31-1.29)	1.41 (0.99-2.00)	1.36 (0.95-1.93)

3 \*Due to partially missing data, 210 persons were excluded from the regression analysis

4 \*\*also adjusted for age, sex, suicide attempt within one year preceding the index date, country of birth, marital  
 5 status, nursing home residence, highest level of education, last registered occupation, annual income, type of  
 6 facility issuing the index medication.

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3 1 Differences unfolded in the gender stratified analyses (Table 4). In men, the risk of suicide  
4 2 was lower among the oldest (0.45, 95% CI 0.24 to 0.85). This risk was however higher among  
5 3 those who were single (1.81, 95% CI 1.13 to 2.89) or divorced (1.58, 95% CI 1.06 to 2.36).  
6 4 Such differences were not found among women. Women who had a lower white-collar or a  
7 5 blue-collar occupation before retirement had lower risk of suicide compared to those with  
8 6 upper white-collar positions.  
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1 **Table 4. Factors associated with suicide among new users of antidepressants aged 75 and**  
 2 **above stratified by gender (N=185 015)\***

Variable	Men, suicide n=199 N = 67 539		Women, suicide n=96 N = 117 476	
	Crude SHR (95% CI)	Adjusted SHR** (95% CI)	Crude SHR (95% CI)	Adjusted SHR** (95% CI)
<b>Age group (years)</b>				
75-79	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
80-84	0.88 (0.63-1.22)	0.90 (0.64-1.25)	0.57 (0.34-0.91)	0.62 (0.37-1.03)
85-89	0.75 (0.52-1.08)	0.80 (0.55-1.16)	0.48 (0.28-0.82)	0.62 (0.35-1.11)
≥90	0.38 (0.20-0.72)	0.45 (0.24-0.85)	0.43 (0.22-0.83)	0.65 (0.30-1.41)
<b>Country of birth</b>				
Sweden	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Nordic countries (except Sweden)	1.40 (0.79-2.45)	1.24 (0.68-2.27)	1.71 (0.83-3.53)	1.70 (0.80-3.60)
Non-Nordic countries	0.56 (0.21-1.51)	0.52 (0.19-1.42)	0.84 (0.31-2.29)	0.84 (0.30-2.33)
<b>Marital status</b>				
Married	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Single	1.67 (1.06-2.65)	1.81 (1.13-2.89)	1.27 (0.59-2.74)	1.46 (0.65-3.26)
Widow/Widower	0.92 (0.64-1.32)	1.15 (0.79-1.65)	0.57 (0.36-0.91)	0.75 (0.44-1.29)
Divorced	1.52 (1.02-2.27)	1.58 (1.06-2.36)	0.96 (0.52-1.78)	1.02 (0.53-1.94)
<b>Highest level of education</b>				
Mandatory (≤ 9 years)	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Secondary	0.71 (0.46-1.09)	0.71 (0.46-1.10)	0.85 (0.51-1.41)	0.68 (0.40-1.17)
Higher education	1.17 (0.86-1.59)	1.30 (0.88-1.91)	1.47 (0.87-2.50)	0.66 (0.34-1.28)
<b>Last registered occupation</b>				
Upper white collar	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Lower white collar	1.22 (0.70-2.12)	1.37 (0.78-2.42)	0.55 (0.30-1.01)	0.50 (0.26-0.96)
Blue collar	1.02 (0.74-1.41)	1.14 (0.76-1.70)	0.40 (0.24-0.65)	0.35 (0.20-0.61)
<b>Annual income</b>				
Tertile 1	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Tertile 2	0.82 (0.55-1.21)	0.80 (0.54-1.18)	1.05 (0.67-1.66)	1.09 (0.67-1.78)
Tertile 3	0.81 (0.56-1.16)	0.74 (0.49-1.11)	1.00 (0.60-1.69)	0.82 (0.45-1.49)
<b>Nursing home residence</b>	0.23 (0.09-0.56)	0.24 (0.10-0.59)	0.23 (0.07-0.72)	0.28 (0.08-0.94)
<b>Type of the healthcare facility issuing the index prescription</b>				
Primary care	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Specialised ambulatory care	0.93 (0.68-1.27)	0.93 (0.68-1.27)	0.99 (0.63-1.55)	0.99 (0.63-1.56)
Inpatient care	0.75 (0.48-1.17)	0.68 (0.44-1.05)	0.90 (0.45-1.83)	0.81 (0.40-1.65)
Other	0.47 (0.17-1.29)	0.47 (0.17-1.27)	1.02 (0.37-2.82)	1.01 (0.37-2.80)

3 \*Due to partially missing data, 210 persons were excluded from the regression analysis

4 \*\*also adjusted for age, sex, suicide attempt, country of birth, marital status, nursing home residence, highest  
 5 level of education, last registered occupation, annual income, type of facility issuing the index medication.

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3 1 Regarding factors associated with suicide attempt (Table 5), for women a lower risk was  
4 2 observed for those aged 90 and above. Suicide attempts were more common among men born  
5 3 in another Nordic country (1.59, 95% CI 1.02 to 2.46), and women born outside of Nordic  
6 4 countries (1.65, 95% CI 1.12 to 2.41). Women with the highest education level had a higher  
7 5 risk of suicide attempt (1.98, 95% CI 1.43 to 2.75).  
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1 **Table 5. Factors associated with suicide attempt among new users of antidepressants**  
 2 **aged 75 and above stratified by gender (N=185 015)\***

Variable	Men, suicide attempt n=300 N = 67 539		Women, suicide attempt n=354 N = 117 476	
	Crude SHR (95% CI)	Adjusted SHR** (95% CI)	Crude SHR (95% CI)	Adjusted SHR** (95% CI)
<b>Age group (years)</b>				
75-79	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
80-84	0.84 (0.64-1.11)	0.87 (0.66-1.15)	0.74 (0.58-0.96)	0.81 (0.62-1.04)
85-89	0.70 (0.51-0.95)	0.76 (0.55-1.06)	0.65 (0.49-0.85)	0.76 (0.56-1.02)
≥90	0.58 (0.38-0.89)	0.73 (0.48-1.13)	0.36 (0.24-0.54)	0.50 (0.33-0.77)
<b>Country of birth</b>				
Sweden	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Nordic countries (except Sweden)	1.72 (1.13-2.64)	1.59 (1.02-2.46)	1.57 (1.05-2.34)	1.32 (0.87-2.00)
Non-Nordic countries	1.47 (0.87-2.47)	1.46 (0.86-2.47)	1.72 (1.17-2.51)	1.65 (1.12-2.41)
<b>Marital status</b>				
Married	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Single	0.78 (0.47-1.28)	0.96 (0.58-1.59)	0.71 (0.42-1.22)	0.81 (0.47-1.39)
Widow/Widower	1.00 (0.75-1.31)	1.22 (0.92-1.62)	0.77 (0.61-0.98)	1.02 (0.78-1.34)
Divorced	1.04 (0.72-1.49)	1.06 (0.74-1.54)	0.92 (0.65-1.30)	0.94 (0.65-1.34)
<b>Highest level of education</b>				
Mandatory (≤ 9 years)	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Secondary	0.97 (0.70-1.35)	0.92 (0.66-1.28)	1.14 (0.88-1.47)	1.03 (0.79-1.35)
Higher education	1.49 (1.16-1.91)	1.32 (0.98-1.80)	2.08 (1.60-2.70)	1.98 (1.43-2.75)
<b>Last registered occupation</b>				
Upper white collar	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Lower white collar	0.81 (0.50-1.32)	0.95 (0.58-1.57)	0.92 (0.66-1.29)	1.31 (0.91-1.90)
Blue collar	0.75 (0.58-0.97)	0.98 (0.72-1.32)	0.66 (0.49-0.88)	1.03 (0.72-1.46)
<b>Annual income</b>				
Tertile 1	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Tertile 2	1.12 (0.78-1.62)	1.14 (0.78-1.67)	1.09 (0.86-1.39)	1.11 (0.86-1.44)
Tertile 3	1.38 (0.99-1.93)	1.23 (0.85-1.79)	1.11 (0.85-1.46)	0.88 (0.64-1.22)
<b>Nursing home residence</b>				
Primary care	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Specialised ambulatory care	0.93 (0.68-1.27)	1.31 (1.01-1.69)	0.91 (0.72-1.17)	0.94 (0.74-1.20)
Inpatient care	0.75 (0.48-1.17)	1.15 (0.83-1.62)	1.08 (0.77-1.53)	1.01 (0.72-1.42)
Other	0.47 (0.17-1.29)	1.14 (0.63-2.06)	1.54 (0.99-2.39)	1.52 (0.97-2.36)

3 \*Due to partially missing data, 210 persons were excluded from the regression analysis.

4 \*\*also adjusted for age, sex, suicide attempt, country of birth, marital status, nursing home residence, highest  
 5 level of education, last registered occupation, annual income, type of facility issuing the index medication.

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## 1 DISCUSSION

2 Higher risks of fatal and non-fatal suicidal behaviours were observed among the “younger”  
3 older adults (75-79 years), and suicide attempts were more common among new users of  
4 antidepressants born in a foreign country. In the gender-stratified analyses, being single or  
5 divorced was associated with elevated risk of suicide among men. Educational and  
6 occupational history influenced risk of suicidal behaviours in women only.

7 We found lower risk of suicidal behaviour among those aged  $\geq 85$  years compared to those  
8 aged 75-79 years old. This was somewhat unexpected as higher rates of suicide are observed  
9 in those aged 85+ in the general population. We could identify no previous studies focusing  
10 on new users of antidepressants for comparison. Our population of new users of  
11 antidepressant may differ from their peers in the general population since late-life depression  
12 is associated with vascular, neuroanatomic, and inflammatory risk factors, as well as anxiety,  
13 dementia and sleep disorders.<sup>20</sup> However, we could not compare the medical characteristics of  
14 our population with all Swedish residents aged  $\geq 75$  years since these data were not available  
15 in our dataset. After the age of 85, a large proportion of the population has dementia,<sup>21</sup> one of  
16 the few psychiatric diagnoses not related to elevated suicide risk.<sup>22</sup> Also, it must be  
17 remembered that the very old in this study represent a survival population. Nonagenarians and  
18 centenarians alive today have benefited from a number of factors that have contributed to  
19 prolonged life expectancy, such as healthier lifestyle, better health conditions and caretaking.  
20 All this may have a positive effect on their quality of life and thus on the suicide rate in the  
21 oldest age groups.

22 Our result regarding higher risk of suicide attempts among foreign-born older adults extends  
23 the findings of mixed-age studies conducted in Sweden and other Western countries.<sup>23-25</sup> The  
24 higher risk of suicide attempt among those born in other Nordic countries may in part be  
25 related to the fact that high suicide attempt rates are observed in immigrants from Finland,  
26 who constituted a large proportion of immigrants, compared to the native Swedish  
27 population.<sup>26 27</sup> The authors of a recent meta-analysis reported substantial continuity between  
28 the suicide rates in the country of birth and those of the country of immigration.<sup>28</sup> Cultural  
29 factors including attitudes to suicide and lifestyle may also play a role for the higher suicide  
30 rates among Nordic-born immigrants. We have previously shown increased risk of both fatal  
31 and non-fatal suicidal behaviours in older adults with alcohol use disorders,<sup>29</sup> and differential  
32 rates of alcohol consumption may be a partial explanation.<sup>30</sup> The higher risk of suicide  
33 attempt among those born in non-Nordic countries may be explained by life conditions that

1 we were unable to capture in our study, such as refugee status, post-traumatic stress,  
2 migration experience, and an experience of being distanced from Swedish society.<sup>31</sup> Social  
3 isolation in terms of limited social network, language limitation and sparse contact with  
4 family members may also be relevant to explain elevated rates of suicidal behaviour among  
5 the oldest adults born in non-Nordic countries. However, the gender-difference in the  
6 association between the country of birth and suicidal behaviours warrants more research to  
7 better elucidate this association.

8 In our gender-stratified analysis, being single or divorced had significant effect on suicide risk  
9 among men but not among women. While we could find no study focusing on depressed older  
10 adults for comparison, one partial explanation of our findings may be that depressed old men  
11 living alone may be more prone to social isolation than their female counterparts.<sup>32</sup> Another  
12 issue might be men's unwillingness to seek mental health services,<sup>33</sup> and living alone  
13 probably reduces their motivation to seek care. Partner loss was not associated with suicidal  
14 behaviour in our study. One Danish cohort study found increased risk for suicide among the  
15 oldest widowed, especially among men.<sup>34</sup> However, the study included only deaths of partners  
16 that occurred during a 5-year observation period. It may therefore not be relevant to compare  
17 the findings of the two studies.

18 The higher risk of suicidal behaviours among women with higher education and those who  
19 have had positions requiring more advanced qualifications is a new finding. Most previous  
20 research on socio-economic status and suicidal behaviours in late life has overlooked the  
21 gender dimension and gender-stratified studies have yielded disparate results.<sup>8 35 36</sup> Our results  
22 support the need for a life-course approach to better understand and prevent late-life suicidal  
23 behaviours.<sup>20</sup> As pointed out by Alexopoulos,<sup>37</sup> even if there is a late onset form of  
24 depression, recurrent depressive episodes may arise in older patients who have experienced  
25 life stressors and depression earlier in life. A large prospective cohort study with over 50  
26 years of follow-up and a wide range of life course measures and job characteristics has found  
27 that women in leadership positions at time of retirement were significantly more exposed to  
28 job-related stressors than lower status women and men in both positions.<sup>38</sup> Women who had  
29 higher education and leadership positions have often experienced a work environment highly  
30 dominated by men, and as such might have experienced higher demands for excellent work  
31 performances. These demands combined with a possible tendency to adapt to ideals that  
32 traditionally have been associated with men and masculinity might put these women in a more  
33 vulnerable situation. For example, they might experience conflicting roles, or loss of social

1 status, in the context of retirement. When faced with functional limitations, they might feel  
2 that they are better off dead than having compromised autonomy. Further, they might have  
3 restricted their social networks to manage demanding work situations prior to retirement,  
4 resulting in a more limited social situation after retirement. Despite the social advantages that  
5 women with higher socio-economic status may have had, the gendered macro- and meso-level  
6 social contexts may have limited the extent to which women in higher-status positions have  
7 derived psychological benefits from their socio-economic situation.<sup>38 39</sup>

8 New users of antidepressants who resided in nursing homes had lower risks of both fatal and  
9 non-fatal suicidal behaviours compared to their peers living in the community. A partial  
10 explanation might be that nursing home staff are more able to monitor older adults who are on  
11 treatment for depression.<sup>40</sup> Being in a nursing home provides the older adults with a social  
12 network, which may reduce feelings of loneliness. Further, many of the new users of  
13 antidepressants residing in nursing homes might have been prescribed antidepressants for  
14 behavioural symptoms of dementia, rather than for depression.<sup>22</sup>

15 The sociodemographic factors associated with fatal or non-fatal suicidal behaviours in new  
16 users of antidepressants in our study (e.g. male sex, level of education, occupational history in  
17 women, and country of birth) seem less susceptible to a reverse causality. Therefore, the  
18 interpretation of our results should take into account the underlying assumption that the  
19 associations between the exposures and suicidal behaviours are unidirectional. However,  
20 more research is needed on possible mechanisms and mediators influencing these  
21 associations. Variables analysed in this study may also be proxies for non-measured risk factors for  
22 suicide in older adults distributed over social and economic living conditions. Medical comorbidity,  
23 chronic pain, frailty and cognitive impairment, as well as prolonged grief may be amplified by  
24 depression to a higher extent in persons in constrained socioeconomic situations. The combined effects  
25 of depression, comorbidities, functional limitations and social factors should thus be taken into  
26 consideration in the evaluation of suicide risk in older adults

### 27 **Strengths and limitations**

28 The use of national population-based data means that there are no exclusion criteria. This  
29 minimises the risk of selection bias that may potentially result from the sole use of hospital-based data.  
30 Our study was sufficiently large to explore the association of numerous sociodemographic  
31 variables with fatal and non-fatal suicidal behaviours. Register-based studies on suicidal  
32 behaviours rely on collection of data from many different settings and variations in data



1 validity can occur. An important limitation is that only suicide attempts that have been  
2 registered in hospitals or specialised outpatient services can be captured with our study  
3 design. Despite the wide range of covariates included in the analyses, information on other  
4 potential confounders such as health behaviours including alcohol consumption was not  
5 available. Gender-stratified analyses should be interpreted with caution due to the low number  
6 of suicides, especially among women and therefore low power. Education, income, and last  
7 occupational class measure different social dimensions and tap into different causal  
8 mechanisms related to health.<sup>41</sup> Their possible correlation does not affect the validity of the  
9 regression models or other predictors. It may however decrease the statistical power of the  
10 analyses.

11 One strength of our research is the investigation of suicidal behaviours in 5-year age bands  
12 after the age of 75 years. This is particularly relevant due to the aging of populations  
13 worldwide. A previous study found that suicide rates slightly increased again in the 100 years  
14 age-band.<sup>42</sup> Due to the low number of centenarians in our study, we could not investigate the  
15 risk of suicidal behaviours in this age group.

16 We had access to information about the initiation of antidepressants to define our population  
17 but we acknowledge that using this method is not the same as using structured clinical  
18 interviews or diagnostic criteria to define depression, and we therefore do not rule out an  
19 indication bias or a residual confounding. Antidepressants are prescribed not only for the  
20 treatment of depression but also for anxiety disorders and obsessive compulsive disorder as  
21 well as behavioural symptoms of dementia. Further, the Swedish Prescribed Drug Register  
22 does not include drugs administered in a hospital setting which may lead to a slight  
23 misclassification of those who initiated their antidepressant therapy during their  
24 hospitalisation. However, only 4.3% of the study population had a record of depression in  
25 inpatient/outpatient specialised care during the year preceding their inclusion in the study.  
26 Antidepressant treatment initiated in hospital will in most cases be followed up with  
27 continuation treatment after discharge, and thus recorded in the Swedish Prescribed Drug  
28 Register. This would suggest only a marginal effect on our findings. Furthermore, being  
29 married does not inform about the actual support received from the partner, and it is possible  
30 that age-related changes that affect one or both partners can burden the relationship.  
31 Therefore, it seems possible that some of the observed associations of the marital status and  
32 suicidal behaviours could be explained, at least in part, by unmeasured factors. Another  
33 limitation is that, when considering findings related to immigrant status, we did not have

1 information about the date of immigration, which may have influenced degree of  
2 acculturation and assimilation to the hosting country,<sup>43</sup> which in turn could impact on suicidal  
3 behaviours. Due to power issues, a more detailed analysis of region of birth was not possible.  
4 Data on suicides and attempted suicides by region of birth is reported in the online  
5 supplementary appendix 2. The influence of race and ethnicity on suicidal behaviour could  
6 not be investigated in our study as those born in Sweden and other Nordic countries may be  
7 considered ethnically rather homogeneous.

## 8 **Implications**

9 While our findings cannot be extrapolated to older adults not taking antidepressants, or long-  
10 term users of these drugs, they offer clues to the prevention of suicidal behaviours in persons  
11 recently identified as depressed and in need of treatment. Our findings highlight the need for  
12 gender-specific, multifaceted approaches to the prevention of suicidal behaviours in late-life.  
13 The identification and treatment of late-life depression remains an important target for suicide  
14 prevention in our oldest adults, but the current findings highlight the need for new initiatives  
15 that go beyond the healthcare sphere.

16 Research is needed in other settings as socio-economic conditions, availability of healthcare,  
17 and cultural differences may have an impact on risk of both fatal and non-fatal suicidal  
18 behaviours in late-life.

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1 **Authors' contributorship:** KH conceived and designed the study, helped acquire the data, helped  
2 with data analysis and interpretation of results, drafted the article, and had the final approval for  
3 submission. KAS conceived and designed the study, helped acquire the data, helped with data  
4 analysis, revised the article for content, and gave the final approval for submission. GH helped with  
5 interpretation of results, revised the article for content, and gave the final approval for submission. IS  
6 helped with interpretation of results, revised the article for content, and gave the final approval for  
7 submission. SG performed data analysis, revised the article for content, and gave the final approval  
8 for submission. MW is the primary investigator of the project. She conceived and designed the study,  
9 helped acquire the data, helped with interpretation of results, revised the article for content, and gave  
10 the final approval for submission. All authors had full access to all of the data (including statistical  
11 reports and tables) and can take responsibility for the integrity of the data and the accuracy of the data  
12 analysis. KH is the guarantor.

13 **Competing interests:** All authors have completed the ICMJE uniform disclosure form at  
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15 the Swedish Research Council for Health, Working Life and Welfare, ALF, and the Söderström-  
16 König Foundation for the submitted work; no financial relationships with any organisations that  
17 might have an interest in the submitted work in the previous three years; no other relationships or  
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25 Hospital (ALF).

26 **Data sharing:** No additional data available.

27 **Ethical approval:** This study was approved by the Regional Ethical Review Board in Gothenburg  
28 (No: 111-15).

29 **Transparency:** The first author (KH) affirms that the manuscript is an honest, accurate, and  
30 transparent account of the study being reported; that no important aspects of the study have been

1 omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been  
2 explained.

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For peer review only

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**Online supplementary appendix S1.****Table 1. Number of suicide and suicide attempts by region of birth**

<b>Region of birth</b>	<b>N Suicide</b>	<b>N Suicide attempt</b>
Sweden	266	562
European countries (EU15) except Nordic countries*	9	16
Nordic countries except Sweden	8	45
Other countries of Europe**	8	25
North America	2	2
Asia	1	3
Africa	1	0
South America	0	3

\*Austria, Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, United Kingdom

\*\*Other countries of Europe except Nordic countries and countries of EU15

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3 **Online Supplementary appendix S2\***  
4

5 **Table 1. Methods of suicide by gender (N=295)\*\***  
6

Method of suicide	Number of suicides among men (%)	Number of suicides among women (%)
Hanging, strangulation and suffocation	76 (38)	11 (11)
Poisoning	36 (18)	42 (44)
Jumping from a high place	23 (12)	13 (14)
Drowning and submersion	15 (8)	20 (21)
Firearm	31 (16)	0 (0)
Sharp object	5 (3)	1 (1)
Moving object	4 (2)	1 (1)
Other	9 (5)	8 (8)
<b>Total</b>	<b>199</b>	<b>96</b>

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23 \*Data previously published by Hedna et al; EJCP 2017<sup>1</sup> (<http://creativecommons.org/licenses/by/4.0>)

24 \*\*Based on the International classification of Diseases (ICD-10) from the Cause of Death Register. Both  
25 diagnoses of international self-harm and of undetermined intent were included.  
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**Table 2. Methods of suicide attempt by gender (N=654)\***

Method of suicide attempt	Number of suicide attempts among men (%)	Number of suicide attempts among women (%)
Poisoning	201 (67)	308 (87)
Sharp object	55 (18)	27 (8)
Hanging, strangulation and suffocation	16 (5)	3 (1)
Jumping from a high place	10 (3)	5 (1)
Drowning and submersion	6 (2)	4 (1)
Moving object	4 (1)	0 (0)
Other	8 (3)	7 (2)
<b>Total</b>	<b>300</b>	<b>354</b>

\*Based on the International classification of Diseases (ICD-10) from the National Patient Register. Both diagnoses of international self-harm and of undetermined intent were included.

1. Hedna K, Andersson Sundell K, Hamidi A, et al. Antidepressants and suicidal behaviour in late life: a prospective population-based study of use patterns in new users aged 75 and above. *European Journal of Clinical Pharmacology* 2018;74(2):201-8

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Reported on page #
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	Title: Page 1, line 2, Abstract: Page 2, line 6
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Page 4, line 11
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 4, line 22
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	Page 5, line 3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 5, line 3
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	Page 5, line 5
		(b) For matched studies, give matching criteria and number of exposed and unexposed	NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Exposures: Page 5, line 8
			Outcomes: Page 5, line 16
			Confounders: Page 6, line 13
Data sources/measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Page 6, lines 9 and 17
Bias	9	Describe any efforts to address potential sources of bias	Page 17, line 17
Study size	10	Explain how the study size was arrived at	NA: population-based study
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 6, line 1
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Page 6, line 8
		(b) Describe any methods used to examine subgroups and interactions	Page 6, line 19 (gender-stratified analyses)
		(c) Explain how missing data were addressed	Page 10, line 3
		(d) If applicable, explain how loss to follow-up was addressed	NA
		(e) Describe any sensitivity analyses	NA
<b>Results</b>			

1	Participants	13	(a) Report numbers of individuals at each stage of study— eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	NA
2			(b) Give reasons for non-participation at each stage	NA
3			(c) Consider use of a flow diagram	NA
4	Descriptive data	14	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Page 7, line 2 and Table 1
5			(b) Indicate number of participants with missing data for each variable of interest	Table 1, Table 2
6			(c) Summarise follow-up time (eg, average and total amount)	Page 10, line 1
7	Outcome data	15	Report numbers of outcome events or summary measures over time	Page 10, lines 2 and 4
8	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Page 10, line 6 and Table 3
9			(b) Report category boundaries when continuous variables were categorized	NA
10			(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
11	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Page 12, line 1 and Table 4. Page 14, line 1 and Table 5
12	<b>Discussion</b>			
13	Key results	18	Summarise key results with reference to study objectives	Page 16, line 2
14	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Page 18, line 22
15	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Page 16, line 7
16	Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 16, line 10. Page 19, line 22
17	<b>Other information</b>			
18	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Page 20, line 20