

## RESEARCH ARTICLE

# Psychoactive medication use and risk of suicide in long-term care facility residents

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## Abstract

**Objectives:** To investigate psychoactive medication use and risk of suicide in long-term care facility (LTCF) residents aged 75 and above. A second aim was to investigate the role of psychiatric and medical conditions in the occurrence of suicide in LTCF residents.

**Methods:** A Swedish national register-based cohort study of LTFC residents aged  $\geq 75$  years between 1 January 2008 and 31 December 2015, and followed until 31 December 2016 ( $N = 288,305$ ). Fine and Gray regression models were used to analyse associations with suicide.

**Results:** The study identified 110 suicides (15.8 per 100,000 person-years). Half of these occurred during the first year of residence. Overall, 54% of those who died by suicide were on hypnotics and 45% were on antidepressants. Adjusted sub-hazard ratio (aSHR) for suicide was decreased in those who were on antidepressants (aSHR 0.64, 95% confidence interval 0.42–0.97), even after the exclusion of residents who had healthcare contacts for dementia or were on anti-dementia drugs. The aSHR for suicide was more than two-fold higher in those who were on hypnotics (2.20, 1.46–3.31). Suicide risk was particularly elevated in those with an episode of self-harm prior to LTCF admittance (15.78, 10.01–24.87). Specialized care for depression was associated with increased risk, while medical morbidity was not.

**Conclusions:** A lower risk of suicide in LTCF residents was found in users of antidepressants, while elevated risk was observed in those on hypnotics. Our findings suggest that more can be done to prevent suicide in this setting.

## KEYWORDS

aged, cohort study, long term care facility, nursing homes, psychopharmacoevidence, risk factors, suicide

## Key points

- Half of the suicides occurred within a year after moving to the long-term care facility (LTCF).

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- Over the 8-year study period, less than a half of LTCF residents in Sweden aged 75 and above who died by suicide were on antidepressants.
- The use of antidepressants was associated with a decreased risk of suicide, which is compatible with a positive effect of such agents in the LTCF population.
- Suicide risk was increased two-fold in those who were on hypnotics.

## 1 | INTRODUCTION

In parallel with the ageing of the world population, the number of older people who need long-term care is on the rise.<sup>1</sup> In Sweden, it is estimated that every tenth adult aged  $\geq 75$  years lives in a long-term care facility (LTCF).<sup>2</sup> Suicidal thoughts and death wishes are common among LTCF residents.<sup>3</sup> We recently showed that institutional residence was associated with a fourfold increase in active/passive suicidal ideation.<sup>4</sup> Despite these facts, suicide in LTCF is sparsely studied.

Residents of LTCF may have experienced stressful life transitions including bereavement, loss of health,<sup>5</sup> and physical disabilities, all of which may contribute to increased risk of suicide.<sup>6</sup> Further, they frequently suffer from neuropsychiatric morbidity and behavioural symptoms including agitation and outwardly directed aggression.<sup>7,8</sup> On the other hand, LTCF provide various forms of protection from suicide.<sup>9</sup> Yet some research has suggested that protective factors are not always effectively operating, which underlines the need for strengthening research to develop appropriate preventive and therapeutic strategies in this geriatric setting.<sup>10</sup>

Depression is common among older LTCF residents,<sup>11-14</sup> and was found in up to two thirds of those who died by suicide in this setting.<sup>10,15</sup> Identifying and treating depression among residents of LTCF may be challenging as symptoms are often experienced together with cognitive impairment, physical disorders, and other psychiatric disorders.<sup>14,16</sup> Therefore it may remain under recognized and under treated.<sup>12,17</sup>

Antidepressants and other psychoactive medications are widely used in LTCF to treat psychiatric and behavioural symptoms associated with elevated suicide risk.<sup>18</sup> Concerns about their efficacy and safety have been expressed,<sup>19,20</sup> while their relationships with suicide risk in LTCF is little studied. Extrapolating results from studies conducted in the general older population may be suboptimal as LTCF residents are frailer,<sup>21</sup> suffer from more morbidities, and have a greater degree of polypharmacy,<sup>22</sup> which could result in different response profiles and a greater susceptibility to side effects. We could identify one small retrospective study of suicides in LTCF where eight of the twelve suicides diagnosed with depression were not receiving any pharmacological treatment at the time of death.<sup>23</sup> Another study found a particularly elevated risk of suicidal ideation in LTCF residents who were on psychoactive medications, but the types of medications were not specified.<sup>24</sup> There is therefore a need to better understand the associations between the use of antidepressants and other psychoactive medications and suicide in LTCF to identify individuals with increased suicide risk who may need a closer monitoring.

Given the rarity of suicides, large national population-based studies provide a useful context to examine factors associated with suicide in LTCF. The aim of the current study was to investigate the relationship between psychoactive medication use and the risk of suicide in LTCF residents aged 75 and over. A second aim was to investigate the role of psychiatric and medical conditions in the occurrence of suicide in LTCF residents.

## 2 | METHODS

### 2.1 | Study design and study population

We conducted a national register-based retrospective cohort study in persons aged 75 and older who were residents in LTCF between January 1, 2008 and December 31, 2015. Individuals were followed from the first registration of LTCF residence (index date) until December 31, 2016 or until death, whichever occurred first.

### 2.2 | Data sources

Multiple registers were linked through the personal identity number.<sup>25</sup> Information on LTCF residence was obtained from the National Register of Care and Social Services for Older Adults and Persons with Impairments.<sup>2</sup> Information on dispensed prescription medications was extracted from the Swedish National Prescribed Drug Register.<sup>26</sup> Medications were classified according to the Anatomical Therapeutic Chemical (ATC) code. Information on medical diagnoses at baseline and during follow-up was extracted from the National Patient Register which contains prospectively collected data on all inpatient stays and specialised outpatient visits in Sweden. The coverage of inpatient discharges is  $>99\%$ .<sup>27</sup> Medical diagnoses are classified according to the International Classification of Diseases, Tenth Revision (ICD-10). Information on all-cause mortality, including suicide, was extracted from the National Cause of Death Register which covers 100% of deaths in Sweden.<sup>28</sup> The above mentioned registers are held by the National Board of Health and Welfare. The sociodemographic characteristics of the study population were retrieved from Statistics Sweden. The Swedish Dementia Registry (SveDem) is a national quality registry for monitoring the diagnosis, treatment and care of people with dementia in Sweden and covers 100% of memory clinics and 75% of primary care units in Sweden.<sup>29</sup>

## 2.3 | Characteristics of LTCF residents

Sociodemographic characteristics included: sex, age, marital status (married, widow/widower, single, divorced), and country of birth (Sweden, other Nordic countries, outside of Nordic countries). Clinical conditions diagnosed in specialised outpatient and inpatient care were retrieved up to 5 years before the index date. They included medical conditions (cerebrovascular disease, cardiovascular disease, cancer and chronic pain), psychiatric conditions (depression, anxiety, schizophrenia, and substance use disorders) and a previous self-harm episode. For the purpose of this study, a person was considered to have dementia if a diagnosis of dementia was identified from the SveDem register, the National Patient Register, or if the person had a prescription for an anti-dementia drug.

Medication dispensing scheme was either ordinary prescriptions or multidose (medication dispensed in machine-packed pouches and usually provided every 2 weeks). All ICD and ATC codes included in the study are listed in detail in Table S1.

## 2.4 | Identification of suicide

We identified suicides from the National Cause of Death Register based on the following ICD-10 codes: Intentional self-harm (X60-X84) and harm of undetermined intent (Y10-Y32).

## 2.5 | Statistical analysis

Psychoactive medication use was considered as a time-varying exposure, assessed both in the 3 months after the index date and prior to the occurrence of suicide or study end. We compared the use of psychoactive medications and other medical conditions between men and women who died by suicide.

Given the high mortality in LTCF residents, we used the Fine and Gray proportional hazard model to investigate the psychoactive medications and clinical factors associated with suicide. The Fine and Gray model is a time-to-event model similar to the Cox proportional hazard model. However, unlike Cox's regression, the Fine and Gray regression is developed for competing data and considers mortality by causes other than suicide as a competing risk.<sup>30</sup> Adjusted sub-hazard ratios (aSHRs) and 95% confidence intervals (95% CIs) were calculated for the occurrence of suicide. The independent variables included in the regression model were selected based on the previous associations found with suicide in the 75+ population.<sup>5,31,32</sup> The regression models included use of antidepressants, anxiolytics and hypnotics. Use of specialised care for depression, other psychiatric conditions (anxiety, schizophrenia, and substance use disorders), and somatic conditions (cerebrovascular disease, cardiovascular disease, cancer and chronic pain) were considered as proxies for serious conditions as in Sweden milder forms are treated within the LTCF while more serious cases are referred to specialized care. We also considered a previous episode of self-harm up to 5 years before the

index date. The models were adjusted for age, sex and marital status. This last variable was found to be associated with both late-life suicide,<sup>31</sup> and use of psychoactive medications in older population.<sup>33</sup> In order to assess the robustness of our findings, we used the Cox proportional hazards models to estimate the hazard ratios for cause-specific risk. Regression analyses were conducted in men and women separately. We conducted sensitivity analyses excluding persons identified with dementia, and excluding persons who used poisoning as a suicide method to investigate whether this would affect the association between the use of psychoactive medications and occurrence of suicide. A 0.05 significance level was used. Data analyses were performed by SAS version 9.4 (SAS Institute, NC, USA).

## 3 | RESULTS

Characteristics at baseline are shown in Table 1 for the 288,305 persons aged 75+ who were registered as LTCF residents in Sweden between 2008 and 2015. The mean age was 86.5 years and about two-thirds were women. Over a half were widowed and almost one tenth had a foreign background. Nine out of ten were on a prescription medication; this was supplied via the multidose system for three fourths of the residents. Antidepressants were the most prescribed psychoactive medications, followed by hypnotics prescribed to about four out of ten LTCF residents. About one fifth were on antipsychotics. Anti-dementia drugs were the least prescribed psychoactive medications. One fifth had used specialised care for cardiovascular or cerebrovascular conditions up to 5 years prior to the index date and a similar proportion was observed for inpatient or specialist healthcare for cancer. Overall, 7% used specialised care for depression. One percent had an episode of self-harm within the 5 years prior to residence in LTCF.

The median follow-up time was 579 days (Interquartile Q1-Q3: 263–914). In total, 74% died during the follow-up time. Suicide was the cause of death for 110 individuals (64 men and 46 women), corresponding to an incidence rate of 15.8 per 100,000 person-years for the total LTCF population (32 per 100,000 person-years in men, and 9.3 per 100,000 person-years in women). The median time spent in LTCF before the suicide was 292 days (Interquartile Q1-Q3: 115–489). About one third of suicides occurred in the first 6 months of residence in the LTCF, and about one half occurred within a year after moving to the LTCF facility. Suicide methods are presented for men and women in Table 2. One third of the male suicides involved hanging, strangulation or suffocation. Poisoning was employed in 39% of the women.

Just over a half (54%) of persons who died by suicide were on hypnotics during their final 3 months of life. Slightly less than a half (45%) who died by suicide were prescribed antidepressants (Table 3). One fourth used specialised care for depression, and one out of twelve for anxiety disorders. About one tenth (10.9%) had one or more episodes of self-harm during residence in the LTCF.

The adjusted sub hazard ratio (aSHR) for suicide was lower in LTCF residents who were on antidepressants (Table 4). The aSHR for

**TABLE 1** Baseline characteristics of long-term care facility residents in Sweden aged 75+ during 2008–2015 (N = 288,305)

Characteristics	Total n (%)
<b>Gender</b>	
Female	193,542 (67.1)
<b>Age group</b>	
75–84	104,283 (36.2)
85+	184,022 (63.8)
<b>Marital status</b>	
Widow/Widower	158,550 (55.0)
Married	69,850 (24.2)
Divorced	34,697 (12.0)
Single	24,480 (8.5)
<b>Country of birth</b>	
Sweden	263,627 (91.4)
Other nordic country	13,445 (4.7)
Outside of nordic countries	11,233 (3.9)
<b>Use of any prescribed medication<sup>a</sup></b>	
Antidepressants	1,21,111 (42.0)
Citalopram	51,458 (18.0)
Mirtazapine	39,165 (13.6)
Sertraline	10,263 (3.6)
Tricyclic antidepressants	6022 (2.1)
Hypnotics	1,11,383 (38.6)
Zopiclone	70,630 (24.5)
Zolpidem	20,175 (7.0)
Anxiolytics	94,866 (32.9)
Oxazepam	77,977 (27.0)
Antipsychotics	47,461 (16.5)
Risperidone	27,505 (9.5)
Anti-dementia	42,490 (14.7)
Donepezil	19,422 (6.7)
Memantine	15,416 (5.4)
Beta-blockers	108,843 (37.8)
Statins	46,316 (16.)
<b>Specialised care for psychiatric conditions<sup>b</sup></b>	
Depression	19,316 (6.7)
Anxiety disorders	10,355 (3.6)
Substance and drug use disorders	4993 (1.7)
Schizophrenia	3996 (1.4)
Sleeping disorders	3164 (1.1)
<b>Specialised care for medical conditions<sup>b</sup></b>	
Cerebrovascular disease	60,307 (20.9)

**TABLE 1** (Continued)

Characteristics	Total n (%)
Cardiovascular disease	60,279 (20.9)
Cancer	53,768 (18.6)
Chronic pain	22,917 (7.9)
<b>Previous episode of self-harm<sup>b</sup></b>	2942 (1.0)

Abbreviations: %, percentage of individuals per variable; n, number of individuals per variable.

<sup>a</sup>Based on their prescription within a period of 3 months after the index date.

<sup>b</sup>Up to 5 years prior to the index date of residence in the long-term care facility.

suicide was more than two-fold higher in users of hypnotics while the use of anxiolytics was not associated with increased suicide risk. Suicide risk was also elevated in those with history of use of specialised care for depression. A fifteen-fold increase in aSHR for suicide was found in those with a previous episode of self-harm. Results of aSHR for non-suicide deaths are presented in Table S2 and Figure S1. Slightly lower risks of natural death were found in those who used specialised care for depression and for other psychiatric conditions, users of antidepressants and persons with previous episodes of self-harm. Users of hypnotics, anxiolytics and who had specialised care for somatic conditions had a marginal increase in risk of natural deaths. Overall factors had a small effect on natural deaths compared to their effect on suicide risk.

The results of the adjusted Cox regression (Table S3) were in accordance with the findings of the Fine and Grey analyses, with the exception of psychiatric comorbidity which was not significant in the Cox adjusted regression. The sensitivity analyses excluding LTCF residents with diagnosis of dementia in specialised care, those who used anti-dementia drugs or those identified in the SveDem register yielded results similar to those of the main analyses (Tables S4). Use of hypnotics remained associated with higher risk of suicide even after the exclusion of suicide by poisoning (Table S5).

## 4 | DISCUSSION

In this register-based study, less than a half of LTCF residents aged 75 and above who died by suicide were on antidepressants and use of antidepressants in those who died by suicide was similar to the total LTCF residents. A decreased risk of suicide was found among LTCF residents who were prescribed ADs, once relevant covariates were adjusted for. Hypnotics, on the other hand, were associated with a two-fold increase in suicide risk. Suicide risk was elevated fifteen-fold in persons with a previous episode of self-harm.

The finding that antidepressant use was associated with lower risk of suicide among LTCF residents contrasts with data reported for the general Swedish population aged 75 years and above, where

**TABLE 2** Methods of suicide in long-term care facility residents in Sweden aged 75+ during 2008–2016<sup>a</sup>

	Total (n = 110)	Men (n = 64)	Women (n = 46)
Poisoning	28	11	17
Hanging, strangulation and suffocation	28	22	6
Jumping from a high place	23	14	9
Drowning and submersion	10	5	5
Smoke, fire and flame	3	1	2
Sharp object	3	3	0
Shotgun	1	1	0
Moving object	1	1	0
Other or unspecified	13	6	7

Abbreviation: n, number of individuals per variable.

<sup>a</sup>Based on the International Classification Codes of Diseases Version 10 from the National Cause of Death Register.

antidepressant treatment was associated with an increased risk of suicide, a finding that most likely reflects confounding by indication.<sup>31</sup> Antidepressants may also be used for other conditions (as sub-threshold depression, symptoms of anxiety, pathological crying in dementia). Our contrasting finding in the LTCF population suggests that suicide risk varies among subpopulations of older adults, and that risk of suicide in LTCF residents should be considered separately from that of community-dwelling older adults. We could identify no other studies investigating the risk of suicide in LTCF residents treated with antidepressants. Since dementia is considered one of the few mental conditions associated with lower suicide risk in some studies,<sup>32,34</sup> we anticipated that the reduced risk among LTCF residents who were on antidepressants might be attenuated after exclusion of those with dementia. However, this was not the case. More research is needed to better understand association between antidepressant use and suicide in LTCF and to elucidate any potential confounders.

The higher suicide risk in users of hypnotics parallels our previous finding in older adults in the general population who initiated antidepressant therapy in Sweden.<sup>32</sup> Elevated risk may be explained by the possible role of these drugs in worsening depression, impairing judgement, and creating behavioural confusion, as well as through pharmacological overdose.<sup>35,36</sup> Another explanation may be that these drugs indicate underlying sleep disorders, previously shown to be associated with increased risk of self-harm.<sup>37</sup> We could not consider the effect of insomnia in our regression model as this condition is mainly treated in the LTCF setting and thus not captured in the National Patient Register. While poisoning was a common method of suicide among LTCF residents in our study, our data lacked detail regarding the specific substances involved in self-poisoning. Yet, hypnotics remained associated with higher risk of suicide after exclusion of self-poisoning, which might suggest a suicidogenic effect of hypnotics. However, there may be other explanations, and the association with suicide needs to be further explored.

Suicide risk was more than doubled in both men and women who required specialised care for depression. While depression is a known risk factor for suicide in LTCF residents,<sup>10,24,38,39</sup> we lacked individual-level data on depressive symptoms so we do not know whether depression was adequately diagnosed and treated among LTCF residents. However, our findings, in line with others,<sup>23</sup> suggest that some LTCF residents who died by suicide might not have received adequate antidepressant treatment or it may not have been managed appropriately.

As physical illness/disability associates with late life depression,<sup>40</sup> and suicidal behaviour,<sup>5</sup> we anticipated that specialised care for somatic morbidities would be a marker of elevated risk also in the LTCF population. This was not the case, and there could be several reasons for this finding. First, somatic morbidities are common LTCF residents, and there may therefore be a built-in selection bias in the population. Further, persons with somatic morbidities may lack the required strength to self-harm in LTCF,<sup>41</sup> or may have a reduced opportunity to end their own life as a result of the increased care and supervision.<sup>40,42</sup> One other reason may be that some somatic conditions not referred to specialised care, but rather managed within the LTCF facility,<sup>43</sup> and thus not captured in the National Patient Register.

A previous episode of self-harm carried by far the most elevated risk estimate. The two small studies that have investigated the history of suicidal behaviour in LTCF residents reported that about one third of persons who died by suicide had a documented history of self-harm.<sup>23,44</sup> In our population, most self-harm episodes occurred before moving to the facility. This finding highlights the need for LTCF staff to be aware of residents' past history, in order to watch for signs and symptoms of mental distress, to improve early recognition of persons in need of extra support. Gatekeeper training for members of LTCF staff has been found to have a positive effect in terms of managing suicidal residents and routine suicide prevention measures.<sup>45</sup>

**TABLE 3** Clinical characteristics and use of psychoactive medications in long-term care facility residents in Sweden aged 75+ who died by suicide during 2008–2016 (*n* = 110)

Characteristics	Total ( <i>n</i> = 110) (%)	Men ( <i>n</i> = 64) (%)	Women ( <i>n</i> = 46) (%)	<i>p</i> -value <sup>a</sup>
<b>Use of psychoactive medications<sup>b</sup></b>				
Antidepressants	50 (45.5)	26 (40.6)	24 (52.5)	0.23
Citalopram	14 (12.7)	7 (19.9)	7 (15.2)	0.51
Sertraline	10 (9.1)	7 (19.9)	3 (6.5)	0.42
Mirtazapine	12 (10.9)	6 (9.4)	6 (13)	0.54
Tricyclic antidepressants	1 (0.9)	1 (1.6)	0	-
Hypnotics	59 (54)	34 (53)	25 (54)	0.90 <sup>2</sup>
Zopiclone	40 (36)	24 (38)	16 (35)	0.77 <sup>2</sup>
Zolpidem	13 (12)	6 (9.4)	7 (15)	0.35 <sup>2</sup>
Anxiolytics	41 (37)	25 (39)	16 (35)	0.65 <sup>2</sup>
Oxazepam	33 (30)	22 (34)	11 (24)	0.24 <sup>2</sup>
Antipsychotics	24 (22)	14 (22)	10 (22)	0.99 <sup>2</sup>
Risperidone	7 (6.4)	4 (6.3)	3 (6.5)	0.95 <sup>2</sup>
Antidementia	10 (9.1)	6 (9.4)	4 (8.7)	0.90 <sup>2</sup>
Donepezil	8 (7.3)	6 (9.4)	2 (4.3)	0.32 <sup>2</sup>
<b>Specialised care for psychiatric conditions<sup>c</sup></b>				
Depression	26 (24)	13 (20)	13 (28)	0.33 <sup>2</sup>
Anxiety disorders	8 (7.3)	2 (3.1)	6 (13)	0.05 <sup>2</sup>
Schizophrenia	7 (6.4)	3 (4.7)	4 (8.7)	0.40 <sup>2</sup>
Substance and drug use disorders	4 (3.6)	2 (3.1)	2 (4.3)	0.74 <sup>2</sup>
Bipolar disorder	2 (1.8)	1 (1.6)	1 (2.2)	0.81 <sup>2</sup>
Sleeping disorders	1 (0.9)	1 (0.9)	0 (0)	-
<b>Specialised care for somatic conditions</b>				
Cardiovascular disease	24 (21.8)	19 (29.7)	5 (10.9)	0.02 <sup>2</sup>
Cerebrovascular disease	15 (13.6)	9 (14.1)	6 (13.0)	0.88 <sup>2</sup>
Cancer	9 (8.2)	7 (10.9)	2 (4.3)	0.21 <sup>2</sup>
Chronic pain	6 (5.5)	5 (7.8)	1 (2.2)	0.20 <sup>2</sup>
<b>Previous episode of self-harm</b>				
During LTCF residence	12 (10.9)	7 (10.9)	5 (10.9)	0.44 <sup>2</sup>
Up to 5 years prior to residence in LTCF	13 (11.8)	7 (10.9)	6 (13)	0.62 <sup>2</sup>

Abbreviations: %, percentage of individuals per variable; LTCF, Long-term care facility; *n*, number of individuals per variable; *p*, significance probability.

<sup>a</sup>Chi<sup>2</sup>-test for comparison between men and women to establish if there are differences between Categories.

<sup>b</sup>Based on their prescription within a period of 3 months prior to suicide or end.

<sup>c</sup>Occurring during residence in the LTCF and up to 5 years prior the index date of LTCF residence.

Half of suicides occurred in the first year of LTCF residence. This finding is in line with the aggregate results of the systematic review of Murphy et al. grouping three small studies and indicating that 52% of residents who died by suicide resided in the LTCF for less than 12 months<sup>46</sup> Transition to LTCF can be disruptive both on its own and as a correlate of precipitating changes (as becoming widowed or developing difficulties with activities of daily living) that are

associated with suicide.<sup>3</sup> This result indicates the importance of early recognition and adequate monitoring of mental health during the early stage of LTCF residence.

We did not anticipate that as much as one fourth of all the suicides would be due to poisoning, as medications are distributed by residential care staff, which should limit stockpiling. It is likely that many of these deaths, as well as the one gunshot suicide occurred in

TABLE 4 Fine and Grey Sub-hazard ratios for factors associated with suicide in long-term care facility residents aged 75+ (N = 288,305)

Variables	All residents		Men		Women	
	Univariate regression <sup>a</sup>	Multivariate regression <sup>a</sup>	Univariate regression <sup>a</sup>	Multivariate regression <sup>a</sup>	Univariate regression <sup>a</sup>	Multivariate regression <sup>a</sup>
Use of antidepressants <sup>b,c</sup>	1.06 (0.73–1.55)	0.64 (0.42–0.97)*	0.99 (0.6–1.63)	0.58 (0.33–1.01)	1.31 (0.74–2.34)	0.75 (0.39–1.43)
Use of hypnotics <sup>b,c</sup>	2.62 (1.8–3.82)***	2.20 (1.46–3.31)**	2.58 (1.58–4.21)**	2.17 (1.3–3.65)**	2.7 (1.51–4.82)**	2.23 (1.15–4.32)*
Use of anxiolytics <sup>b,c</sup>	1.29 (0.88–1.9)	0.97 (0.64–1.46)	1.61 (0.97–2.65)	1.23 (0.72–2.12)	1.09 (0.59–1.99)	0.68 (0.37–1.24)
Specialised care for depression <sup>c,d</sup>	4.83 (3.21–7.27)***	2.65 (1.53–4.58)**	4.47 (2.54–7.88)***	2.62 (1.26–5.41)**	6.12 (3.37–11.14)***	2.6 (1.12–6.03)*
Specialised care for other psychiatric disorder <sup>c,d,e</sup>	3.64 (2.43–5.45)***	1.71 (1.05–2.8)	2.65 (1.51–4.67)**	1.32 (0.66–2.63)	5.29 (2.92–9.55)***	2.44 (1.2–4.98)*
Specialised care for somatic conditions <sup>b,c,f</sup>	0.95 (0.65–1.39)	0.69 (0.47–1.01)	0.88 (0.53–1.47)	0.77 (0.45–1.3)	0.79 (0.44–1.41)	0.59 (0.32–1.06)
Previous episode of self-harm <sup>d</sup>	27.29 (17.94–41.5)***	15.78 (10.01–24.87)***	20.75 (11.65–36.97)***	13.17 (7.23–24)***	36.45 (19.67–67.55)***	19.71 (9.79–39.66)***

<sup>a</sup>Adjusted for all variables of the univariate regression, age, sex and marital status.

<sup>b</sup>Based on their prescription within a period of 3 months prior to suicide or end of study.

<sup>c</sup>Reference group: Non-use.

<sup>d</sup>Occurring during residence in the in the long-term care facility (LTCF) and up to 5 years prior the index date of LTCF residence.

<sup>e</sup>Anxiety, schizophrenia and substance use disorders.

<sup>f</sup>Cancer, cardiovascular, cerebrovascular disease or chronic pain.

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

some other setting, for example, while on leave from the facility. Our dataset lacks details regarding the place of death. A different study design would be needed to determine how residents gained access to lethal means.

#### 4.1 | Methodological considerations

The use of high-quality national registers is a main strength of this study. However, findings should be interpreted with certain limitations in mind. We were only able to identify psychiatric and somatic morbidities requiring hospitalization or specialized outpatient care. Milder or stable conditions would be managed by healthcare providers within the LTCF. The same would apply for persons with severe dementia or terminal conditions, with advance directives for palliative care in the LTCF setting. These types of situations cannot be captured with our study design. Despite our combination of multiple sources to identify persons with dementia, we acknowledge that our study design underestimated the prevalence of dementia as we could not identify those who were only managed by LTCF healthcare providers or those previously prescribed anti-dementia drugs whose treatment may have ceased due to lack of efficacy or side-effects.<sup>47</sup> Further, we have no objective measure of medication adherence. Use was based on filled prescriptions and some LTCF residents may not have taken the medications provided by staff. However, previous research has found that adherence to medications was higher in LTCF residents compared to community dwelling older adults.<sup>48</sup> Further, LTCF offer many factors promoting medication adherence.<sup>49</sup> Another consideration is that our regression analyses conducted in men and women should be interpreted with caution due to the low number of suicides in women and therefore low power. Moreover, while we adjusted our regression models with factors known to be associated with suicide, we could not account for behavioural factors or organizational factors related to the characteristics of the LTCF.

While the quality of reporting LTCF residence in the national register has improved with time, it is likely that some persons living in this setting were missed in our national data set. Also, even though the National Cause of Death Register covers all deaths in Sweden, LTCF suicides may be underreported. For example, a sudden death might be attributed to a pre-existing condition by the attending physician. If no post-mortem forensic examination is carried out, a self-poisoning death may be missed. This issue is attenuated somewhat by the inclusion of uncertain suicides in our study outcome. Finally, our study design did not enable identification of deaths due to indirect suicidal behaviour such as refusing medication or food.<sup>50</sup> Such deaths are not classified as suicide in the National Cause of Death Register.

There have been no substantial changes in the organisation of LTCF in Sweden since the end of the study in 2016. Results will be followed up in a new study that will examine data during and after the COVID-19 pandemic. Results of the current research cannot be extrapolated directly to other countries considering variations in the availability and organization of residential LTCF, the availability of care for mental health issues, and differences in medico-legal death

investigation systems. Future research should explore variation in suicide risk among different types of LTCF and in different geographical settings.

## 5 | CONCLUSIONS

Half of suicides occurred in the first year of LTCF residence. The increased risk of suicide in LTCF residents who were users of hypnotics suggest that more can be done to improve the mental health of older adults living in LTCF. The lower risk of suicide in antidepressant users is compatible with a positive effect of such agents in this population, although more research is needed to better elucidate the association between use of antidepressants and suicide in LTCF residents both with and without dementia.

Our findings provide an impetus to improve the quality of individualized care provided to the oldest residents of LTCF to prevent suicides. Further, we need to know more about staff knowledge and attitudes, in order to inform suicide prevention interventions in LTCF settings.

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## CONFLICT OF INTEREST

The authors report no conflicts with any concept discussed in this article.

## ETHICS STATEMENT

The study was approved by the Regional Ethics Committee in Gothenburg (Ethical approvals 111-15 and 735-17). Approval was also granted by the register holders and data were coded and anonymized by Statistics Sweden prior to statistical analyses.

## AUTHOR CONTRIBUTIONS

Khedidja Hedna designed and planned the study, organised data collection, participated in the statistical analysis and interpretation of the results, and drafted the manuscript. Johan Fastbom, Katarina Wilhelmson and Mattias Jonson contributed to the interpretation of the results, and participated in manuscript writing. Margda Waern is the principal investigator of the project. She acquired funding and contributed to the design and planning of the study, to data collection and interpretation, and she took part in the writing of the manuscript. All authors declare that they have reviewed and approved the manuscript prior to its submission.

## DATA AVAILABILITY STATEMENT

The datasets generated and/or analysed during the current study are not publicly available due to confidentiality as they include sensitive private information. Aggregated data may be available from Statistics Sweden or from the National Board of Health and Welfare upon request. Requests to access these datasets should be directed to <https://scb.se/vara-tjanster/bestalla-mikrodata/>, and <https://www.socialstyrelsen.se/statistik-och-data/bestalla-data-och-statistik/>.

## PATIENT CONSENT STATEMENT

The analyses were based on existing national register data; informed consent from participants was not required.

No consent was required from patients as the study was based solely on national register data. All data were matched by Statistics Sweden and analysed anonymously.

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## SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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