



Research Paper

Firearm suicides in Sweden

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ABSTRACT

In a setting with restrictive firearm laws, prevention of firearm deaths is challenging. Around 100 firearm suicides occur annually in Sweden, representing the most common manner of death from firearm use. In order to explore a possible correlation between firearm suicides and firearm availability, legality of firearm possession, and demographic and geographical factors, all firearm suicides in Sweden among adults during the years 2016–2017 were studied. Data were collected from the National Board of Forensic Medicine and the Swedish Police. In total, 221 firearm suicides were found. Most victims were male (99%) and half (49%) were ≥ 65 years old. Firearm suicide rates were positively correlated with firearm ownership rates in Swedish counties. Legal firearms (80%) and long-barreled firearms (76%) predominated in the overall material, but illegal firearms were common among young suicide victims (18–29 years) and in urban areas. Prevention work needs to emphasize strategies to reach firearm owners at risk of suicide. Local health and healthcare-related factors, as well as geographic and demographic factors, should be considered in tailoring such strategies.

1. Introduction

Suicide is a significant public health issue worldwide, and prevention of intentional self-harm is hence an important task for health care and the community at large.¹ Under the United Nations Sustainable Development Goals and the WHO Comprehensive Mental Health Action Plan 2013–2030,¹ global suicide rates need to be reduced by one third by 2030. Restriction of suicide means is one of the most commonly recommended prevention measures,¹ but suicide prevention is a complex issue and numerous measures are necessary for achieving this goal.

Firearms is a highly lethal method of suicide, with case fatality rates as high as 90%.² In Western countries, suicide tends to be the dominating manner of death among all firearm fatalities, with a proportion of 89% found in Switzerland, 75% in Sweden, and 62% in the US.³ In 2015, firearms was the suicide means in half (50%) of all suicides in the US, whereas this figure was 19% in Switzerland, 17% in Austria, 10% in Sweden, 7% in Denmark, and 5% in Spain.³

The availability of firearms varies between countries, due to differences in, e.g., firearm legislation, firearm-related activities, and cultural aspects. The risk of dying from firearm suicide increases with high firearm availability, unsafe storage practices, and a firearm culture with high societal acceptability of firearms, such as that in the US setting.⁴ In Sweden, with a population of ~ 10 million, 6% of the population possess a total of ~ 2 million firearms,^{5,6} mostly for hunting purposes.⁵

Identifying firearm owners at risk of suicide is a challenging issue,

not least in a setting with strictly limited firearm availability due to restrictive firearm legislation. Under the Swedish Offensive Weapons Act,⁷ a firearm license is granted by the police and a certified safety locker must be used for firearm storage. Furthermore, physicians have a duty to report to the police any patients not suitable for having a firearm license due to their mental or physical status. Firearm licenses are generally granted only to applicants aged ≥ 18 years. Penalties for illegal firearm possession and use have been strengthened in Sweden in recent years.⁷

Knowledge about firearm suicide and its relation to firearm legality in the European setting is limited and studies are scarce.^{5,8,9} To provide a basis for further prevention efforts, this study aimed to investigate i) the association between firearm suicides and firearm ownership, ii) the correlation between age, firearm type, and legality of firearm use in suicide, and iii) the origin of firearms in illegal firearm use in suicides.

2. Methods

National data regarding all registered firearm suicides in adults (≥ 18 years age) in Sweden from 2016 through 2017 were retrieved from the database of the National Board of Forensic Medicine. This authority is responsible for all medico-legal investigations of unnatural deaths in Sweden. The database contains demographic data, autopsy and police reports.

In total, 231 firearm suicides among adults were found. Ten suicides

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with a bolt gun were excluded, leaving 221 cases in the study sample. Variables collected from the database were: age, sex, date and place of death, cause of death, type of firearm, and information about circumstances. Age subgroups were 18–29 years, 30–44 years, 45–64 years, 65–84 years and ≥ 85 years, in accordance with the national suicide statistics for adults.¹⁰ The Swedish Police provided information on the number of licensed firearm owners by county (all counties are subject to the Offensive Weapons Act), if the firearm used was licensed to the victim, if the firearm owner's license had been revoked, and if a firearm used by an unlicensed victim was licensed to another person and stored in the safety locker by its licensed owner. In the present study, illegal firearm use was defined as the use of an unlicensed firearm or illegal use of a licensed firearm (firearm stolen or taken from a licensed owner), and legal firearm use as the use of a licensed firearm by its legal owner.

Information on population size and county population density was retrieved from Statistics Sweden.¹¹ SPSS (version 28) for Windows was used in statistical data analyses. A Spearman's rank-order correlation was used for analysis of the correlation between the county firearm suicide rate and the county firearm ownership rate for individuals aged ≥ 18 years and for all 21 Swedish counties. A chi-squared (χ^2) test was applied for the comparisons of differences between legal and illegal firearm use and between two age groups (18–64 years and ≥ 65 years). The cut-off of 65 years is the official retirement age in Sweden. Statistical significance was defined as a p-value < 0.05 .

This retrospective study involved register data about decedents only, and ethical approval was not required under Swedish law. Register data retrieval for research purposes was approved by the Swedish Police and the Swedish National Board of Forensic Medicine (Dnr X19-90291).

3. Results

In total, 221 firearm suicides occurred during 2016–2017. Almost all who died by firearm suicide (99%) were males. Only two females (1%) were found in the study material. The mean age was 61 years (median 63 years, SD 17.3). The number of suicides increased with age and almost half (49%) of those who died by suicide were ≥ 65 years old (Table 1).

Table 1

The number of firearm suicides by age subgroup, legal/illegal firearm use and firearm type in Sweden, 2016–2017.

	Legal firearm use N (%)	Illegal firearm use N (%)	Total N (%)
Age subgroup			
18–29 years	3 (2%)	6 (13%)	9 (4%)
30–44 years	23 (31%)	14 (31%)	37 (17%)
45–64 years	57 (32%)	9 (20%)	66 (30%)
65–84 years	81 (46%)	13 (29%)	94 (43%)
≥ 85 years	12 (7%)	3 (7%)	15 (7%)
Total N (%)	176 (100%)	45 (100%)	221 (100%)
Long-barreled firearm			
Age group			
18–64 years	71 (40%)	16 (36%)	87 (39%)
≥ 65 years	73 (42%)	9 (20%)	82 (37%)
Total N (%)	144 (82%)	25 ^a (56%)	169 (76%)
Short-barreled firearm			
Age group			
18–64 years	9 (5%)	13 (29%)	22 (10%)
≥ 65 years	19 (11%)	7 (16%)	26 (12%)
Total N (%)	28 (16%)	20 (44%)	48 (22%)
Information missing			
Age group			
18–64 years	3 (2%)	0	3 (1%)
≥ 65 years	1 (1%)	0	1 (1%)
Total N (%)	4 (2%)	0	4 (2%)

^a One military automatic firearm.

The smallest share of firearm suicides (4%) was among 18–29-year-olds (Table 1). Firearm suicide rate in males (per 100,000 males and by age subgroup) increased with age and was more than three times higher among ≥ 65 -year-olds than among 18–64-year-olds (Fig. 1). The cause of death was firearm injury to the head and/or neck in 85% of cases, to the chest in 12%, and to the abdomen in 3%. Most of the victims (72%) died indoors, 14% outdoors, 3% in a vehicle, and 3% in a hospital. For the remaining 8%, there was no information on place of death.

The annual mortality rate was 1.4 firearm suicides per 100,000 adults (the Swedish adult population averaged 7.95 million in 2016–2017). The annual firearm suicide rate (legal firearm use) was 18.3/100,000 licensed firearm owners. The county mortality rate (number of firearm suicides per 100,000 adults in a county) ranged from 0.7 to 5.3 and was lower in southernmost counties than in the rest of the country (Table 2, Fig. 2). The annual number of firearm suicides by county ranged from 0.5 to 16.0 (Table 2). The county firearm suicide rate was positively correlated with the county firearm ownership rate (Table 2). There was also a positive correlation between the county firearm ownership rate and the county firearm suicide rate for legal firearm use, but not for illegal firearm use (Table 2).

The share of legal firearm use in suicide was much larger (80%) than that of illegal firearm use (20%). Among illegal firearm use cases in both 2016 and 2017, the highest share of suicides occurred in Västra Götaland (22%) and Stockholm (20%), two large urban counties; the remaining cases were spread across 15 counties, with four counties having no such cases (Table 2). Legal firearm use was more common than illegal use in all age subgroups except 18–29 years (Table 1). There was a significant association between age group (18–64 years vs ≥ 65 years) and legal versus illegal firearm use [$\chi^2 = 4.284$, $df = 1$, $p = 0.038$]. The share of legal firearm use was larger in the age group ≥ 65 years, while the share of illegal firearm use was larger for ages < 65 years (Table 1). Among illegal firearm use cases ($n = 45$), 34 decedents were never licensed firearm owners prior to the suicide, and 11 were licensed owners whose license had been revoked.

Most firearms (76%) used were long-barreled, 22% were short-barreled, with information missing in 2% of cases (Table 1). All four cases where the firearm classification was unknown involved legal use. Most long-barreled firearms (85%) were legal, whereas almost half of the short-barreled firearms (42%) were illegal. Use of long-barreled guns dominated in both age groups (Table 1).

The origin of the firearm was unknown in 82% ($n = 37$) of illegal firearm use cases. In two cases, the firearm was stolen (4%), and in six cases (13%), the firearm was licensed to another person. In all but one case where the firearm was licensed to another person, the firearm had been kept in a certified safety locker (storage was unknown in the single case). The number of firearms confiscated (after the suicide) in illegal firearm use cases was one in 37 cases, two in four cases, and three in four

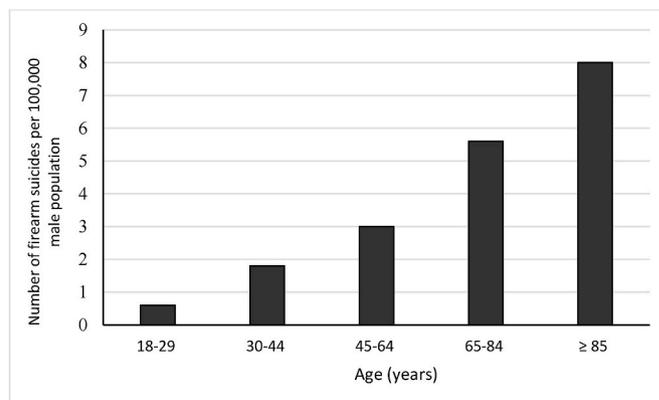


Fig. 1. The annual incidence of firearm suicides per 100,000 males by age group in Sweden, 2016–2017.

Table 2
Rates per 100,000 adults and correlation between the rates of firearm owners and the rates of firearm suicides (2016–2017), in 21 Swedish counties.

County	Adult population N	Firearm owners N	Firearm ownership rate	Firearm suicides N			Firearm suicide rate		
				Firearm use			Firearm use		
				Legal	Illegal	Legal and illegal	Legal	Illegal	Legal and illegal
Blekinge	126,923	9,771	7,698	1.5	1	2.5	1.1	0.7	1.9
Dalarna	228,416	24,768	10,843	5.5	0	5.5	2.4	0	2.4
Gotland	47,613	4,356	9,149	0.5	0	0.5	1.0	0	1.0
Gävleborg	229,010	20,323	8,874	4	1	5	1.7	0.4	2.1
Halland	253,318	15,766	6,224	3.5	0.5	4	1.3	0.2	1.5
Jämtland	103,637	19,403	18,722	5	0.5	5.5	4.8	0.4	5.3
Jönköping	278,547	20,969	7,528	3	1	4	1.0	0.3	1.4
Kalmar	195,534	17,886	9,147	1	1.5	2.5	0.5	0.7	1.2
Kronoberg	154,340	13,599	8,811	1	1	2	0.6	0.6	1.3
Norrbottn	204,515	36,066	17,635	5.5	0.5	6	2.6	0.2	2.9
Skåne	1,051,888	41,992	3,992	6	1.5	7.5	0.5	0.1	0.7
Stockholm	1,787,625	46,755	2,616	9	4.5	13.5	0.5	0.2	0.7
Södermanland	227,737	11,927	5,237	2	0.5	2.5	0.8	0.2	1.0
Uppsala	288,864	16,638	5,759	4	0.5	4.5	1.3	0.1	1.5
Värmland	226,200	23,067	10,198	6.5	1	7.5	2.8	0.4	3.3
Västerbotten	214,243	30,328	14,156	4.5	0	4.5	2.1	0	2.1
Västernorrland	197,056	21,285	10,802	4.5	1.5	6	2.2	0.7	3.0
Västmanland	213,869	10,140	4,741	1.5	0	1.5	0.7	0	0.7
Västra Götaland	1,332,599	62,945	4,724	11	5	16	0.8	0.3	1.2
Örebro	235,575	13,999	5,943	5	0.5	5.5	2.1	0.2	2.3
Östergötland	361,193	19,546	5,412	3.5	0.5	4	0.9	0.1	1.1
Correlation with firearm ownership rate							r = 0.738	r = 0.191	r = 0.778
							p < 0.001	p = 0.407	p < 0.001

N = annual number.

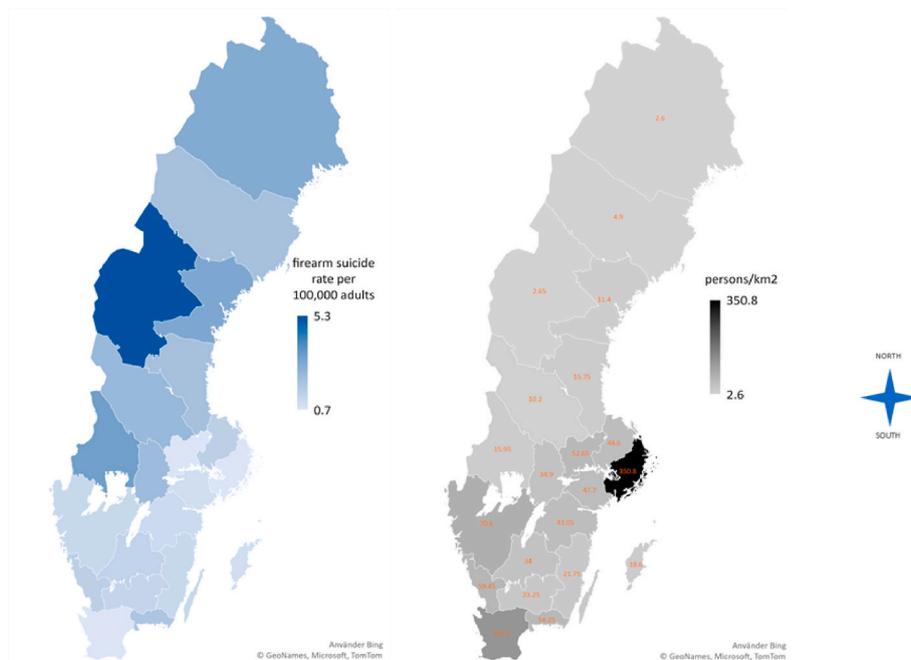


Fig. 2. Annual number of firearm suicides per 100,000 adults in Swedish counties (left) and population density in Swedish counties (right), 2016–2017.

cases.

4. Discussion

This national study of firearm suicides clearly demonstrates evidence of a positive correlation between firearm suicides and firearm ownership. Unique information regarding the origin of illegal firearms used in suicide is also presented.

The annual rate of firearm suicides in Sweden has remained stable from 2012–2013.^{5,11} While firearm owners represent 6% of the Swedish population,⁵ firearm suicides account for 10% of all suicides.³ A positive

correlation between the firearm ownership rate and the firearm suicide rate confirmed previous findings in Sweden,⁵ supporting the evidence that firearm availability is an important risk factor. Firearm ownership and availability have also in previous publications been strongly associated with the risk of firearm suicide⁴; most of the evidence presented pertains to the US^{12–15} and Australia,¹⁶ with less from European countries.¹⁷

The present study adds unique aspects of this relationship also at a county level in a European setting. Higher firearm suicide rates were observed in northern Swedish counties than southern ones, corresponding to the distribution of the overall suicide rate, especially among

men.¹⁰ However, explaining differences in overall suicide rates between countries is challenging.¹⁰ The rates of overall suicides were lower in urban than in rural municipalities with unfavorable socioeconomic factors (low employment, income, and education levels) in both sexes, but particularly males.¹⁰ Northern Swedish counties are also more rural than southern ones, a fact that may partly explain the differing county rates in firearm suicides. Males from rural settings in Australia and Finland have been shown to be at higher risk of choosing firearms as a means of suicide.^{16,18} Beyond socioeconomic factors, such variation between rural and urban settings may also be related to differences in availability of firearms and in prevalence of mental health disorders and health care availability.¹⁹ Hunting is a traditional activity in Sweden and most licensed firearms are for hunting purposes. The higher firearm ownership rates in the north of Sweden are thus expected, due to more hunting activities in these rural parts of the country. In addition, county differences in psychiatric health care availability have been reported in Sweden.²⁰ Health care availability and proximity may increase the likelihood of seeking care, an issue that may also affect the observed geographical variation in firearm suicide rates.

Individual risk factors (e.g., male sex, mental illness) may also predict the choice of a firearm as the means of suicide.⁴ In line with results of previous studies,^{3-5,21,22} males outnumbered females in firearm suicides in the present study. Firearm owners in Sweden are most often male²³ and males account for two thirds of overall suicides,¹⁰ explaining this sex asymmetry. The mean age was high, confirming the findings of a previous Swedish study,⁵ and the number of firearm suicides increased with age, as is seen for overall suicides in Sweden.¹⁰ A high rate among males ≥ 65 years old shows that this is an important risk group to consider in prevention work. In fact, the firearm suicide rate per 100,000 males was higher in the age group ≥ 85 years than in any other age group.

There are several possible explanations for these age differences. First, similar statistics have been presented regarding overall suicide rates in men,¹⁰ showing that the oldest men are at particular risk. Risk factors for firearm suicide would thus seem to differ between age groups²⁴ and aging itself implies social and health changes that entail an increased risk of both psychiatric and physical disorders.²⁵ It is also common that mental health issues in older people present (also) in the form of somatic findings (e.g., weight loss and fatigue),²⁵ which might explain the age variation in health care utilization prior to suicide, with older persons mostly utilizing non-psychiatric services.²⁶

Second, the age distribution of male firearm suicides may also be explained by a presumed higher firearm ownership prevalence among the elderly. A Swedish survey study reported a mean age of 53 years among adult male members of the Swedish Association for Hunting and Wildlife Management in 2009.²³ However, official statistics on the age distribution among firearm owners overall are missing.

Lastly, a greater proportion of young firearm owners might use an alternative suicide means (e.g., hanging) compared with older ones, as was observed in Queensland in Australia.¹⁶ As yet, there is no research supporting such a hypothesis in the European setting.

As expected, legal long-barreled firearms dominated in this Nordic setting, where most licensed firearms are for hunting purposes.^{5,18} Similarly, long-barreled hunting gun use in suicides increased with increasing rurality in the US.²¹ The present study found that only a small share of the firearms used in suicide were stolen, in accordance with the finding that theft of licensed firearms in Sweden is rare²⁷ – most likely due to the very strict firearm storage regulations. It is also probable that firearms for hunting and sports are not attractive for illegal activities, lowering the theft frequency. Still, some of the firearms used in suicide belonged to another person and should have been kept in a safety locker, a circumstance also reported in firearm suicides among children in Sweden.²⁸ Only the firearm owner should have access to the key/code to their firearm locker.

Interestingly, illegal firearm use was more common in younger ages in this study and the origin of the firearm was unknown in most of these

cases. The number of illegal firearms and their users is unknown, but a higher share of illegal firearm in suicides in urban areas may be expected, since the incidence of firearm violations is highest in these areas.²⁹ In addition, a recent report showed an increase in firearm homicides in Sweden, almost exclusively involving 20–29-year-old males.³⁰ Thus, illegal firearm users in this age group may be at risk of both suicide and homicide. However, the age differences in prevalence of firearm suicide with legal versus illegal firearm use need to be further investigated, including as regards possible differences in risk and precipitating factors.

Suicide prevention is a very complex issue including both general and specific measures regarding means, risk groups, and risk individuals. Preventing firearm suicides and helping firearm owners at risk choose life may lower overall suicide deaths. According to a systematic review, restricting access to specific suicide means in a setting where such means are common has been associated with a reduction of overall suicide rates (e.g., regarding firearms in Canada, barbiturates in Australia, vehicle emissions in England),³¹ indicating that means restriction may have broader positive effects. In the US, both firearm suicide rates and overall suicide rates declined with decline in household firearm ownership.¹³ However, when restricting lethal means, one suicide method may be replaced by another. Evidence of such substitution is lacking and studies with longitudinal data, including studies of possible confounders, are desirable.³¹ Information on firearm owners' use of suicide methods other than firearms is also lacking. It is less likely that suicide means other than firearms would be used by firearm owners – availability and knowledge of gun-handling have been cited as reasons to choose a firearm as the means of suicide.^{4,16} In Sweden, issuing a firearm license is contingent upon formal education, training, and examination.³² However, the issue of suicide means among firearm owners may vary between settings and needs to be further explored in Sweden and other European countries.

Interventions focusing on hunters, with information on safe storage practices, for instance through hunting forums, have been suggested.²¹ Providing information and education on suicide risks among firearm owners, e.g., through hunting associations, could constitute a prevention strategy.

Research on suicide preventive measures in older people has been limited.³³ According to systematic reviews, collaborative care (several care providers) in depression treatment,^{33,34} training of medical staff to recognize suicide risk factors among the elderly, and broad community-based initiatives, are some interventions that may reduce the risk of suicide in older people.³³ Furthermore, studies on a possible age-specific association between firearm policies and firearm suicides are rare, but indicate that age- and sex-specific policies may be necessary.³⁵ In the US, ages 45–64 years have been found to be predominant in firearm suicides in both sexes,²⁴ unlike what is seen in Sweden. Aside from different legislation, such differences between countries may also be explained by firearm availability and cultural variations. Thus, firearm control policy and prevention efforts specific for age and sex groups need to be adapted to local demographics and characteristics.

In addition, if no means are easily available to a person at risk, e.g., in a suicidal crisis or with an impulse to commit suicide, the crisis or impulse may subside before they access a means of suicide. One strategy for keeping firearms away from people at risk of suicide can be seen in the temporary firearm transfer laws in the US, but the procedure for returning the firearm to the owner after the suicidal crisis is unclear.³⁶ To the author's knowledge, there are no European studies evaluating involuntary or voluntary firearm transfer from a home to an authority and/or back to the owner. However, under Swedish law,⁷ physicians have a duty to report to the police all patients not suitable for having a firearm, due to patient's mental health issues and/or physical disorders. After a police investigation, a patient's firearm license may be revoked. It is not known how many lives are – or can be – saved by physicians' reports, and it is also not known if individuals choose a different means of suicide if their firearm license is revoked due to a physician's report to

the police. The number of suicide victims with a revoked firearm license was relatively small in the present study. In a previous Swedish study, no firearm suicide victims had been reported to the police under this law, although almost half of them had been in contact with health care due to, among other things, mental health problems.⁵ Further, diagnosed and treated mental health problems were common among illegal firearm users in suicides.⁵ However, the physicians' duty will not affect an illegal firearm user.

Physical health issues are the second leading circumstance in male firearm suicides, after mental health problems.³⁷ Firearm owners may be less likely to seek help for mental health issues⁴ than for physical problems. Physicians who have patients in somatic care must be aware of this comorbidity, as there is an opportunity to assess mental health problems and strengthen patient safety.

In summary, firearms represent a very lethal means of suicide and the prevention issue is challenging, not least in a society where firearm legislation is already very strict. Reduced availability of firearms in risk groups and among persons at risk of suicide needs to be emphasized. The framework for the physicians' professional duty should be evaluated and optimized to identify people at risk of suicide. It is also necessary to improve the collaboration between health care, firearm owners, social workers, and police. The strategies should be tailored for specific regional and demographic characteristics.

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