Firearm-Related Homicide in Sweden: A Latent Class Analysis of Suspected Offenders

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Abstract
Sweden has witnessed a significant increase in the rate of firearm-related homicide. We therefore aimed to study the characteristics of individuals suspected of homicide, attempted homicide, preparation to commit homicide as well as conspiracy to commit homicide with a firearm in Sweden. By using information from different registers, suspected individuals between 2000 and 2017 and aged 15 to 60 were included in the study. A total of 889 individuals were evaluated. A notable part were females (5.1%). Latent Class Analysis identified three classes, where two classes were high-offending-classes, and one class was a low-offending-class. The identification of these classes may be used for more effective preventive measures.

Keywords
firearm, homicide, violence, Sweden, offender profiling

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Introduction

The latest report by the global Small Arms Survey from 2017 stated that during 2016, >200,000 individuals were killed by a firearm in intentional homicides. The report also showed that Sweden had one of the most significant increases in the world of the proportion of firearm-related homicides; the increase was 52% when the years 2005 to 2010 were compared to the years 2011 to 2016 (McEvoy & Hideg, 2017).

While Sweden is one of the world’s most prosperous nations, and has historically had low numbers of deadly violence, the numbers are now, unfortunately, increasing. After 2014, Sweden has had a higher rate of deadly violence than its Nordic neighbors (Khoshnood, 2019). In 2019, Sweden witnessed a total of 111 cases of deadly violence (Lundbeck, 2020). While serious violent crimes like intimate partner homicide (Caman et al., 2017), child homicide (Hedlund et al., 2016; Sturup & Granath, 2015), and homicide because of intoxication (Granath, 2011) have decreased, firearm-related violence, including firearm-related homicides, have significantly and drastically increased in Sweden during the last decade (Granath, 2015; Khoshnood, 2018; Sturup et al., 2018). In 2017, the Swedish police stated, in a report concerning vulnerable areas in the country, that the threshold for using a firearm in a conflict had decreased and that the situation is highly serious (National Operations Department, 2017b).

As the rates of firearm-related violence and firearm-related homicide are increasing, it is of utmost importance to define the individuals behind these crimes, with respect to their characteristics. The objective of this study is thus to identify meaningful profiles of the individuals who, in Sweden between the years 2000 and 2017, were suspected of homicide with a firearm, attempted homicide with a firearm, preparation to commit homicide with a firearm as well as conspiracy to commit homicide with a firearm (in short: firearm homicide+).

In identifying various profiles, some common characteristics can be detected, which in turn may contribute to a better knowledge base about the possible suspects in order to tailor improved crime preventive programs (Kocsis & Palermo, 2007). Understanding suspect characteristics can also contribute to more effective crime investigations, as it may help the criminal justice system to narrow their search for offenders after a crime has taken place (Ainsworth, 2001). Furthermore, knowledge of offender characteristics can contribute to more precise offender risk assessments (Bonta, 2002). The present study will also add to the knowledge of firearm-related violence in Europe, which is also, unfortunately, increasing (Duquet & Van Alstein, 2015).
Firearm-Related Violence in Sweden

Statistics from the Swedish Police show that Sweden had a total of 324,306, and 334 shootings during 2017, 2018, and 2019, respectively. An absolute majority ($n = 688$; 71.4%) of the total number of shootings between 2017 and 2019 ($n = 964$) were conducted in Sweden’s three largest police regions, that is, Stockholm (Sweden’s largest city), West (where the city of Gothenburg, Sweden’s second largest city is located), and South (where the city of Malmö, Sweden’s third largest city is located). During these 3 years, a total of 394 individuals were injured and hospitalized because of a shootout incident. During the same period, a total of 130 persons were killed (Swedish National Police, 2020). According to the Swedish National Council for Crime Prevention, the rate of firearm-related homicide of the total rate of all homicides, has significantly increased from close to 20% in the 1990s and until 2011, to an all-time high of 40.5% in 2019 (Lundbeck, 2020).

A systematic review, which was published in 2018, evaluated the trends of firearm-related violence in Sweden with respect to rate, modus operandi, homicide typology, injury panorama, and causes of death. This review could only identify 25 studies and concluded that while knives/sharp weapons are the most common modus operandi in violent crimes, the use of firearms is highly increasing and is more lethal (Khoshnood, 2018).

In discussing the medical part of firearm-related violence, a recent study evaluating 235 individuals with gunshot wounds at the Karolinska University Hospital in Stockholm between 2005 and 2016, pointed out that the 30-day mortality was 12.8% ($n = 30$), and that the most common gunshot injuries were to the head/neck and chest (Bäckman et al., 2020). A previous study from Malmö focusing on victims of homicide and attempted homicide ($n = 19$), where at least one offender of that crime had been convicted at a court of law, also indicated that gunshot wounds to the head and the chest are the most common causes of death in firearm violence (Khoshnood et al., 2017).

A report by the Swedish National Council for Crime Prevention was just published after having been ordered by the Swedish government; the report suggests that the increase in Swedish homicide rates since 2013 may be a direct result of the increase in firearm-related violence in the country (Hradilova Selin, 2021). The report furthermore compares Sweden with 22 other European countries, foremost in the European Union. The average rate of homicide combined for these countries were four homicides per million people in 2017. During the same time period, Sweden had 11 homicides per million people. Europe as a whole had an average rate of 1.6 firearm-related homicides per million people while Sweden had almost four firearm-related homicides per million people.
The serious consequences of firearm violence, the current increase in firearm violence in Sweden and the relative lack of previous studies from Sweden call for further research on the offenders behind fire-arm related crimes in Sweden.

**Methods**

We analyzed data on individuals from Swedish population-based registers with national coverage. These registers were linked using each individual’s unique identification number replaced by a serial number to preserve confidentiality. This study was part of a larger project, which received ethical approval from the Regional Ethics Review Board in Lund, Sweden (Ethics approval No: 2012/795). The latest amendment was approved by the Swedish Ethical Review Authority (Ethics approval No: 2019-01588).

We used the Criminal Suspect Register that is regulated by the Criminal Suspect Register Act (1998:621). §1 states that anyone being suspected on reasonable grounds for a crime will be registered in the Criminal Suspect Register. §13 describes when a suspect is to be removed from the register: when the preliminary inquiry by the police has been dropped, an indictment by the prosecutor has been dropped, a court of law has passed a sentence convicting or acquitting the suspected individual, or when a suspect is requested to be extradited and this appeal has been refused or executed. In this study, we have used data from the register as available until 2017.

In order to be included in the dataset, the individual had to be registered as a suspect for a firearm-related homicide during the period 2000 to 2017 (firearm-related violence is defined by the following codes: 0312, 0313, 0325, 0330, 0335, 0336, 0337, 9391, 9392, 9397, 9398, 9399, 0301, 0302, and 0307). Furthermore, we required that the individual should be aged between 15 and 60 years old at the time of registration and, if born outside Sweden, they must have been registered in Sweden prior to age 16. In total, we included 889 individuals.

We also included individual information from the Swedish Crime Register, which includes convicted individuals, on White Collar Crimes, Property Crimes, and Violent Crimes. Based on information from other Swedish population-based registers, such as the Swedish nationwide health care registers, we also included information on Drug Abuse, Alcohol Abuse, and Psychiatric Disorders. For a definition, please see Supplemental Appendix. The registrations had to occur prior to the registration for suspected firearm homicide in order to be considered.

Previous studies have shown that the above-mentioned crimes as well as the other studied variables—drug abuse, alcohol abuse, and psychiatric
disorder—all correlate to violent crimes and deadly violence where the use of a firearm is prevalent (Bijleveld & Smit, 2006; Brody & Kiehl, 2010; Cornell, 1990; Gottlieb et al., 1990; Howitt, 2006; Khoshnood & Väfors Fritz, 2017; Khoshnood et al., 2020; Langevin & Handy, 1987; Pridemore, 2006; Rosenfeld, 2009).

**Suspected and Convicted Individuals**

The reason for focusing on suspects of firearm homicide+, and not only on individuals convicted of firearm homicide+, was due to limitations in the Swedish criminal registers. Unfortunately, information on whether the homicide was committed by using a firearm or not is only available for individuals being suspected of a crime and not for those who have been convicted for the same offence.

However, in an attempt to validate and strengthen our results based on the suspects, we performed a sensitivity analysis including those who had been convicted for a homicide within a year after they had been suspected of a firearm homicide+. We chose 1 year in order to allow for a legal investigation of the suspicion followed by a conviction. This much smaller cohort included 154 individuals.

**Latent Class Analysis**

Latent Class Analysis (LCA) was used to identify homogeneous classes of individuals suspected of firearm homicide+ based on the variables selected for this purpose. We therefore entered, into the LCA, six dichotomous variables (yes/no) for each of the following registration types: White Collar Crime, Property Crime, Violent Crime, Drug Abuse, Alcohol Abuse, and Psychiatric Disorder.

The number of latent classes indicated by the selected variables was determined by comparing model fit statistics between nested models. Improvement in model fit was indicated by smaller values of the log-likelihood, Akaike’s Information Criterion (AIC), and the adjusted Bayesian information criterion as well as the Entropy value. The number of classes is influenced by the number of included variables, so both empirical (improved model fit) and theoretical (model interpretability) aspects were also considered. Individuals were then assigned class membership based on their particular response profile’s resemblance/fit to the latent class. Based on the log-likelihood, AIC as well as the entropy, a model with three classes was selected (Table 1). The LCA was performed using the Mplus software (Muthén & Muthén, 2012).
We then included several external validators at the individual level (year of birth, sex, low education, age at first suspicion of firearm homicide, conviction for homicide, manslaughter or attempt to the same, resilience, IQ, school achievement, income, social welfare, and neighborhood deprivation) and at the parental level (Psychiatric disorder, White collar crime, Property crime, Violent crime, Drug abuse, Alcohol abuse). For further description of the external variables/validators (see Supplemental Appendix). Then, we used the external validators to investigate potential differences across LCA classes. Chi-square analyses were used to compare categorical variables and one-way ANOVA was used for continuous variables. The statistical analyses were performed using SAS 9.4.

**Results**

**Descriptive Data**

A total of 889 individuals suspected of firearm homicide were included in the study (Table 2). Only a small number of these suspects \((n=154; 17.3\%)\) were later convicted of homicide. Although the majority of the suspects were male \((n=844; 94.9\%)\), a notable part were females \((5.1\%)\). Just over half of the suspects \((n=444; 51\%)\) had low education.

A majority of the cohort was previously convicted of a violent crime \((n=580; 65.2\%)\) or property crime \((n=531; 59.7\%)\). A majority had also a known drug use disorder \((n=492; 55.3\%)\). The rates of psychiatric disorders \((n=144; 16.2\%)\) and alcohol use disorder \((n=276; 31.1\%)\) were also high among the firearm homicide suspects included in this study. Their resilience, IQ, and school achievement were also low compared to average levels and many of them were socially deprived; more than one third \((n=321; 36.1\%)\) had social welfare.

Information on convictions and psychiatric disorders was available for 877 of the suspects’ parents (Table 3). Property crimes \((n=293; 33.4\%)\) were the most common crimes among the parents, followed by violent crimes.
A little over one-fourth of the parents had psychiatric disorders \((n=253; 28.9\%)\). The corresponding percentages for alcohol abuse and drug abuse were 20.8% and 14.5%, respectively.

**Latent Class Analysis**

Table 4 shows the assignment probabilities as well as the item response probabilities by class for the three identified classes. Class B constitutes the highest share of individuals (40.9%) followed by Class A (30.5%) and Class C (28.6%). Class A and Class C are similar with regards to the rates of violent crimes, property crimes as well as white-collar crimes. Class C, however, has a higher rate of individuals with alcohol abuse (100%), drug abuse (80%), and psychiatric disorders (32.5%) in comparison to Class A where the corresponding rates are 0%, 67%, and 11.8%, respectively. Class B, on the other hand, has significantly lower rates of the studied crimes (violent crimes...
33.1%, property crimes 20.6%, and white-collar crimes 9.8%) as well as alcohol abuse (6%), drug abuse (29.4%), and psychiatric disorders (8.1%). In summary, Classes A and C can be classified as high-offending classes while Class B can be classified as low-offending.

Table 5 shows a comparison between the classes based on the external validators. Most of the comparisons were statistically significant. Class B had a substantially higher rate of female suspects (10.4%) than Class A (1.1%) and Class C (1.9%). The rate of low education was also considerably lower in Class B (38.3%) than in Class A (56.8%) and Class C (61.9%).
Similarly, the rate of individuals receiving social welfare was lower in Class B (25.6%) than in Class A (41.1%) and Class C (43%). Class C was also constituted by around 5 year older individuals (mean year of birth is 1976) than those found in Class A (mean year of birth is 1981). Comparing the proportion of suspects by parental characteristics, there were statistically significant differences in the rates for violent crimes, psychiatric disorders, and alcohol abuse; these rates were lower for Class B in comparison to Classes A and C.

Because of the large age range among the individuals included in our cohort, we also show descriptive statistics of the three classes based on the year of birth, age at registration as well as year of registration (Table 6). The sensitivity analysis of the 154 individuals convicted of homicide within 1 year of the suspicion for firearm homicide + revealed two high-offending and one low-offending class with patterns of the other characteristics that, to a large extent, resembled those for the suspects (data not shown in tables).
Discussion

We aimed to identify classes of individuals who were suspected of firearm homicide using Latent Class Analysis. Our main findings are the identification of three classes of suspects, and a higher rate of female suspects than we expected.

Three Classes of Suspects

Classes A and C were considered as high offending compared to Class B. Despite some differences between Class A and C, in regard to the other variables, they both had considerably higher rates of previous criminality in comparison to Class B. For example, in regard to prior violent crimes, the rates were 87.9% and 87.2% for Class A and C, respectively, while the rate in Class B was 33.1%. Although the rate in Class B was lower than in the other two classes, it is still much higher than in the general population.

Firearm homicide is a serious violent crime, hence it is no surprise that such a high proportion of the individuals in the three classes (a total of 65.2% of the total cohort) have previous violent crime convictions. Studies have shown that a history of previous crimes, and especially violent crimes, is a strong and important risk factor for committing other serious violent crimes.

Table 6. The Three Classes Based on Year of Birth, Age at Registration, and Year of Registration.

| Year of birth  | Class 1 (%) | Class 2 (%) | Class 3 (%) | p-Value |
|----------------|-------------|-------------|-------------|---------|
| 1943–1972      | 18.1        | 23.7        | 33.7        | <.0001  |
| 1973–1981      | 28.6        | 16.3        | 27.5        |         |
| 1982–1988      | 26.5        | 26.2        | 23.6        |         |
| 1989–2000      | 26.8        | 33.8        | 15.2        |         |
| Age at registration |           |             |             |         |
| 15–21          | 17.4        | 29.9        | 4.6         | <.0001  |
| 21–26          | 33.3        | 29.0        | 26.4        |         |
| 26–34          | 30.1        | 18.6        | 33.7        |         |
| 34–60          | 19.2        | 22.5        | 35.3        |         |
| Year of registration |         |             |             |         |
| 2000–2002      | 20.3        | 16.9        | 20.2        | .5420   |
| 2003–2008      | 29.4        | 28.2        | 25.2        |         |
| 2009–2012      | 23.6        | 28.5        | 24.0        |         |
| 2013–2007      | 26.7        | 26.4        | 30.6        |         |
The identification of three classes, where two (classes A and C) were high-offending and one was low-offending (class B), is consistent with our previous studies in regard to deadly violence (Khoshnood et al., 2020) as well as rape (Khoshnood et al., 2021a, 2021b). In these studies, we used LCA and could reveal that a non-negligible part of the cohort are constituted by individuals who commit serious violent crimes without previously having been convicted for crimes or even been known to the authorities. While our study is the first to distinguish different types of suspects of firearm homicide+, some previous international studies have shown that offenders of deadly violence and sexual crimes may be low-offending or high-offending (Fox & DeLisi, 2018; Vaughn et al., 2009, 2014). Our study showed that the largest group of suspects were low-offending (40.9%).

The individuals in the low-offending class (Class B) may be constituted by individuals who do not have a criminal lifestyle, but who may have committed a firearm homicide in the heat of the moment. In addition, Class B constituted of 10.4% females, who usually commit fewer crimes than males.

One reason why low-offending individuals in Sweden are able to use a firearm in a crime may be the unfortunate situation that Sweden has a serious problem in regard to illegal firearms, as a firearm may be relatively easy to get hold of and used in different crime typologies (Khoshnood, 2017; Khoshnood et al., 2017; Khoshnood, 2018; Khoshnood & Väfors Fritz, 2017; Rikspolisstyrelsen & Tullverket, 2014; Savona & Mancuso, 2017; Swedish National Police, 2020).

Scholars state that there has been a threefold increase in the rate of firearm-related violence in Sweden during the past two decades and conclude that it is related to the establishment of gangs and the increase of gang criminality (Khoshnood, 2017; Khoshnood & Gerell, 2019). Even though Sweden has had problems with criminal gangs as long back as during the 1940s, it was during the 1980s that organized crime became a fact of life in the country. Shortly after that, in the 1990s, Sweden witnessed the establishment of outlaw motorcycle clubs. Criminal street gangs, which today are those most active with respect to firearm-related violence, were established in Sweden in the late 1990s (Rostami, 2016, 2017). In addition, the police state that gang criminality, foremost related to the sale of drugs, is the main reason that the violence between criminals has become more serious and violent, similarly to their persistent use of firearms (Gerell et al., 2021; National Operations Department, 2017a). Another potential reason is the gangs’ desire to revenge a shooting. A study evaluating the role of near-repeat shootings, in Sweden between 2011 and 2015, found that in both Stockholm and Malmö there was
a fourfold increase for a new shooting incident within 100 m and 2 weeks after a prior shooting (Sturup et al., 2018). Not surprisingly, criminal gangs and loose networks are considered to be a major threat to Swedish democracy (Rostami et al., 2015).

Female Suspects

The absolute majority of our cohort was constituted by males \((n=844; 94.9\%)\). This is in-line with one of the best-known facts in the field of criminology; males are overrepresented in crime both as offenders and as victims (Howitt, 2006; Khoshnood et al., 2017; Liem et al., 2013). This is especially the case with respect to firearm-related violence (Granath, 2015; Khoshnood et al., 2017; Sturup et al., 2019).

However, the use of a firearm in committing a crime is not uncommon among females in the US. Planty and Truman (2013) stated in their report that the rate of firearm homicide for females in 2010 was 1.1 per 100,000 females while the rate of non-fatal firearm violence was 1.6 per 1,000 females. The rate is, of course, lower in Sweden. In this study, we found that 5.1\% \((n=55)\) of the cohort were females. Although small, it is surprisingly high for Sweden. A previous study that examined 1,463 homicide offenders in Sweden between 1990 and 2010, identified 1,463 males and 114 female offenders. Only nine females (0.6\%) had used a firearm in the homicide. The corresponding number for men was 222 (15.2\%) (Trägårdh et al., 2016). Another Swedish study, which focused on intimate partner homicide, studied 36 male and 9 female offenders. Six men (13.3\%, 6/45) used a firearm to kill their partner. The same figure for the females was one (2.2\%, 1/45) (Caman et al., 2016). One reason for the large discrepancy between our findings and the two studies presented above may be that we have focused on suspects of firearm homicide while the two studies mentioned above focused on convicted males and females.

While the reader should be cautious in interpreting our results on this matter, there is one indication that the use or the handling of a firearm is becoming more common among females in Sweden. Statistics from the National Council for Crime Prevention reveal that in 2019, a total of 5,492 individuals were suspected of violation of the Firearms Act, of which 634 (11.5\%) were females. The same figures for 2016, 2017, 2018 were 432, 539, and 580 respectively. Since 2016, the rate of females being suspected for this crime has thus increased by 31.9\% (Brottsförebyggande rådet, 2020). The Firearms Act regulates, among other things, the ownership of a firearm and ammunition. The Act states that an individual who possesses a firearm without having the right to it—having a license issued by the Swedish Police Authority—is
in violation of the Act and can be sentenced to imprisonment for a maximum of 3 years (Riksdagen, 2020).

Conclusion
As the rate of firearm-related violence has increased significantly in Sweden, we aimed to characterize individuals being suspected of firearm homicide in Sweden between 2000 and 2017. Our main findings were the identification of two high-offending-classes and one low-offending-class, and a higher rate of female suspects than we expected. Our identification of a low-offending-class creates an important yet difficult challenge for the police authority as well as other crime fighting and crime preventive organs of the country because they are not known by the authorities and do not comply with other offender profiles. More in-depth studies with respect to this group of individuals should be conducted.

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Supplemental Material
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