

Original research

## Self-poisoning across ages in men and women – Risk for suicide and accidental overdoses

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**Abstract:** Self-poisoning with licit or illicit opioids, alcohol or other prescribed drugs affects mostly young people, but also older patients are at risk for self-poisoning and suicide.

This study investigates suicide methods and drugs involved in 2342 Swedish patients and compares different age categories regarding drug use and causes of death included suicide.

All consecutive patients who had been treated for self-poisoning at the emergency department at the Karolinska University Hospital, from 1994 to 2000 were followed up until year 2006 for mortality. Of the whole cohort of 2342 (943 men and 1299 women) at an average age of 38.74 years at admission, 122 (5.2%) had committed suicide during the follow-up period. Standard mortality ratio (SMR) was highest (SMR=70.89) in patients older than 55 years, followed by the youngest age category (15-35 years) (SMR=61.95). Poisoning as suicide method was most common in the younger age categories, while violent methods in older ages. The drugs involved in the suicide cases were predominantly prescribed or illicit opioids in the youngest ages, while alcohol and medications were most common in the elderly.

Patients presented to emergency department due to self-poisoning are at high risk for subsequent suicide in comparison with the general population. Women had significantly lower suicide rate, but no differences between men and women were found concerning type of suicide methods. Patients at emergency department due to poisoning should be offered treatment and follow-up for both drug abuse but also for psychiatric problems in order to prevent repetitive overdoses, suicides and other deaths.

**Keywords:** Age, alcohol, opioids, self-poisoning, suicide.

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Self-poisoning is a serious problem worldwide. WHO estimated that more than 800 000 persons die by suicide or 11.4 per 100.000 persons per year (WHO, 2014). Illicit and prescribed opioids including heroin have increased during the last decade. From 2000 to 2013, the age-adjusted rate

for drug-poisoning death increased from 0.7 to 2.7 per 100.000 inhabitants. An increase of average 6 % per year was observed from 2000 to 2010 and 37 % per year from 2010 to 2013 (Hedegaard et al., 2015).

Nearly 1 000 persons died in 2013 due to self-poisoning, 10,000 had been treated at hospital and 15,000 had visited an Emergency Department (ED) because of self-poisoning in Sweden with a population of about 10 million, (Swedish Civil Contingencies Agency, 2014). The most common

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means were self-poisoning with alcohol and illicit drugs.

Young people are at high risk for suicide, which was ranked as the second leading cause of death in 15-29 years young people in 2012 (Kutcher et al., 2008; WHO, 2014). Self-harm is a serious risk factor for suicide which often occurs shortly before the fatal self-poisoning (Hawton et al., 2003; Stenbacka & Jokinen, 2015; Jokinen et al., 2016). McMahon et al., (2014) found that drugs involved vary both geographically as well as availability and trends in prescribing. Other studies have shown that people who experienced self-poisoning have received more prescribed medications than the general population (Gjelsvik et al., 2012). A later study by Gjelsvik et al., (2014) claims that the total medication load is higher the year after self-poisoning compared to the year before indicating a high morbidity in these patients. That was especially significant for psychotropic medication (Gjelsvik et al., 2014). Other studies have found mental disorders to be evident in one of three patients irrespective of methods of suicide (Madsen et al., 2013; Chartran et al., 2016) and one third of the psychiatric admissions had a history of deliberate self-harm (Madsen et al., 2016). Alcohol use is often presented in self-poisoning with an estimation of 28-40% of the cases (Lo et al., 2003; Carter et al., 2005; Vaiva et al., 2006).

In this study we aimed to investigate suicide methods and drugs involved in the cohort of 2342 consecutive patients with self-poisoning and compare different age categories regarding drugs involved and causes of death included suicide. We also studied type of drugs involved in fatal accidental poisonings.

## Method

All consecutive patients who had been treated for self-poisoning at the emergency department at the Karolinska University Hospital, from January 1, 1994 to 31 of December 2000 were followed up until 1 January 2006 for mortality. The mean age of the patients was 38.74 years (SD=17.94) when enrolled in treatment.

The mean follow-up time was 6.97 years (SD=2.24, range: 0-11 years). A total of 365 persons had died during this period and the causes of death were obtained from Statistics Sweden which keeps the National Swedish Cause of death register for the National Board of Health and Welfare (Cause of Death register, 2009). Most of the death cases

(67%) had undergone forensic autopsy. The other death certificates are based on data from hospitals and Forensic Medicine. The Regional Ethical Review Board in Stockholm did not find any objections to the study (Dnr.98-117).

## Statistical analyses

Standard mortality ratio (SMR) was calculated for mortality, by standardizing against the general population for age, both sexes, catchment area and study period, expressed as SMR, with 95% confidence intervals (95%CI).

Kaplan Meier survival curves were conducted for suicide in both men and women and violent suicide methods in the three age categories: 15-34 years, 35-54 and 55+.

Chi-Square tests were conducted when compared different age categories according to methods of suicide, expressed as p-value.

## Results

Of the whole cohort of 2342 (943 men and 1299 women) presented at Emergency Department (ED) after self-poisoning, 122 (5.2%) had committed suicide during the follow-up period (Table 1). The proportion of suicide as a cause of death was 33.4 % (122/365). Men had significantly higher rate of suicide than women (6.57% vs. 4.27%) ( $p < 0.05$ ). Figure 1 shows the survival rate of suicide in men and women in which the men's survival curve declined steeply at the beginning of the observation period. The mean age at suicide death was 45.04 years, SD=16.75. The average age was 38.74 years at admission, in which the women were in average one year younger than the men (38.17 vs. 39.58), (Table 1).

When comparing suicide with the general population according to age and catchment-area and study period, the standard mortality ratio (SMR) with 95% confidence intervals for the three age categories (15-34, 35-54 and 55 years or older) were: SMR=61.95 (95%CI, 60.0-63.9), SMR=57.30 (95%CI, 42.46-72.13) and SMR=70.89 (95%CI, 54.39-87.39), respectively.

Poisoning was the most common method of suicide in all age-categories (Table 2).

The youngest patients were more likely to use poisoning than the older age categories ( $p=0.026$ ), while the proportion of hanging was highest in older persons (23.98% vs. 15.38% and 11.36%) ( $p=0.43$ ) and that was also the case for drowning, 23.08% versus 7.69% and 4.55 %, respectively ( $p=0.033$ ).

Table 1. Age at admission and suicide in different age categories in 2342 men and women

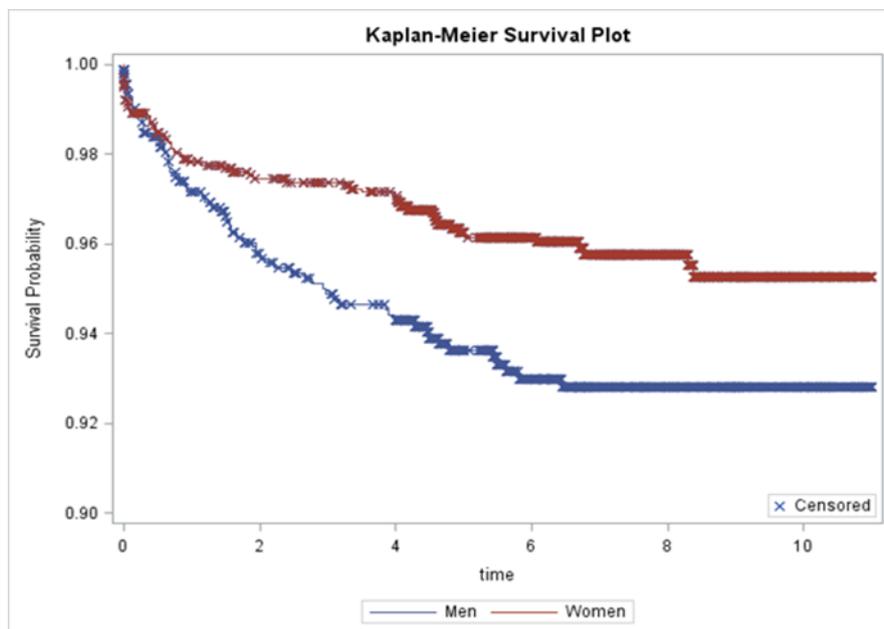
	Men	Women	Total
Number %	943 (40.3%)	1399 (59.7)	2342
Age categories			
15-34	406	713 (63.2%)	1119
35-54	378	458 (54.78%)	836
55+	159	228 (58.9%)	387
Age mean (SD)	39.58 (SD=15.89)	38.17 (SD=17.94)	38.74 (SD=17.94)
Suicide	N (%)	N (%)	N (%)
Age			
15-34	22 (5.42)	22(3.09)	44 (3.93)
35-54	27 (7.14)	25(5.46)	52 (6.22)
55+	13 (8.18)	13 (5.70)	26 (6.72)
Total*	62(6.57)	60 (4.27)	122 (5.21)

(\*) chi square=5.961, p= 0.015.

Table 2. Suicide methods in different age categories

Suicide methods	Age 15-34 years N=44 %	Age 35-54 years N=52 %	Age 55+ years N=26 %	Sign p-value
Poisoning	77.27	59.62	46.15	P=0.026
Hanging	11.36	15.38	23.98	P=0.43
Drowning	4.55	7.69	23.08	P=0.033
Train	2.27	11.54	0	P=0.05
Shooting	2.27	0	3.85	P=0.41
Others	2.27	5.77	3.85	P=0.69

Figure 1. Suicide in men and women during follow-up



The Kaplan-Meier analyses (Fig.2) demonstrates that the patients between 15-34 had the highest survival rate of suicide by violent methods, while the oldest age category died more frequently of violent suicide methods. Opioids were the most commonly used drug for

self-poisoning in the youngest age-category, while alcohol use in those 35-54 years of age (Fig.3). In the youngest age-category, illicit drugs were most prevalent, while in older categories alcohol and other prescribed medications were more prevalent.

Figure 2. Violent suicide method in different age groups

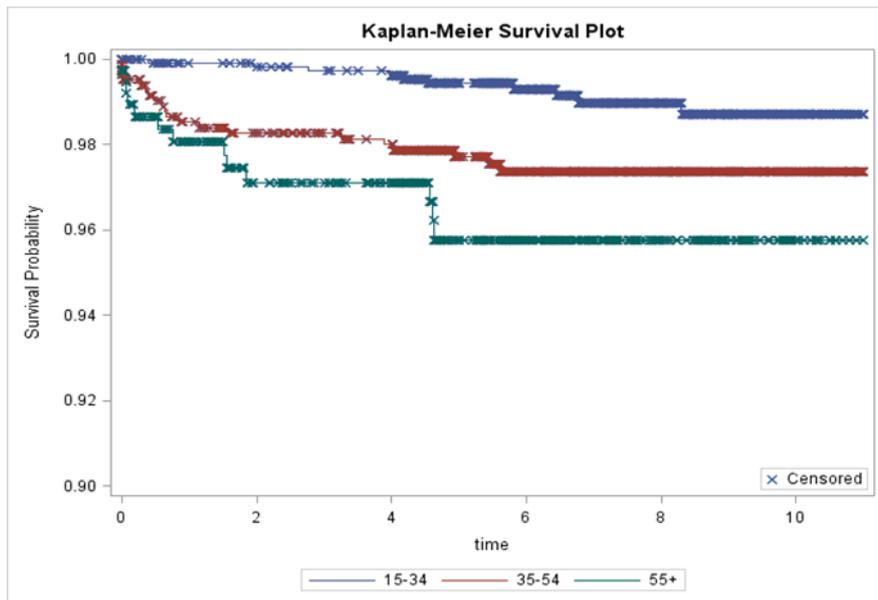
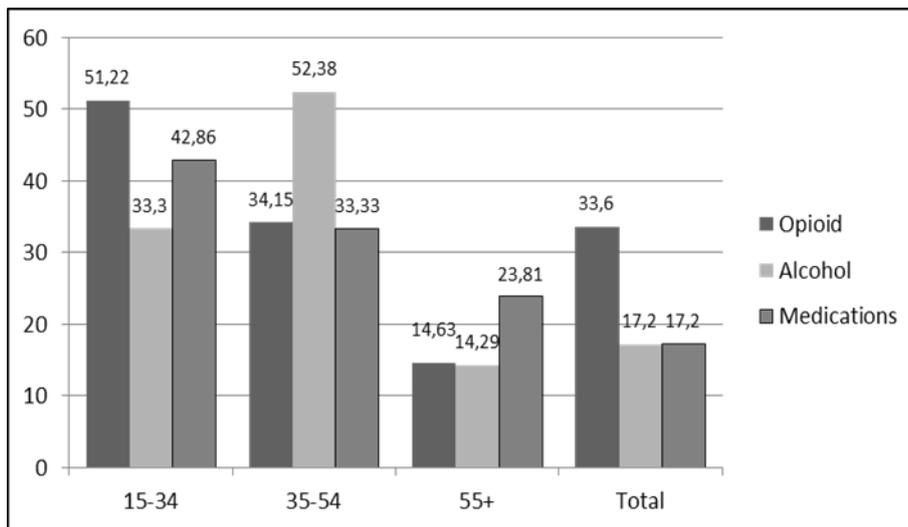


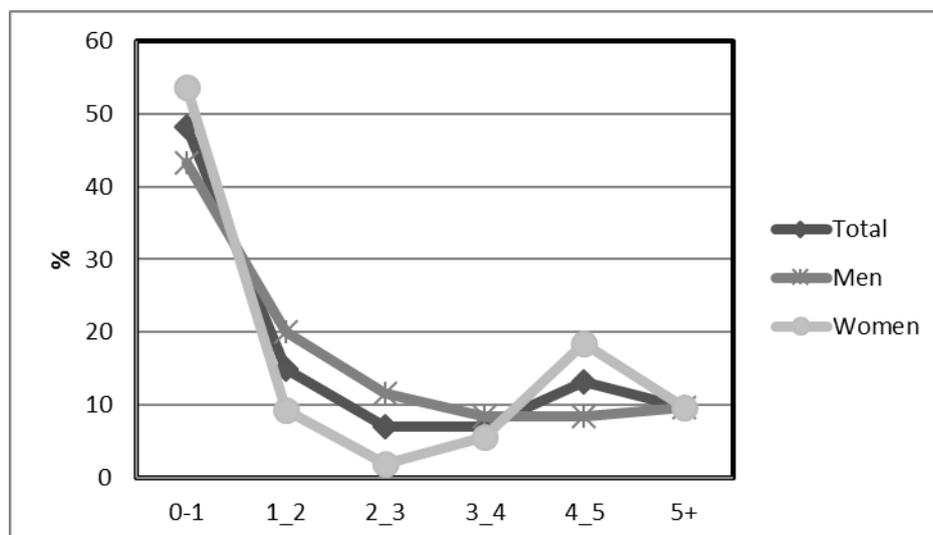
Figure 3. Substances involved in suicide by age. Percent



Multiple drugs (2+) were evident for nearly one third (26 %) of the patients. A large proportion of those who had used violent methods had combined suicide method with poisoning (42%). For example, more than half of those who had committed suicide by drowning had also taken other substances (61%) such as alcohol and opioids.

Nearly half (48.3%) of the suicide cases occurred in the first year after the admission to ED because of self-poisoning and 72% during the first two years. However, the risk of suicide persisted throughout the entire observation period. Nearly 20 percent of the female suicides occurred after four years (Fig.4).

Figure 4. Time-lag between admission and suicide.



#### Accidental overdoses

Thirty four persons (5 women and 29 men) had unintentionally died due to overdoses. The differences between men and women was significant ( $p < 0.0001$ ). The drugs involved were heroin, other opioids and alcohol. Most of the overdoses were with multiple drugs. The age at death due to accidental overdoses was 41.5 years ( $SD = 10.37$ , range: 22-62 years).

The risk for accidental overdose was highest for the age category 35 to 54 years ( $SMR = 246$ , 95%CI, 216.15-277.75), while the youngest patients (15-34 years) had the lowest risk ( $SMR = 125$ , - 51, 95%CI, 103.55-147.47). The oldest age category had the risk:  $SMR = 145.39$ , (95% CI, 121-169).

Other causes of deaths: circulatory diseases ( $n = 85$ ), tumor diseases ( $n = 36$ ), respiratory diseases ( $n = 38$ ) and accidents ( $n = 8$ ) were the most common causes of deaths. The deaths due to natural causes were evident for 1.86% in the youngest age category, 9.95% in patients 35-54 and 40.17% in the oldest age category. The risk ( $SMR$ ) for natural causes of death was 5.39, (95%CI, 0.841-9.95) for the youngest age-category (15-34 years), followed by 38.03, (95%CI 29.94-50.11) for patients 35-54 years and 12.87, (95%CI 5.83-19.90) for the oldest patients.

#### Discussion

In this study we investigated the risk of suicide and the choice of suicide method after self-poisoning in a consecutive cohort of 2342 patients admitted to ED in Stockholm with a follow-up of about 7 years. In the present study, the proportionate mortality (the percentage of the dead who died by suicide) was 33.4% of all deaths among patients admitted to ED, which is high. We found, as expected, that

men died significantly more often of suicide than women and that was true in all age categories. However, women were more in numbers than the men in the cohort (59.7% vs.40.3 %) which is well in line with the literature of gender differences in suicidal behavior (Bertolote & Fleischmann, 2002; de Beurs et al., 2016; Canner et al., 2016). It may indicate that women search treatment more often which have been demonstrated in previous studies (Reith et al., 2003; Peiris-John et al., 2013).

Self-poisoning seems to be often a repetitive behavior, which in turn increases the risk of both intentional and non-intentional overdoses (Kapur et al., 2002; Owens et al., 2002; Reith et al., 2004; Carroll et al., 2014; Finkelstein et al., 2015). In this consecutive cohort of patients presenting at ED after self-poisoning, over 63% had used poisoning as suicide method and 9% had died due to accidental overdoses mainly due to heroin, other opioids or alcohol or a combination of these drugs. The methods of suicide seem to vary between different countries and different ages (WHO, 2016), but self-poisoners are considered at high risk of suicide with poisoning as a suicide method. In a systematic review by Owens et al., (2002), it was found that a quarter of suicides was preceded by non-fatal self-harm in the previous year and another study showed that half of the suicide cases had previous experience of non-fatal self-harm and shortly before a fatal act (Gairin et al., 2003; Geulayov et al., 2016).

In this study, younger patients used significantly more often poisoning as suicide method in comparison with the elderly who used more violent methods i.e. drowning, hanging etc. Our finding is in line with reports from register based studies reporting that over 80% of elderly suicide

victims had committed suicide using a violent method (Karvonen et al., 2008). Further, illicit drugs as heroin were more common in the younger ages, while alcohol was more common in the older suicide cases. Notably, combinations of both violent methods and poisoning were common in suicide cases in this study.

Research has claimed that self-harm including self-poisoning is associated with not only suicide but also other negative outcomes such as poorer physical and mental health and natural causes of deaths, which mostly affects older people (Carter et al., 2005). Circulatory diseases, cancer, respiratory diseases and accidents were common natural causes of deaths in this study. The risk for natural causes of death was mostly elevated for patients in the age-category 35-54 compared to the general population (SMR=38.03). This finding indicates that self-poisoning is associated not only to suicide but also to higher risk of dying of natural causes (Karasouli et al., 2011). However, even though the risk of natural causes of death was elevated even in the youngest age-category, the finding was not significant due to the relatively low number of events leading to low power to detect the risk.

We found high risks (SMRs) of suicide when compared with the general population. That was true for all age categories, but the oldest patients (55+) carried the highest risk (SMR=70.89). The youngest age group had more than 60 times higher risk to die due to suicide compared to the general population (Owens et al., 2002; Jokinen et al., 2016).

Accidental overdoses, both fatal and non-fatal, seem to be common in poly drug users, often opioids with different combination of other drugs such as benzodiazepines, central stimulants and other drugs (Darke et al., 2014). We found that 9% of all death cases were accidental self-poisonings. The risk for fatal accidental self-poisoning was high in all three age-categories compared to the general population. The highest risk had patients in the ages 35-54 years (SMR=246.95), which possibly could be explained by previous periods of substance abuse with several drugs involved, which increase the risk of both fatal and non-fatal overdoses (Gossop et al., 2002; Kerr et al., 2006). In Sweden, deaths because of overdose have increased during the last decade and the increase is mainly due to both licit and illicit opioids (Leifman, 2016).

Nearly half of the suicide cases occurred during the first year after admission, but the risk was elevated for a long period (Fig.2). For instance, females had a small peak after five years and their male counterparts after three years indicating that there

are other factors associated with the risk of suicide such as periods of substance use and mental health problems (Finkelstein et al., 2015). The results also indicate that the relevant authorities and healthcare institutions that meet patients with previous experience of self-poisoning should consistently work longitudinally with tertiary prevention (Finkelstein et al., 2015).

#### *Advantages and limitations*

The main advantages is the use of a consecutive cohort of all patients who sought treatment for self-poisoning at ED between the years 1994 and 2000 representing a more general cohort of severe overdoses regardless of intentions. Both men and women were included. The women were more in numbers that visited ED which has been demonstrated in prior studies (Towsend et al., 2001; Buykx et al., 2010). We have also included three age categories in the study which allows comparison between groups concerning suicide. Suicide attempt has been considered as the strongest risk factor for suicide, why the intention of self-poisoning is important in order to prevent later suicide (Darke et al., 2014; Runeson et al., 2010; Stefansson et al., 2012). We also analyzed the risk of natural causes of death, which gives a greater insight of causes of death for people with previous non-fatal self-poisoning. We had no knowledge of what type or combination of substances involved before the visit to the ED. Furthermore, the information of follow-up treatment of patients was lacking, which would have been valuable information for preventive measures.

#### **Conclusions**

In conclusion, the female patients had a lower (4.27%) suicide rate than men (6.57%), while no significant difference was found between men and women concerning methods of suicide.

The same pattern existed for the proportion of men and women who overdosed (0.3 and 3.1%). The youngest age group was more likely to use illicit opioids and poisoning as a method of suicide, while the older persons used more violent methods. Poly drug use seems to be common in self-poisoners and that increase the risk for accidental poisoning (Darke et al, 2014). Suicide death after self-poisoning was markedly increased compared to the general population, which also was the case for death due to accidental overdose and natural causes. This knowledge indicates a great need for both preventive measures but also monitoring and offer appropriate treatment such as drug treatment and if necessary referral to psychiatric counseling and treatment.

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