

Restrictions in Availability of Drugs Used for Suicide

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Abstract. Availability of drugs with high lethality has been hypothesized to increase the risk of self-poisoning suicides. A literature search concerning deliberate self-poisoning and the effect of restricting access to drugs was conducted, and the effect of restrictions in availability of barbiturates, tricyclic antidepressants, dextropropoxyphene, and weak analgesics was reviewed. The correlations between method-specific and overall suicide rates and sales figures for barbiturates, dextropropoxyphene, weak analgesics, and tricyclic antidepressants were reviewed. It is concluded that restriction in availability of drugs with high case fatality should be a part of suicide prevention strategies.

Keywords: suicide, Denmark, barbiturates, analgesics, carbon monoxide

There is huge variation in the use of methods for suicide all over the world. In the United States, more than half of all suicides are committed with firearms (National Center for Injury Prevention and Control, 2004), while in Southeast Asia, a similar figure accounts for pesticide suicides (Eddleston, Sheriff, & Hawton, 1998; Gunnell & Eddleston, 2003).

It has long been hypothesized that restrictions of means for suicide can positively influence suicide rates (Marzuk et al., 1992; Farmer & Rohde, 1980), and many studies have been carried out to elucidate the effect of restricting means for suicide. Some studies are based on ecological data, while some are based on data at the individual level. Some of the ecological studies evaluate the method-specific suicide rate and suicide rate before and after a change in legislation; others evaluate regional differences in the method-specific pattern in one country or between countries; still others evaluate method-specific suicide rates in specific professional groups. Figure 1 and Figure 2 show the time change in methods for suicide in Denmark for each gender. The decrease in suicide by household gas coincided with the detoxification of household gas in Danish cities; the decrease in suicide by car exhaust coincided with catalytic converters being mandatory for cars bought after 1991; the decrease in suicide with barbiturates coincided with restrictions in prescription rules in 1986, and the decrease in suicides with strong analgesics coincided with more strict rules concerning prescription of dextropropoxyphene being applied since 1987 (Nordentoft, Qin, Helweg-Larsen, & Juel, in press).

Availability of the means for suicide is definitely not the only factor determining suicide. Relying only on crude ecological data, it is possible, for instance, that in one country, restrictions seem worthless because other factors such as social disintegration work against the effect of restrictions. Yet, in another country the impression that restrictions have

a very strong effect may be false because they take place concomitantly with changes in other factors that have a beneficial influence on the suicide rate. In ecological studies, data should be analyzed in age- and gender-specific subgroups wherever possible in order to avoid, for instance, that a positive effect among middle-aged women of restrictions in availability of some specific drug is outweighed by an increase in hanging among young men. In this example, there might not be an overall change in suicide rate, but it would be wrong to conclude that method substitution was responsible for this lack of effect on the overall suicide rate.

When evaluating the effect of restricting the availability of means, it is obviously most important to restrict access to the means with the highest case-fatality rate. Case fatality is defined as:

$$\frac{A}{B}$$

where

A = Number of persons who died by suicide by method X
B = Number of persons who commit suicidal acts using method X (fatal and nonfatal cases)

In a study in seven states, Miller, Azrael, & Hemenway (2004) concluded that case fatality for all the evaluated methods was 13%, while it was 91% for firearms, 3% for poisoning/cutting/piercing, 80% for suffocation/hanging, and 30% for all other methods. In a study based on information from eight states, Spicer and Miller (2000) found that case fatality was 83% for firearms, 61% for suffocation/hanging, 66% for drowning/submersion, 2% for drug/poison ingestion, and 1% for cutting/piercing. When planning suicide preventive efforts, including restrictions of the means for suicide for each method, attention must

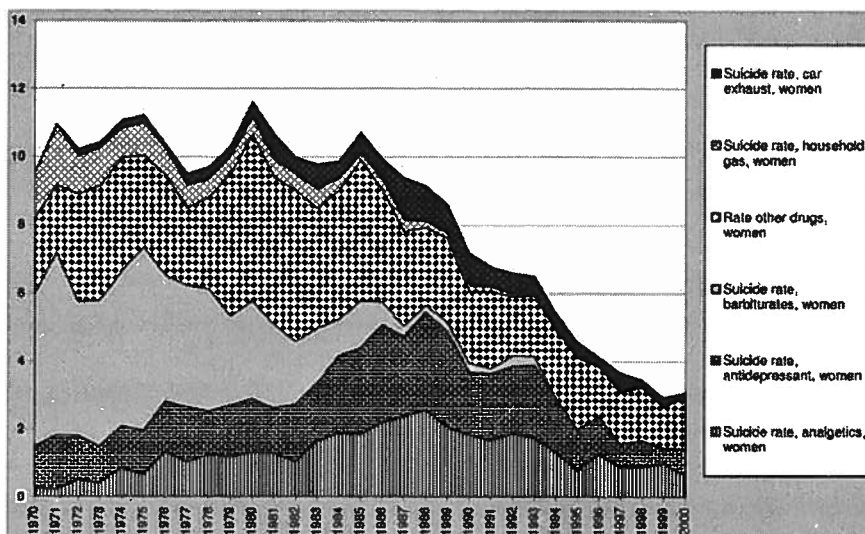


Figure 1. Method-specific suicide rates per 100,000 Danish women, from 1970 to 2000, self-poisoning.

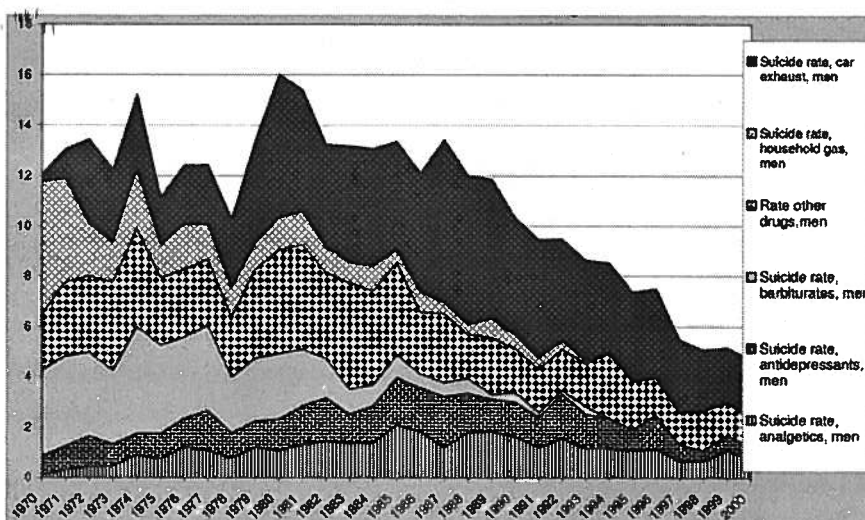


Figure 2. Method-specific suicide rates per 100,000 Danish men, from 1970 to 2000, self-poisoning.

be paid to case fatality and the proportion of all suicides using the method.

Drug Poisoning

In many countries, an increasing number of suicides with drugs was observed for several decades starting in 1950, a phenomenon which Whitlock named the drug-death epidemic (Whitlock, 1975).

This unfortunate time change was primarily because of increased method-specific suicide mortality with barbiturates, dextropropoxyphene, and tricyclic antidepressants, but also because of carbon monoxide from household gas.

A literature search concerning deliberate self-poisoning and the effect of restricting access to drugs was conducted

in the following databases, using the search terms listed below:

- PubMed: (Cause of Death (Mesh) OR "methods of suicide" OR "method") AND (Suicide (mesh) OR Suicide, Attempted (mesh)) AND (Centers for Disease Control and Prevention (mesh) OR "choice of method" OR "availability")
- Similar search criteria were used in Cinahl, Embase, PsycInfo, and The Cochrane Library.

This search was supplemented by hand search of relevant references and by searching the names of authors known to have this area as a research interest. The search resulted in a large number of abstracts, which were all read, and relevant studies were selected. In the following, the literature is divided into different compounds, and for each compound, the design of the studies is examined.

Several studies described increasing method-specific suicide rates with drug poisoning in the period; 1950s to 1980s. DeLeo et al. found that there was a 55% increase in suicide by poisoning (solids/liquids) in Italy from 1951–1961 to 1980–1990 (De Leo, Conforti, and Carollo, 1997), and Moens, Loysch, Honggokoeseomo, and van de Voorde (1989) found the same tendency in Belgium from 1968–1972 to 1978–1981, as did Whitlock (1975) in Australia, Bille-Brahe and Jessen (1994) in Denmark, and Gunnell, Middleton, and Frankel (2000) in England and Wales. In the last decades of the last century, a range of studies identified a falling trend in method-specific suicide rates with drug poisoning. McClure described reduced suicide rates by self-poisoning with solids and liquids in England and Wales from 1975 to 1984 (McClure, 1987). These changes were not a result of restrictions in legislation concerning any specific drugs, but it is likely that prescription habits among doctors and changes in cultural perception of methods for suicidal acts might have influenced the rates. When evaluating studies of suicide by drug poisoning, it must be kept in mind that there is a risk of misclassification between suicides and accidents.

Barbiturates

Several studies described the barbiturate epidemic. It is obvious that barbiturates as a means for suicide have played an important role in many countries, and that suicide with this method declined as this group of drugs became less commonly prescribed (Schapira, Linsley, Linsley, Kelly, & Kay, 2001; Whitlock, 1975; Retterstol, 1989; Carlsten, Allebeck, & Brandt, 1996; Cantor, 1989; Ohberg, Lonnqvist, Sarna, Vuori, & Penttila, 1995).

Few studies of legislation changes have been carried out, but our own study (Nordentoft, Qin, Helweg-Larsen, & Juel, 2006) revealed that the suicide rate with barbiturates decreased markedly after restrictions in prescription rules in 1986 without any indication of method switch. From 1986, barbiturates could no longer be prescribed as hypnotics in Denmark. However, the decline in barbiturate suicides began before legislation change, reflecting that, to a large extent, doctors had changed the prescription pattern before the new prescription rules were in force.

Several other studies investigated restrictions on the prescription and sale of barbiturates (Crome, 1993; Oliver, 1972; Carlsten et al., 1996; Retterstol, 1989), and where the method was common, the restriction led to reduction of the overall suicide rate (Oliver, 1972).

Dextropropoxyphene

In United States, Finkle (1984) found that suicides using dextropropoxyphene rose and fell from the early 1970s to the beginning of the 1980s. The same tendency could be observed in Norway (Retterstol, 1989). Carlsten et al. (1996) found that increasing rates of suicide using dextropropoxy-

phene were associated with increasing prescription rates. Our own study (Nordentoft et al., 2006) revealed that the suicide rate using dextropropoxyphene decreased markedly after the restrictions in prescription rules were made in 1987, without any indication of method switching. Since 1987, dextropropoxyphene could only be prescribed on the same conditions as strong analgesics, which require the National Board of Health to have copies of each prescription that is filled.

Tricyclic Antidepressants

Whitlock found increasing sales figures for tricyclic antidepressants to be associated with increased method-specific suicide rates with these compounds (Whitlock, 1975), as did we in the Danish study (Nordentoft et al., 2006), Carlsten in a Swedish study (1996), and Ohberg et al. in a Finnish study (1995). Buckley et al. found a large variation in case fatality for different tricyclic antidepressants, and venflaxin actually had higher case fatality than some of the least toxic tricyclic antidepressants (e.g., clomipramine and nortriptyline; Buckley & McManus, 2002).

Weak Analgesics

Carlsten et al. (1996) in a Swedish study found increasing numbers of suicides with paracetamol along with increased prescriptions. We (Nordentoft et al., 2006) found a weak but statistically significant association between sales figures of weak analgesics and method-specific suicide rates with analgesics.

There are only a few studies on the effect of restricting access to weak analgesics. In a comparison of data from the United Kingdom and France, Gunnell et al. (1997) found that these data add to a body of evidence that suggests that restrictions in the packet size of paracetamol could reduce suicide and liver failure related to paracetamol. Hawton et al. (2001, 2004) studied the effect on suicidal behavior of UK legislation (October 1998) limiting the size of packs of paracetamol and salicylates sold over the counter. The legislation limited pack size sold over the counter to 32 tablets in pharmacies and 16 in free sale. All packages should be blister-packed. Suicidal deaths from paracetamol and salicylates were reduced by 22% during the year after the change in legislation, and this reduction persisted for the next 2 years. Liver unit admissions and liver transplants for paracetamol-induced hepatotoxicity were reduced by around 30% for 4 years after the legislation. Quantities of paracetamol and salicylate tablets in nonfatal overdoses were reduced for 3 years after the legislation. Large overdoses were reduced by 20% for paracetamol and by 39% for salicylates in the second and third years after the legislation. Ibuprofen overdoses increased after the legislation, but with little or no effect on deaths. The effect on overall suicide mortality was not mentioned (Hawton et al., 2001), but the official statistics shows that

suicide rates in the UK increased during the 1990s but declined after 1998.

Method Substitution

As mentioned above, a number of studies have investigated the changes in method-specific suicide rates and showed as a consistent pattern that method-specific suicide rates decreased when sales figures or other changes revealed that the method became less available. In some cases, however, the positive development in one method-specific suicide rate was partly compensated by an increase in suicide rates with other methods.

When restricting methods for suicide, method substitution must be considered. When restrictions are limited to methods with high case fatality, the problem of method substitution seems to be negligible. If the case fatality of the method is low, it is necessary to consider the possibility that the suicidal person will choose a method with a higher case fatality. All the reports about restrictions successfully leading to lower suicide rates deal with methods with high case fatality. Only the study of restrictions in packet size of paracetamol and salicylates in UK considers a method with low case fatality (Hawton et al., 2001, 2004). The authors found that the method-specific suicide rate decreased, and the overall suicide rate declined from 1998.

The Danish study indicates that the decline in household gas suicides and suicide with barbiturates was partially substituted for by a period by rising rates of car exhaust suicides for men. However, the general pattern was that the steep decline in Danish suicide rates, especially for women, was to some extent explained by reduced rates of carbon monoxide suicides and suicides with barbiturates, tricyclic antidepressants, dextropropoxyphene, and benzodiazepine, which again were associated with sales figures or other measures of availability of the compound, see Figure 1 and Figure 2 (Nordentoft et al., 2006).

Gunnell reanalyzed the effect of method availability in England and Wales (1950 to 1975) and concluded that the accessibility of household gas containing carbon monoxide profoundly affected overall suicide rates; but in women and in younger men, the effect was partially offset by increases in drug overdoses (Gunnell et al., 2000).

Suicide Among Doctors

Several studies have indicated a high suicide risk among doctors (Carpenter, Swerdlow, & Fear, 1997; Hawton, Clements, Simkin, & Malmberg, 2000; Juel, Mosbech, & Hansen, 1997; Nordentoft, 1988; Kelly, Charlton, & Jenkins, 1995; Agerbo, Gunnell, Bonde, Mortensen, & Nordentoft, 2007). In some of the studies, it was possible to investigate method of suicide, and these studies revealed

that suicide by self-poisoning was responsible for the increased numbers of suicides (Hawton et al., 2000; Juel et al., 1997; Carpenter et al., 1997). This was especially pronounced in the study by Hawton (Hawton et al., 2000), where it was found that a large proportion of suicides among anesthesiologists involved the use of anesthetic drugs. Together, these studies support the notion that easy access to means for suicide increases suicide risk. However, knowledge about the lethality of the method will also differ between occupational groups, and doctors will have both easy access and a high level of knowledge (Nordentoft et al., 2006) of the effect of the chosen agent.

Does Choice of Method Mirror Suicidal Intent?

It is a widespread myth that choice of method mirrors the intention to die. However, studies of suicide after a suicide attempt have shown conflicting results concerning the predictive value of the dangerousness of the attempt with regard to later suicide. It is a consistent finding in studies worldwide that a greater proportion of female suicides involve overdose than male suicides, and male suicides more often involve fatal methods such as shooting, car exhaust, and hanging. Denning, Conwell, King, and Cox (2000) used data from a psychological autopsy study ($n = 141$) and showed that there was a strong association between gender and choice of method (violent vs. nonviolent) even after adjusting for intention to die, presence of psychiatric disorder, substance abuse, and sociodemographic variables. However, it can be hypothesized that a high number of women with low suicidal intent survived the suicidal act and were, therefore, not included in the above-mentioned study.

Gender Differences in Suicide Rate and Case Fatality

The distribution of methods for suicide and suicide attempt for men and women in Funen (a county in Denmark) in 2001 is shown in Table 1.

In Denmark, the national statistics for suicide attempts are incomplete, but in the Register for Suicide Attempts, data from the county of Funen is included, and data from this register were used to describe the distribution of methods for suicide attempts for men and women. The calculation of case fatality in Funen was based on data from the registers, and the estimates of case fatality for each method listed in Table 1 was drawn from Miller et al. (2004) and Spicer and Miller (2000). The calculated and estimated case fatality rates are not very different.

The overall case fatality for suicide attempts for men and women can be calculated, based on the figures in Table 1;

Table 1. Distribution of suicidal act on method for men and women

	Suicides, women, Funen, 2001	Suicidal acts, women, Funen 2001	Case fatality, women, Funen 2001 ^a	Suicides, men, Funen, 2001	Suicidal acts, men, Funen 2001	Case fatality, men, Funen 2001	Case fatality rate, County of Funen 2001	Estimated case fatality (Miller)
Other method	3	16	0.19	4	26	0.15	0.17	0.3
Drowning	6	9	0.67	3	7	0.43	0.56	0.6
Poisoning	10	331	0.03	7	224	0.03	0.03	0.02
Hanging	7	12	0.58	28	37	0.76	0.71	0.7
Cutting	1	86	0.01	2	96	0.02	0.02	0.01
Shooting	0	2	0	8	9	0.89	0.73	0.9
All	27	456	0.06	52	399	0.13	0.09	–

Based on data from Center for Suicide Research, suicides and attempted suicide from 2001 are included (www.selvmordsforskning.dk)

the result is 6% for women and 13% for men. Table 1 includes the distribution of all suicidal acts. The method-specific case-fatality rate was calculated for Funen in 2001. The gender differences in case fatality for each method are small, but overall the case fatality for men is twice as high as for women because a larger proportion of men use methods with high case fatality. It seems reasonable to conclude that the methods used for suicidal acts by women have a lower case-fatality rate than the methods used by men. It also seems reasonable to conclude that the differences in choice of method and differences in method-specific case-fatality rates are very important factors in identifying gender differences in suicide rates.

From a public health point of view it is encouraging that case fatality plays an important role, since it points to areas where effective interventions can be implemented in terms of restricting access to dangerous means for suicide. It is also encouraging because it indicates that suicidal impulses are temporary and can be stopped, reduced, or modified by the suicidal person or by interventions by others.

Recommendations Concerning Restrictions in Means for Suicide

Methods for suicide are different in different countries during different time periods. It is beyond doubt that not only the availability but also the awareness and cultural acceptance of a method determine whether it is frequently used. It is, for instance, obvious that suicide with car exhaust was introduced as a method for suicide after it had been available for decades. One can even speak of a method for suicide being marketed, as for instance asphyxia-suicide with plastic bags, introduced by Humphry in the book *The Final Exit*. As stated by Gunnell et al. (2000), accessibility to and the lethality of a particular method may have profound effect on the overall suicide rate. Such effects appear to depend on the popularity of the method, and the extent to which alternative methods that are acceptable to the individual are available. Therefore, when recommending restricting access to dangerous methods for suicide, avoiding

the "marketing" of lethal methods for suicide must also be considered.

Lester (1998) published a review that concluded by recommending a range of ways to limit access to lethal methods for suicide. These included strict gun laws, control of the carbon monoxide content of car exhaust and natural domestic gas, restricting access to tops of buildings, fencing bridges, limiting the packet-size of medication frequently used for suicidal acts, enclosing pills in plastic blisters, and removing lethal agents before releasing suicide attempters to their homes.

On the basis of the above-mentioned studies, the following recommendations are made: collect detailed information about specific methods used for suicide in cause-of-death-registers and adopt strict laws concerning firearms, make domestic gas without carbon monoxide content available, make catalytic converters mandatory and control carbon monoxide emission from cars and other vehicles, secure controlled environments such as hospitals and prisons with regard to possibilities for hanging, prescribe less toxic medication and small amounts of toxic drugs, and limit the packet size of over-the-counter sale of medication often used for attempted suicide.

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