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Factors associated with history of non-fatal overdose among opioid users in the Swedish criminal justice system

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Abstract

Background: Overdose (OD) is a common cause of death in opioid users. Also, many current opioid users report a history of non-fatal OD. The present study aimed to identify factors associated with a history of non-fatal OD.
Methods: A sample of 7085 Swedish criminal justice clients with alcohol or drug misuse was assessed, using the Addiction Severity Index. Subjects reporting use of opioids during the 30 days prior to incarceration were included ($n = 1113$). Relevant variables of misuse pattern, heredity, psychiatric symptoms and previous criminal charges were analysed in a logistic regression model.
Results: A history of non-fatal OD was reported by 55% ($n = 604$). The estimated contribution to the variance in OD history was 25% for variables describing misuse pattern, compared to 10% for psychiatric symptoms, 8% for heredity, and 8% for previous criminal charges. The final model included the following variables: history of injection drug use (OR 3.28), history of heroin use (OR 2.87), history of suicide attempt (OR 1.92), history of tranquilliser use (OR 1.91), being born in Sweden or other Nordic countries (OR 1.74), difficulty in controlling violent behaviour (OR 1.68), and paternal alcohol problems (OR 1.57).
Conclusions: Suicide attempts and difficulty in controlling violent behaviour were associated with history of non-fatal OD, independent of variables of misuse pattern. This may indicate a possible association with impulse control disturbances, and may have clinical applications. Country of birth and heredity of alcohol problems also had some influence. As expected, severity of misuse most strongly contributed to history of non-fatal OD.

Keywords: Heroin; Opioid; Overdose; ASI; Addiction Severity Index; Opiate

1. Introduction

Heroin overdose has received growing attention over the last decade, with the publication of a substantial amount of research, including several reviews (Darke and Zador, 1996; Warner-Smith et al., 2001; Sporer, 1999; Darke and Hall, 2003). Overdose (OD) is known to be a common cause of death in heroin users (Hulse et al., 1999; Fugelstad et al., 1997; Quaglio et al., 2001; Brugal et al., 2005). Also, several studies report that a large proportion of substance abusers have a history of previous non-fatal overdose (Darke et al., 1996; Gossop et al., 1996; McGregor et al., 1998; Pollini et al., 2006; Brugal et al., 2002; Powis et al., 1999; Seal et al., 2001; Warner-Smith et al., 2002; Bradvik et al., 2007b; Wines et al., 2007).

Several previous papers have described risk factors associated with heroin overdose, e.g. injection as the route of administration (Gossop et al., 1996; Darke et al., 2000). Lowered opiate tolerance at the time of heroin intake, because of recent detoxification, incarceration or abstinence for other reason, has been described as an important risk situation (Warner-Smith et al., 2001; Darke and Hall, 2003; Gossop et al., 1996; McGregor et al., 1998; Bradvik et al., 2007b; Darke et al., 2000; Strang et al., 2003). Seal and co-workers reported that overdose clients were more likely to report a history of detoxification during the past year (Seal et al., 2001). Overdoses have been reported to occur typically while the user is not in maintenance treatment (McGregor et al., 1998; Darke et al., 2000), and the user leaving treatment within the past year has been described as a risk factor (Davoli et al., 1993).

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The complexity of factors underlying heroin overdose has been illustrated by a significant overlap of toxicological findings between deceased 'overdose' patients and intoxicated heroin users who are alive (Darke et al., 1997). Autopsy findings often reveal other CNS depressants along with opiates. Concomitant intake of benzodiazepines or alcohol is commonly reported and is believed to increase the risk of fatal or non-fatal heroin overdose (Darke and Zador, 1996; Warner-Smith et al., 2001; Darke et al., 1996; McGregor et al., 1998). Clients with a history of overdose have been reported to have higher levels of alcohol consumption (Darke et al., 1996; McGregor et al., 1998; Powis et al., 1999; Seal et al., 2001; Kerr et al., 2007), and more commonly report use of benzodiazepines (Kerr et al., 2007). It has also been hypothesised that organic dysfunction, including hepatic and pulmonary failure, may contribute to heroin overdose (Warner-Smith et al., 2001). Gossop and co-workers also report another possible reason for overdose of heroin, i.e. taking a larger dose than normal (Gossop et al., 1996). Unexpected heroin purity has been proposed as a cause of heroin overdose, but more recent literature has stated that variations in heroin purity only play a moderate role in overdose fatalities (Darke and Zador, 1996; Darke and Hall, 2003). It has also been reported that some heroin overdoses are intentional, although this is a minority of cases (Gossop et al., 1996; Darke et al., 2000; Heale et al., 2003; Tobin and Latkin, 2003).

In the Swedish setting too, opioid overdose has been an important cause of death in substance users (Fugelstad et al., 1997, 1995; Steentoft et al., 2006). In a survey of fatal intoxications in Swedish drug addicts 1991–2002, opioids were the assumed cause of death in between 76 and 91% of cases, with heroin being by far the most common drug reported (Steentoft et al., 2006). In a Swedish sample of syringe exchange clients with heroin abuse, a history of non-fatal heroin overdose was reported by as many as 74% (Bradvik et al., 2007b).

Many risk factors have been commonly described, and the roles of misuse pattern (in particular polydrug intake and injection) and lowered tolerance in heroin overdose have been particularly well documented. However, less attention has been paid to other underlying traits of overdose patients, such as psychiatric characteristics and heredity. An association between depressive symptoms and a history of drug overdose has been reported (Tobin and Latkin, 2003; Wines et al., 2007), and suicide is markedly more common in opioid users than in the general population (Hulse et al., 1999; Wilcox et al., 2004). In a Swedish study, previous suicide attempts were more frequently reported among heroin users with a history of unintentional overdoses, compared to heroin users without overdose history, and the reporting of suicide attempts was more common with an increasing number of heroin overdoses (Bradvik et al., 2007a). From Australia, Darke and co-workers reported an association between recent suicide attempts and recent overdose in a sample of heroin users (Darke et al., 2004).

The present study investigates factors associated with previous non-fatal drug overdose among prison and probation clients with recent (before incarceration) use of opioids, examined with the Addiction Severity Index (ASI) (McLellan et al., 1980; McLellan et al., 1992). The aim of the study was to identify further characteristics of current opioid users with a history of non-fatal overdose, based on the hypothesis that, apart from misuse pattern, important underlying traits may separate overdose subjects from the rest of the group. We hypothesised that such underlying characteristics may be found among psychiatric traits such as impulse control disturbances and depressive symptoms, and also in criminal behaviour and heredity. ASI variables of relevance to these fields were included in this study, along with items describing misuse pattern (alcohol and drug use, injection drug use), age, gender and country of birth.

2. Methods

Since 2001, a growing number of units of the Swedish Prison and Probation Service, in different parts of the country, have routinely used the Addiction Severity Index (ASI), a semi-structured interview instrument for the assessment of alcohol- and drug-related problems (McLellan et al., 1980, 1992). ASI assessments have been used for research and as a follow-up tool in the work with clients entering the prison and probation system. The ASI assessment is used when misuse of drugs or alcohol is revealed or suspected at a first contact session with a client entering the prison and probation system. The ASI examination is also required for the clients to be transferred to a treatment unit within the prison and probation system. The ASI examination in the prison and probation system was intended for evaluation, treatment and follow-up, and not as a part of correction or control. Clients who do not speak Swedish are not assessed with the ASI. At the time of this study, in August 2006, a total of 7085 clients in a nationwide sample had been examined with this instrument since 2001.

As opioid users appear to be at high risk of fatal and non-fatal overdose (Steentoft et al., 2006; Bradvik et al., 2007b), and as the study aimed to include subjects with recent drug use rather than any drug use, this study was based on all subjects reporting opioid use during the previous 30 days (before incarceration), which was regarded as an indicator of opioid abuse. Use of opioids was defined as the use of one of heroin, methadone or 'other opioids'. According to the guidelines of the Swedish ASI, 'other opioids' include opium, morphine, ketobemidone, petidine, buprenorphine, codeine and pentazocine.

In the ASI, clients are asked about how many times they have overdosed on drugs. From this question, a dichotomised variable was constructed, reporting whether or not a client reported a history of drug overdose. In this version, overdose was defined as "life-threatening physical complications following drug intake" (Öberg et al., 1999). The ASI does not specify the drug or drugs taken on the occasion of the overdoses. Also, the ASI instrument does not provide information about when overdoses occurred (Sallmén and Öberg, 2002).

Individuals were excluded from analysis if they failed to give an answer to the overdose question ($n = 16$), or if his/her answers were reported by the interviewer to be significantly distorted because of the client's misrepresentation or inability to understand the questions ($n = 1$). None of the included clients was reported to refuse, interrupt the interview or to be judged unable to undergo the interview (this, in the whole sample of 7085 clients, was reported only for 18, 17 and 5 individuals, respectively). For clients who have been interviewed more than once (for a follow-up interview or due to re-incarceration), the first interview has been assessed in the study.

Current opioid users reporting a history of non-fatal overdose were compared to those not reporting overdoses. A large number of ASI variables were investigated, and variables considered relevant to the hypothesis (psychiatric traits, previous criminal charges, heredity, misuse pattern) were included in the analysis. In the ASI, lifetime prevalence is reported for overdoses, so variables reporting lifetime prevalence were also used in this study.

History of use of commonly reported substances was included (heroin, methadone, other opioids, tranquillisers, cocaine, amphetamine, cannabis, hallucinogenic drugs and history of binge drinking), as well as history of injection. History of substance use (or injection) was defined as the reporting of at least 1 year of use of the substance, or at least 1 year of injecting (6 months or more was approximated to 1 year). As an alcohol consumption of four drinks or more per day has previously been shown in association with non-fatal overdose (Seal et al., 2001; Kerr et al., 2007), the ASI variable of 'binge drinking' was used, which was here defined as more than five drinks per day. As vari-

ables of criminal behaviour, the ASI items of previous criminal charges were used for the following categories of crime: drug crime, crime involving property (burglary, theft, shop-lifting, forgery, blackmail, receiving stolen goods, fraud), and crime of violence (robbery, assault and battery, rape, arson, homicide or manslaughter). Heredity was analysed using all ASI items of paternal and maternal heredity: alcohol problems, drug problems, psychiatric problems and criminality. From the ASI domain of psychiatric symptoms, items describing lifetime history of depressive symptoms ('depression' and 'suicidal ideation') were included in the analysis, as well as items more related to impulse control disturbances ('suicide attempts' and 'difficulty in controlling violent behaviour'). Other psychiatric variables, such as 'anxiety', 'hallucinations' and 'memory and concentration problems', were not considered sufficiently specific and reliable, and were not included in the model. Gender, age and country of birth were included in the analysis. At the time of this study, information about town of residence was only available for a part of the sample, and regional differences in drug use behaviour will be assessed in an up-coming study.

The ASI has been translated into many languages, including Swedish (Andréasson et al., 2003). The version used here is the ASI-X (Sallmén and Öberg, 2002; Öberg et al., 1999), an extended version of the European standard version (EuropASI, Blanken et al., 1994; Broekaert et al., 2002). None of the added variables of the ASI-X were included in the study.

The present study was reviewed and approved by the Committee of Ethics of Lund University, Sweden.

2.1. Statistical methods

The overdose variable was dichotomised (overdose versus no overdose). Associations between overdose and each included variable were investigated in a binary analysis (chi-square). All items that were significantly related to overdose were entered into a stepwise forward logistic regression (Tabachnick and Fidell, 2006), comparing the variables within each of the categories above (misuse pattern, previous criminal charges, heredity and psychiatric symptoms). Then, from each domain, all items independently associated with overdose were entered in a final logistic regression model, again adjusted for age and country of birth. All logistic regression models were adjusted for age and country of birth, as these variables varied significantly between the groups.

Variables were fully dichotomised. On average, data on previous criminal charges was missing in 5.3% of cases, for history of substance use in 0.9%, for psychiatric symptoms in 0.8%, for paternal heredity in 11.0%, and for maternal heredity in 5.6% of cases. This missing data was coded '0', i.e. not present, whereas missing data for country of birth (less than 1%, $n=6$), was coded like the majority of subjects, i.e. being born in Sweden/Nordic countries. Sensitivity analyses for country of birth, criminal charges and heredity, coding these variables the opposite way, did not alter the group of variables independently associated with overdose. Information about age is missing in three cases, and so these cases are not included in the logistic regression analyses adjusted for age.

For significant differences, confidence intervals of 95% were used ($p<0.05$). The contribution of groups of variables to the variance in overdose history was estimated using Nagelkerke's R Square (Nagelkerke, 1991).

3. Results

3.1. Sample

In the entire population of individuals assessed with the ASI ($n=7085$), 1113 subjects (16%) reported using opioids during the previous 30 days. Sixteen individuals gave no answer to the overdose question and were excluded, and one individual was excluded due to suspected misrepresentation in one domain of the interview. Among the 1096 recent opioid users finally included, the opioid most commonly reported was heroin, used by 69% ($n=752$) during the previous 30 days (75% in the overdose group, 61% in the non-overdose group, $p<0.001$). Methadone use was reported by 10% ($n=112$, 12% vs. 8%, $p=0.024$), and other opioids by 48% ($n=528$, 48% vs. 48%, $p=0.901$).

Twelve percent ($n=129$) of included clients were women. HIV prevalence was low (0.9%, $n=10$), whereas history of hepatitis B was reported by 25% ($n=273$) and hepatitis C by 58% ($n=641$).

Most of the subjects included in the study were born in Sweden (75%). Another four percent were born in other Nordic countries (Finland, Denmark, Norway or Iceland). Other countries of birth reported by at least one percent were Iran (4%), Serbia-Montenegro (3%), Poland and Iraq (1% each).

A majority, 55% ($n=604$), reported a history of non-fatal drug overdose. The mean of these individuals was 5.49 overdoses. Among subjects reporting history of overdose, twenty-seven percent ($n=165$) reported one overdose, 18% ($n=106$) reported two overdoses, and 55% ($n=333$) reported more than two overdoses. No significant gender difference was observed between overdose and non-overdose clients. Clients reporting a history of overdose were younger (mean age 31.3 vs. 32.4 years, $p=0.026$), and more likely to be born in Sweden or other Nordic countries (87% vs. 71%, $p<0.001$), and so there was a control for age and country of birth (Nordic countries vs. other countries) in the logistic regression models.

3.2. History of substance use

History of use (at least 1 year of use) of several substances was significantly more commonly reported in the overdose group: heroin, methadone, other opioids, tranquillisers, amphetamine, cannabis, hallucinogenic drugs, and binge alcohol drinking. History of injection drug use (at least 1 year) was also significantly more common in the overdose group. History of cocaine use did not differ significantly between the groups (Table 1).

3.3. Previous criminal charges

Patients with a history of overdose were more likely to report history of criminal charges involving drug crime, crime involving property or crime of violence. Differences were significant for all three categories of crime (Table 1).

3.4. Heredity

Heredity of several problems was significantly more commonly reported by the overdose group: paternal alcohol problems, paternal drug problems, paternal psychiatric problems, paternal criminality, maternal drug problems, and maternal psychiatric problems (Table 1).

3.5. Psychiatric symptoms

Overdose patients significantly more commonly reported a history of the psychiatric symptoms included in the study: depression, suicidal ideation, suicide attempts, and difficulty in controlling violent behaviour (Table 1).

Table 1
Binary analysis of factors associated with history of non-fatal overdose (OD) in a sample of 1096 clients in the Swedish prison and probation system

	OD history ($n=604$) (%) (N)	No OD history ($n=492$) (%) (N)	OR (95% CI)	p value
Mean age (years)	31.3	32.4		*
Born in Nordic countries	87% (523)	71% (349)	2.65 (1.95–3.59)	***
Female gender	12% (73)	11% (56)	1.07 (0.74–1.55)	NS
History of substance use, ≥1 year				
Heroin	80% (484)	58% (287)	2.88 (2.20–3.77)	***
Methadone	17% (101)	11% (53)	1.66 (1.16–2.37)	**
Other opioids	52% (317)	46% (228)	1.28 (1.01–1.62)	*
Tranquillisers	69% (415)	45% (223)	2.65 (2.07–3.39)	***
Cocaine	20% (119)	21% (103)	0.93 (0.69–1.25)	NS
Amphetamine	73% (441)	52% (256)	2.49 (1.94–3.21)	***
Cannabis	79% (479)	68% (333)	1.83 (1.39–2.40)	***
Hallucinogenic drugs	23% (138)	15% (74)	1.67 (1.22–2.28)	**
Injection drug use	84% (508)	52% (257)	4.84 (3.65–6.41)	***
Binge drinking	46% (276)	37% (184)	1.41 (1.10–1.80)	**
History of criminal charges				
Drug crime	85% (514)	79% (391)	1.48 (1.08–2.02)	*
Crime involving property	86% (519)	75% (369)	2.04 (1.50–2.77)	***
Crime of violence	68% (408)	58% (283)	1.54 (1.20–1.97)	***
Heredity				
Maternal alcohol problems	15% (91)	11% (56)	1.38 (0.97–1.97)	NS
Maternal drug problems	10% (60)	5% (26)	1.98 (1.23–3.18)	**
Maternal psychiatric problems	13% (77)	8% (38)	1.75 (1.16–2.63)	**
Maternal criminality	5% (28)	3% (15)	1.55 (0.82–2.93)	NS
Paternal alcohol problems	41% (247)	26% (127)	1.99 (1.53–2.58)	***
Paternal drug problems	17% (102)	9% (43)	2.12 (1.45–3.10)	***
Paternal psychiatric problems	8% (50)	4% (22)	1.93 (1.15–3.23)	*
Paternal criminality	19% (116)	13% (64)	1.59 (1.14–2.21)	**
History of psychiatric symptoms				
Depression	61% (370)	54% (266)	1.34 (1.06–1.71)	*
Difficulty in controlling violent behaviour	52% (316)	37% (183)	1.85 (1.45–2.36)	***
Suicidal ideation	50% (300)	35% (173)	1.82 (1.43–2.32)	***
Suicide attempts	36% (215)	19% (95)	2.31 (1.75–3.05)	***

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

3.6. Logistic regression analyses

Variables with significant differences between overdose and non-overdose clients were compared within each domain in a logistic regression model adjusted for age and country of birth, and the contribution of each domain to the variance overdose/non-overdose was estimated (Table 2). Within the domain of substance use history, history of injection drug use, heroin use, use of tranquillisers and amphetamine use were associated with history of overdose. Among heredity variables, paternal alcohol and drug problems were independently associated with overdose, and among items of previous criminal charges, crime involving property and crime of violence were associated with overdose. Among psychiatric symptoms, suicide attempts and difficulty in controlling violent behaviour were independently associated with overdose.

Significant substance use variables contributed to an estimated 25% of the variance in overdose history (Nagelkerke's R Square), psychiatric characteristics to 10%, heredity to 8%, and previous criminal charges to 8% of the variance. Being born in Nordic countries contributed to 5% of the variance.

Independently related variables above were entered in a final logistic regression analysis, again adjusted for age and country of birth. Factors independently associated with overdose history were history of injection drug use, history of heroin use, history of suicide attempts, history of tranquilliser use, birth in Nordic countries, difficulty in controlling violent behaviour, and paternal alcohol problems (Table 2). These independently associated variables altogether explained an estimated 29% of the variance in overdose history (Nagelkerke's R Square).

4. Discussion

The findings of this study, based on a criminal justice population, indicate several factors independently associated with a history of non-fatal overdose in subjects reporting opioid use during the 30 days before incarceration. As hypothesised, the findings of this study indicate the contribution of other variables than misuse pattern. Most importantly, history of suicide

Table 2
Logistic regression analysis of factors associated with history of non-fatal overdose (OD), adjusted for age and country of birth

	OR (95% CI)	Estimated contribution to the variance (Nagelkerke's R Square, NRS)
History of substance use, ≥1 year		0.25
Injection drug use	3.16 (2.30–4.36)	
Heroin	2.46 (1.81–3.36)	
Tranquillisers	2.03 (1.53–2.69)	
Amphetamine	1.60 (1.18–2.17)	
History of criminal charges		0.08
Crime involving property	1.71 (1.24–2.37)	
Crime of violence	1.30 (1.00–1.69)	
Heredity		0.08
Paternal alcohol problems	1.62 (1.23–2.13)	
Paternal drug problems	1.52 (1.02–2.27)	
History of psychiatric symptoms		0.10
Suicide attempts	2.01 (1.51–2.69)	
Difficulty in controlling violent behaviour	1.55 (1.20–2.01)	
General model		0.29
Injection drug use	3.28 (2.39–4.52)	
Heroin use	2.87 (2.08–3.96)	
Suicide attempts	1.92 (1.40–2.63)	
Tranquilliser use	1.91 (1.44–2.54)	
Born in Sweden/Nordic countries	1.74 (1.22–2.49)	
Difficulty in controlling violent behaviour	1.68 (1.26–2.23)	
Paternal alcohol problems	1.57 (1.16–2.12)	

attempts and difficulty in controlling violent behaviour were related to overdose history. Country of birth and paternal alcohol problems also had some influence. As expected, misuse pattern (injection drug use, heroin use and tranquilliser use) was most strongly associated with overdose, which is consistent with previous research (Darke and Zador, 1996; Warner-Smith et al., 2001; Sporer, 1999; Darke and Hall, 2003; Darke et al., 1996; Gossop et al., 1996; McGregor et al., 1998; Powis et al., 1999; Darke et al., 2000).

The present study appears to contribute to the current knowledge about psychiatric traits associated with a history of non-fatal overdose in this type of population. Psychiatric variables related to impulse control disturbances (suicide attempts and difficulty in controlling violent behaviour), rather than depressive characteristics (depression, suicidal ideation), were found to be associated with overdose history.

Our findings of an association between overdose history and a history of suicide attempts are consistent with the findings of Bradvik and co-workers in Sweden (Bradvik et al., 2007a) and Darke and co-workers in Australia (Darke et al., 2004). Opioid users, including heroin users, are known to be at higher risk of suicide, compared to the general population (Hulse et al., 1999; Wilcox et al., 2004). Also, in the group of opioid users with previous overdoses, some research has focused on the distinction between intentional and accidental overdoses. The percentage of heroin overdoses that are said to be intentional has varied in different studies (Gossop et al., 1996; Heale et al., 2003; Tobin and Latkin, 2003), but is usually low. However, some attention has been paid to the difficulty in distinguishing intentional overdoses from accidental overdoses, e.g. due to different reporting procedures (Farrell et al., 1996).

The results of the present study also indicate an association with problems in aggression control. The association with these types of psychiatric disorders might indicate possible personality traits common to suicide attempts, violent behaviour and overdose risk in drug users. Depressive symptoms, including suicidal ideation, were not independently associated with history of drug overdose. Overdose prevention may need to address opioid users with symptoms of impulse control disturbances. The overdose risk and the need for intervention in injectors and users of heroin and/or tranquillisers are previously well-documented.

In neurobiological research, several studies have found an association between suicide and serotonergic dysfunction, measured by low CSF levels of 5-hydroxyindoleacetic acid, 5-HIAA. Also, a relationship between serotonergic dysfunction and aggressive and impulsive behaviour has been suggested, though biological associations between these traits appear to be complex (see, for example, Asberg, 1997, and Mann and Currier, 2007 for reviews).

Overdose patients in the present study were significantly younger than patients not reporting overdoses. It is well known that the overdose mortality among heroin users is high (Hulse et al., 1999). For example, in a Swedish sample of HIV positive drug injectors, heroin poisoning accounted for a majority of deaths during an observation period, despite HIV seropositivity (Fugelstad et al., 1995). This may explain the age difference as a selection bias, where at-risk individuals may already have died from overdoses, leaving the non-overdose group with a higher mean age.

Independent of injection history, substance use history and age, overdose was more common among subjects born in Sweden or other Nordic countries. History of injection drug use (at least 1 year) was included in the model, but it has previously been suggested, though from a limited number of observations, that heroin-using immigrants in the Swedish drug scene may initiate intravenous heroin use later than native Swedish heroin users (Tops and Silow, 1997). This may be one hypothesis possibly explaining the difference. Other hypotheses may include other differences in misuse pattern between different ethnic groups, for example the extent and frequency of injection drug use among different groups. Differences in misuse pattern between heroin users with different ethnicity within the same society have previously been described (see for example Strang et al., 1999).

In particular, paternal alcohol and drug problems were highly prevalent in this sample. Interestingly, this study also indicated that overdose may be associated with heredity of alcohol prob-

lems. Paternal alcohol problems was the most prevalent heredity variable in this sample of opioid users, and it remained associated with overdose history in the final logistic regression analysis.

The mediators of this association are unclear, and it is also not clear why this association was found for paternal alcohol problems, and not for maternal alcohol problems, and why an independent association was not found for parental drug problems. A genetic component associated with drug use, notably with heroin use, has previously been documented (see for example Tsuang et al., 1998). The particular association with paternal alcoholism in the present study has seldom been addressed in previous literature, but other associations between parental substance abuse and their children's substance abuse have been described, more often for parental alcohol abuse than for parental drug abuse (Johnson and Leff, 1999). Paternal alcoholism has been shown to be a risk factor for both alcohol and drug abuse and steeper aggravation in drug use during adolescence (Chassin and Barrera, 1993), and paternal heavy drinking has been associated with externalizing disorders in their adolescent offspring, including conduct disorder and early substance use (Malone et al., 2002). Parental substance abuse has been described as a risk factor for drug disorders in their children at age 21 (Reinherz et al., 2000). Also, parents' alcoholism has shown an association with alcohol abuse/dependence and drug abuse/dependence in their offspring aged 18–23 (Chassin et al., 1999), and with early substance use in younger children (Chassin et al., 1991). Thus, an association between parental alcohol problems and illicit drug problems in their offspring can be assumed, but studies have mainly investigated children's substance use and behaviour during childhood and adolescence.

4.1. Limitations

The present study uses the Addiction Severity Index for measuring differences between opioid users with and without a history of non-fatal overdose. Although data comes from a particularly large sample, this study has some limitations.

Rather than assessing the exact medical characteristics of previous overdoses and other variables, the ASI aims to assess the problem burden of substance abuse, where a history of self-reported overdoses is one feature that contributes to the assessment of the severity of abuse. The question about overdose in the ASI does not specify which drug or drugs have been overdosed. The problem of defining non-fatal drug overdoses retrospectively has been dealt with in different ways in previous overdose literature. Some authors have used explicit definitions in order to identify heroin overdoses (McGregor et al., 1998; Bradvik et al., 2007a, 2007b; Brugal et al., 2002; Darke et al., 1996; Warner-Smith et al., 2002). Others have not specified the drugs taken when overdosing (Kerr et al., 2007; Wines et al., 2007), whereas some authors have assumed the drug overdosed was heroin (Seal et al., 2001). There is reason to believe that most non-fatal overdoses in substance users do involve heroin, as this has been the case in several previous reports (83% and 96%, respectively, among injecting drug users, Powis et al., 1999; Pollini et al., 2006). The majority of retrospective research on non-fatal drug overdoses has focused on heroin, and opioids are involved in a majority of fatal intoxications among substance abusers (Steentoft et al., 2006; Fugelstad et al., 1997; Coffin et al., 2003). Also, in another study on the present data material, the reporting of overdoses among primary amphetamine and cocaine users varied considerably depending on history of opioid use (50% among individuals reporting at least 1 year of opioid use, compared to 20% among individuals without such history of opioid use, Hakansson et al., 2007). Though less commonly reported, history of non-fatal overdoses has been documented for other illicit drugs as well, including cocaine (Kaye and Darke, 2004) and amphetamine (Robertsen et al., 1998). Amphetamine, but not cocaine, is a common drug in the Swedish drug scene (Olsson et al., 2001), but it plays a substantially smaller role than heroin in fatal drug poisonings (Steentoft et al., 2006). Based on this, one can assume that a substantial number of the overdoses did involve heroin or other opioids. The nature of the ASI instrument is such that it assesses the consequences of drug use, and defining the overdose as a life-threatening event addresses the danger of the overdose situation as perceived by the user him-/herself, regardless of which drugs he/she took on that occasion.

The present study is also limited by the fact that the ASI does not specify when overdoses occurred, and so the temporality between overdoses and other events reported in the interview cannot be established. Also, any assessment using self-reported data may be limited by a certain recall bias.

This study assessed a criminal justice population. The risk of false reporting by clients in this kind of setting has been considered. However, it is to be noted that only one subject was excluded because the interviewer reported (in one domain) that answers were severely distorted by the client's misrepresentation.

A criminal justice population may be skewed towards higher levels of problematic drug use and anti-social behaviour. For example, personality disorders, including anti-social personality disorder, are known to be common in prison populations (Fazel and Danesh, 2002), and are, like substance use, known to be associated with violent behaviour (Nestor, 2002). In a prison population, impulse control disturbances may also be over-represented. Impulsivity is associated with several disorders, including anti-social and borderline personality disorder, AD/HD and substance use disorders (Evenden, 1999), which are known to be prevalent in prison populations (Fazel and Danesh, 2002; Rosler et al., 2004; Rasmussen et al., 2001). As violent behaviour, and factors predisposing for it, are common in prison populations, our findings, for example the association with problems controlling violent behaviour, may not be generally applicable to a non-prison population of substance users. On the other hand, this study may benefit from addressing specifically a criminal justice population, as clients with substance use and criminal behaviour are a group that is frequently seen in psychiatric health care and social services, including situations where the risk of future fatal and non-fatal overdoses is to be assessed.

Regarding missing data, variables of previous criminal charges, heredity and country of birth were considered to be the most sensitive. However, a sensitivity analysis of coding

these missing data the opposite way did not substantially alter the findings.

Only 12% of the subjects of this sample were women. This is lower than the percentage of women in several other studies on non-fatal overdoses (e.g. Bradvik et al., 2007a, 2007b; Darke et al., 1996; Gossop et al., 1996; Kerr et al., 2007; Latkin et al., 2004; McGregor et al., 1998; Pollini et al., 2006; Powis et al., 1999; Seal et al., 2001; Warner-Smith et al., 2002; Wines et al., 2007). However, in our sample, no gender difference was seen between patients with and without overdose history. This is consistent with the findings of several overdose studies (Darke et al., 1996; Gossop et al., 1996; McGregor et al., 1998; Bradvik et al., 2007b; Warner-Smith et al., 2002), though some research has reported gender differences, either reporting that men (Latkin et al., 2004; Wines et al., 2007) or women (Powis et al., 1999) are at higher risk.

4.2. Conclusion

In a sample of recent opioid users in the Swedish criminal justice system, psychiatric characteristics related to impulse control disturbances (suicide attempts, difficulty in controlling violent behaviour) were more common among subjects with history of non-fatal overdose, even when variables of misuse pattern were controlled for. Thus, substance users with a history of suicidal behaviour or difficulty in controlling violent behaviour may also be at risk of drug overdose. The finding of this association may have clinical applications, and the aspect of impulsivity should be further addressed in research on drug overdoses. Heredity of alcohol problems and country of birth had some influence, and deserve further investigation. As expected, known risk factors in the field of misuse pattern had the strongest influence on overdose history in our sample.

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Contributors

Hakansson, Schlyter and Berglund together planned the study. Schlyter was the main responsible of the data collection. Hakansson and Berglund were responsible for the statistical analysis. All authors contributed to the interpretation of data. Hakansson and Berglund wrote the manuscript and managed the literature searches. All authors approved the manuscript.

Conflict of interest

The authors do not have any conflicts of interest.

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References

Andréasson S., Lindström U., Armelius B.A., Larsson H., Berglund M., Frank A., Bergman H., Rydberg U., Zingmark D., Tengvald K., 2003. ASI – en strukturerad intervjumetod för bedömning av alkohol- och narkotikarelaterade problem [ASI interview – a method for assessment of alcohol- and drug-related problems]. Socialstyrelsen [Swedish Social Board]. www.socialstyrelsen.se/Publicerat/2003/1798/2003-112-2.htm.

Asberg, M., 1997. Neurotransmitters and suicidal behavior. The evidence from cerebrospinal fluid studies. Ann. N. Y. Acad. Sci. 836, 158–181.

Blanken, P., Hartgers, C., Kokkevi, A., Uchtenhagen, A., 1994. EuropASI—training manual for the European version of the Addiction Severity Index. COST A6. Comm. Eur. Commun..

Bradvik, L., Frank, A., Hulenvik, P., Medvedeo, A., Berglund, M., 2007a. Heroin addicts reporting previous heroin overdoses also report suicide attempts. Suicide Life-Threat. Behav. 37, 475–481.

Bradvik, L., Hulenvik, P., Frank, A., Medvedeo, A., Berglund, M., 2007b. Self-reported and observed heroin overdoses in Malmoe. J. Subst. Use. 12, 119–126.

Broekaert, E., Haack, M.J., Kaplan, C., Oberg, D., Sallmén, B., Segraeus, V., Soyez, V., Wilson, J., 2002. The biomed II IPTRP project: implementation of diagnostic instruments. Eur. Addict. Res. 8, 201–203.

Brugal, M.T., Barrio, G., De La Fuente, L., Regidor, E., Royuela, L., Suelves, J.M., 2002. Factors associated with non-fatal heroin overdose: assessing the effect of frequency and route of heroin administration. Addiction 97, 319–327.

Brugal, M.T., Domingo-Salvany, A., Puig, R., Barrio, G., García de Olalla, P., De La Fuente, L., 2005. Evaluating the impact of methadone maintenance programmes on mortality due to overdose and aids in a cohort of heroin users in Spain. Addiction 100, 981–989.

Chassin, L., Barrera, M., 1993. Substance use escalation and substance use restraint among adolescent children of alcoholics. Psychol. Addict. Behav. 7, 3–20.

Chassin, L., Pitts, S.C., DeLucia, C., Todd, M., 1999. A longitudinal study of children of alcoholics: predicting young adult substance use disorders, anxiety, and depression. J. Abnorm. Psychol. 108, 106–119.

Chassin, L., Rogosch, F., Barrera, M., 1991. Substance use and symptomatology among adolescent children of alcoholics. J. Abnorm. Psychol. 100, 449–463.

Coffin, P.O., Galea, S., Ahern, J., Leon, A.C., Vlahov, D., Tardiff, K., 2003. Opiates, cocaine and alcohol combinations in accidental drug overdose deaths in New York City, 1990–98. Addiction 98, 739–747.

Darke, S., Hall, W., 2003. Heroin overdose: research and evidence-based intervention. J. Urban Health 80, 189–200.

Darke, S., Ross, J., Hall, W., 1996. Overdose among heroin users in Sydney, Australia: I. Prevalence and correlates of non-fatal overdose. Addiction 91, 405–411.

Darke, S., Ross, J., Lynskey, M., Teesson, M., 2004. Attempted suicide among entrants to three treatment modalities for heroin dependence in the Australian Treatment Outcome Study (ATOS): prevalence and risk factors. Drug Alcohol Depend. 73, 1–10.

Darke, S., Ross, J., Zador, D., Sunjic, S., 2000. Heroin-related deaths in New South Wales, Australia, 1992–1996. Drug Alcohol Depend. 60, 141–150.

Darke, S., Sunjic, S., Zador, D., Prolov, T., 1997. A comparison of blood toxicology of heroin-related deaths and current heroin users in Sydney, Australia. Drug Alcohol Depend. 47, 45–53.

Darke, S., Zador, D., 1996. Fatal heroin 'overdose': a review. Addiction 91, 1765–1772.

Davoli, M., Perucci, C.A., Forastiere, F., Doyle, P., Rapiti, E., Zaccarelli, M., Abeni, D.D., 1993. Risk factors for overdose mortality: a case-control study within a cohort of intravenous drug users. Int. J. Epidemiol. 22, 273–277.

Evenden, J., 1999. Impulsivity: a discussion of clinical and experimental findings. J. Psychopharmacol. 13, 180–192.

Farrell, M., Neeleman, J., Griffiths, P., Strang, J., 1996. Suicide and overdose among opiate addicts. Addiction 91, 321–323.

Fazel, S., Danesh, J., 2002. Serious mental disorder in 23000 prisoners: a systematic review of 62 surveys. Lancet 359, 545–550.

Fugelstad, A., Annell, A., Rajs, J., Agren, G., 1997. Mortality and causes and manner of death among drug addicts in Stockholm during the period 1981–1992. Acta Psychiatr. Scand. 96, 169–175.

Fugelstad, A., Rajs, J., Bottiger, M., Gerhardsson De Verdier, M., 1995. Mortality among HIV-infected intravenous drug addicts in Stockholm in relation to methadone treatment. Addiction 90, 711–716.

Gossop, M., Griffiths, P., Powis, B., Williamson, S., Strang, J., 1996. Frequency of non-fatal heroin overdose: survey of heroin users recruited in non-clinical settings. BMJ 313, 402.

Hakansson, A., Schlyter, F., Berglund, M., 2007. Characteristics of amphetamine users in a prison population examined with the Addiction Severity Index (ASI). A comparison with heroin and cocaine users. In: Poster Presentation, CPDD 69th Annual Meeting, Quebec City, Canada.

Heale, P., Dietze, P., Fry, C., 2003. Intentional overdose among heroin overdose survivors. J. Urban Health 80, 230–237.

Hulse, G.K., English, D.R., Milne, E., Holman, C.D., 1999. The quantification of mortality resulting from the regular use of illicit opiates. Addiction 94, 221–229.

Johnson, J.L., Leff, M., 1999. Children of substance abusers: overview of research findings. Pediatrics 103, 1085–1099.

Kaye, S., Darke, S., 2004. Non-fatal cocaine overdose among injecting and non-injecting cocaine users in Sydney, Australia. Addiction 99, 1315–1322.

Kerr, T., Fairbairn, N., Tyndall, M., Marsh, D., Li, K., Montaner, J., Wood, E., 2007. Predictors of non-fatal overdose among a cohort of polysubstance-using injection drug users. Drug Alcohol Depend. 87, 39–45.

Latkin, C.A., Hua, W., Tobin, K., 2004. Social network correlates of self-reported non-fatal overdose. Drug Alcohol Depend. 73, 61–67.

Malone, S.M., Iacono, W.G., McGue, M., 2002. Drinks of the father: father's maximum number of drinks consumed predicts externalizing disorders, substance use, and substance use disorders in preadolescent and adolescent offspring. Alcohol Clin. Exp. Res. 26, 1823–1832.

Mann, J.J., Currier, D., 2007. A review of prospective studies of biologic predictors of suicidal behavior in mood disorders. Arch. Suicide Res. 11, 3–16.

McGregor, C., Darke, S., Ali, R., Christie, P., 1998. Experience of non-fatal overdose among heroin users in Adelaide, Australia: circumstances and risk perceptions. Addiction 93, 701–711.

McLellan, A.T., Kushner, H., Metzger, D., Peters, R., Smith, I., Grissom, G., Pettinati, H., Argeriou, M., 1992. The fifth edition of the Addiction Severity Index. J. Subst. Abuse Treat. 9, 199–213.

McLellan, A.T., Luborsky, L., Woody, G.E., O'Brien, C.P., 1980. An improved diagnostic evaluation instrument for substance abuse patients. The Addiction Severity Index. J. Nerv. Ment. Dis. 168, 26–33.

Nagelkerke, N.J.D., 1991. A note on a general definition of the coefficient of determination. Biometrika 78, 691–692.

Nestor, P.G., 2002. Mental disorders and violence: personality dimensions and clinical features. Am. J. Psychiat. 159, 1973–1978.

Öberg D., Zingmark D., Sallmén B., 1999. ASI-X. Version 1.1. http://eib.emcdda.europa.eu/index.cfm?fuseaction=public.Content&nnodeid=3538&sLanguageiso=EN.

Olsson, B., Adamsson Wahren, C., Byqvist, S., 2001. Det tunga narkotikamissbrukets omfattning i Sverige 1998 [The extent of heavy drug abuse in Sweden 1998]. Stockholm CAN.

Pollini, R.A., McCall, L., Mehta, S.H., Vlahov, D., Strathdee, S.A., 2006. Non-fatal overdose and subsequent drug treatment among injection drug users. Drug Alcohol Depend. 83, 104–110.

Powis, B., Strang, J., Griffiths, P., Taylor, C., Williamson, S., Fountain, J., Gossop, M., 1999. Self-reported overdose among injecting drug users in London: extent and nature of the problem. Addiction 94, 471–478.

Quaglio, G., Talamini, G., Lechi, A., Venturini, L., Lugoboni, F., Mezzelani, P., 2001. Study of 2708 heroin-related deaths in north-eastern Italy 1985–98 to establish the main causes of death. Addiction 96, 1127–1137.

Rasmussen, K., Almvik, R., Levander, S., 2001. Attention deficit hyperactivity disorder, reading disability, and personality disorders in a prison population. J. Am. Acad. Psychiatry Law 29, 186–193.

Reinherz, H.Z., Giaconia, R.M., Hauf, A.M., Wasserman, M.S., Paradis, A.D., 2000. General and specific childhood risk factors for depression and drug disorders by early adulthood. J. Am. Acad. Child Adolesc. Psychiatry 39, 223–231.

Robertsen, A., Kowalczyk, M., Gabrielsen, A.M., Jacobsen, D., 1998. Amfetaminforgiftning. [Amphetamine poisoning]. Tidsskr. Nor. Laegeforen. 118, 4340–4343.

Rosler, M., Retz, W., Retz-Junginger, P., Hengesch, G., Schneider, M., Supprian, T., Schwitzgebel, P., Pinhard, K., Dovi-Akue, N., Wender, P., Thome, J., 2004. Prevalence of attention deficit-/hyperactivity disorder (ADHD) and comorbid disorders in young male prison inmates. Eur. Arch. Psychiatry Clin. Neurosci. 254, 365–371.

Sallmén B., Öberg D., 2002. ASI-X. Utbildningmanual V. 1.0.[ASI-X. Instruction manual V. 1.0.].

Seal, K.H., Kral, A.H., Gee, L., Moore, L.D., Bluthenthal, R.N., Lorvick, J., Edlin, B.R., 2001. Predictors and prevention of nonfatal overdose among street-recruited injection heroin users in the San Francisco Bay Area, 1998–99. Am. J. Publ. Health 91, 1842–1846.

Sporer, K., 1999. Acute heroin overdose. Ann. Int. Med. 130, 584–590.

Steentoft, A., Teige, B., Holmgren, P., Vuori, E., Kristinsson, J., Hansen, A.C., Ceder, G., Wethe, G., Rollmann, D., 2006. Fatal poisoning in Nordic drug addicts in 2002. Forensic Sci. Int. 160, 148–156.

Strang, J., Griffiths, P., Powis, B., Gossop, M., 1999. Heroin chasers and heroin injectors: differences observed in a community sample in London UK. Am. J. Addict. 8, 148–160.

Strang, J., McCambridge, J., Best, D., Beswick, T., Bearn, J., Rees, S., Gossop, M., 2003. Loss of tolerance and overdose mortality after inpatient opiate detoxification: follow up study. BMJ 326, 959–960.

Tabachnick, B.G., Fidell, L.S., 2006. Using Multivariate Statistics, Fifth edition. Allyn & Bacon, Boston.

Tobin, K.E., Latkin, C.A., 2003. The relationship between depressive symptoms and nonfatal overdose among a sample of drug users in Baltimore, Maryland. J. Urban Health 80, 220–229.

Tops D., Silow M., 1997. En ny generation heroinmissbrukare i Malmö: ("det finns inget rökheroin"): en beskrivning av unga heroinister med svensk och utländsk bakgrund. School of Social Work, Lund University, Lund.

Tsuang, M.T., Lyons, M.J., Meyer, J.M., Doyle, T., Eisen, S.A., Goldberg, J., True, W., Lin, N., Toomey, R., Eaves, L., 1998. Co-occurrence of abuse of different drugs in men: the role of drug-specific and shared vulnerabilities. Arch. Gen. Psychiatry 55, 967–972.

Warner-Smith, M., Darke, S., Lynskey, M., Hall, W., 2001. Heroin overdose: causes and consequences. Addiction 96, 1113–1125.

Warner-Smith, M., Darke, S., Day, C., 2002. Morbidity associated with non-fatal heroin overdose. Addiction 97, 963–967.

Wilcox, H.C., Conner, K.R., Caine, E.D., 2004. Association of alcohol and drug use disorders and completed suicide: an empirical review of cohort studies. Drug Alcohol Depend. 76 (Suppl.), S11–S19.

Wines Jr., J.D., Saitz, R., Horton, N.J., Lloyd-Travaglini, C., Samet, J.H., 2007. Overdose after detoxification: a prospective study. Drug Alcohol Depend. 89, 161–169.