

The relationship between methamphetamine use and violent behaviour

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The current bulletin assesses whether there is any relationship between the increasing assault rate in NSW seen over the past decade and increasing methamphetamine use. During this time, there have been several changes to methamphetamine use patterns that could have contributed to an increase in methamphetamine-related problems, such as violent behaviour. There is currently insufficient evidence to infer a direct causal link between methamphetamine use and violence, but there is considerable evidence that the two entities are related. The strongest evidence for a relationship between methamphetamine use and violence is in the context of methamphetamine-induced psychosis. In this context, violence is likely to be related to persecutory delusions and perceived threat. There is also experimental evidence that chronic use of the drug increases the risk of violent behaviour, and a proportion of chronic methamphetamine users report problems controlling violent behaviour. Despite this evidence, it is not clear whether violent behaviour among chronic methamphetamine users is due to methamphetamine use per se or co-occurring factors (e.g. alcohol use, psychiatric status, personality, lifestyle associated with illicit drug use). Acute intoxication with methamphetamine alone does not appear to lead to violent behaviour, but it may enhance aggression in someone who is otherwise provoked. In conclusion, there is currently insufficient empirical data to estimate whether, or to what extent, methamphetamine use has increased assaults in NSW. Existing evidence suggests that methamphetamine use is likely to have a relatively minor impact on the assault rate in NSW in comparison with other factors.

INTRODUCTION

Over the past decade there has been a dramatic rise in the popularity of crystalline methamphetamine use in Australia. During this time, there has also been increasing attention on aggressive behaviour among people intoxicated with the drug. Many of these reports arise from frontline health and law enforcement personnel, who are required to manage intoxicated methamphetamine users, and include descriptions of extremely unpredictable hostile behaviour (Topp, Degenhardt et al. 2002; McKetin, McLaren & Kelly 2005). These reports have led to speculation that the rising popularity of crystalline methamphetamine may have contributed

to the increase in assaults seen in NSW over the past decade (Moffat & Poynton 2006).

The aims of the current bulletin are to: (a) document the increase in methamphetamine use over the past decade; (b) review the evidence that methamphetamine use increases the risk of violent behaviour; (c) understand in which circumstances methamphetamine use is likely to increase the risk of violence; (d) evaluate the evidence, if any, that the growth in methamphetamine use has contributed to the upward trend in assaults over the past decade; and (e) identify areas where further research and monitoring is needed to understand the impact of methamphetamine use

on individual violent behaviour and aggregate rates of assault.

TRENDS IN METHAMPHETAMINE USE

Methamphetamine is sold under the street names 'speed', 'base', 'pure', 'meth', 'paste', 'amphetamines', 'crystal meth' and 'ice' (Topp & Churchill 2002). These drugs have been tried by around 1.8 million Australians (9%), and approximately half-a-million Australians (3.2%) are current users of the drug (Australian Institute of Health and Welfare 2005a).

Of these current users, most take the drug infrequently, although it is currently estimated that there are approximately 73,000 dependent methamphetamine users in Australia, of whom 28,000 reside in NSW (McKetin, McLaren, Kelly, Hall & Hickman 2005). This is considerably more than the estimated number of regular heroin users, which in 2002 stood at 19,900 and 45,000 in NSW and in Australia respectively (Degenhardt et al. 2004).

Trends in population prevalence

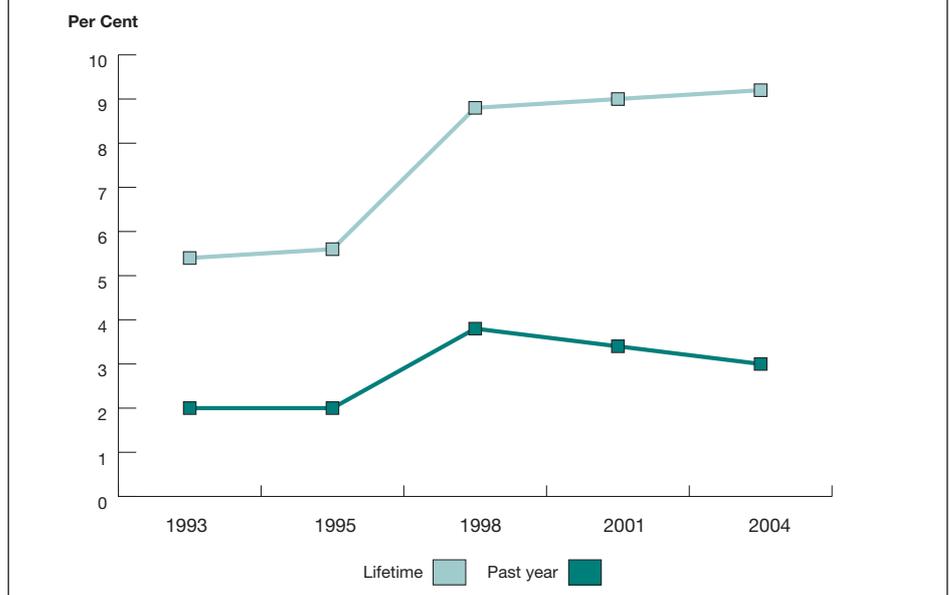
According to data from the National Drug Strategy Household Survey, the prevalence of the use of 'amphetamines' (including methamphetamine and amphetamine¹) increased strongly in the late 1990s and has since stabilized. Specifically, the prevalence of past year use rose from around 2 per cent in 1993 and 1995 to 3.7 per cent in 1998. The prevalence of meth/amphetamine use remained reasonably stable between the 1998 and 2004 surveys (see Figure 1).

It is difficult to be confident of the increased prevalence of meth/amphetamine use between 1993/1995 and 1998 because of the small sample sizes used in the early household surveys (i.e. 1993, 1995) and also because of methodological changes to the survey since this time (Australian Institute of Health and Welfare 2005b). However, the notion that methamphetamine use increased around this time is consistent with most methamphetamine-related indicator data which show a rise in problems related to the drug through the mid-to-late 1990s (McKetin & McLaren 2004).

Treatment admissions for meth/amphetamine use

According to the national census of drug treatment admissions, there was a marked increase in the proportion of drug treatment admissions for amphetamines from around 4 per cent in 1990 and 1992 to 6.5 per cent in 1995 and 8.8 per cent in 2001 (Shand & Mattick 2002).

Figure 1: Lifetime and past year prevalence of methamphetamine use in Australia, 1993-2004 (Source: Australian Institute of Health and Welfare, 2005b).



Since 2001, monitoring of drug treatment admissions has been undertaken routinely through the National Minimum Data Set for Alcohol and Other Drug Treatment Services (NMDS-AODTS). Data from the NMDS-AODTS showed a slight increase in the number of recorded clients with methamphetamine or amphetamine as their primary drug problem since 2001 (2001/2002: 12,211; 2002/2003: 13,213; 2003/2004: 14,208), although the proportion of meth/amphetamine treatment clients has not changed over this period (2001/2002: 10.8%; 2002/2003: 10.7%; 2003/2004: 11.0%; Australian Institute of Health and Welfare 2005c).

Hospital admissions for stimulant psychosis

One of the clear indications that Australia is experiencing a rise in problematic methamphetamine use is increasing hospital admissions for stimulant drugs. Between 1999/2000 and 2003/2004 there was a 58 per cent increase in the number of hospital admissions for stimulant drugs other than cocaine.² This included a corresponding increase in the number of people admitted to hospital for stimulant psychosis from 1,028 in 1999/2000 to 1,626 in 2003/2004 (Australian Institute of Health and Welfare 2005d). A similar increase in stimulant

psychosis admissions was seen in NSW, from 339 admissions in 1999/2000 to 437 in 2002/2003 (McKetin, McLaren & Kelly 2005).

Arrest data

The number of arrests for amphetamine-type stimulant drugs³ has also increased at a national level over the past decade, although these statistics include arrests relating to ecstasy (Australian Crime Commission 2003, 2006). Specifically, the number of arrests for amphetamine-type stimulants has shown a strong increase from 4,214 in 1995/1996 (4% of all drug-related arrests) to 10,068 in 2004/2005 (13% of all drug-related arrests).

NSW data for arrests pertaining to methamphetamine or amphetamine show a similar trend to that seen nationally for amphetamine-type stimulants. Over the past decade, the number of arrests relating to amphetamine or methamphetamine has increased from 18 per 100,000 persons to 46 per 100,000 persons in 2005 (unpublished data, NSW Bureau of Crime Statistics and Research). This increase was most pronounced between 1996 and 2001. After peaking in 2001, the number of arrests per population fell in 2002, but the overall upward trend continued

between 2002 and 2005. There was no corresponding increase in the number of arrests per population for other drug offences during this time (Figure 2).⁴

SHIFTS IN THE METHAMPHETAMINE MARKET

Several shifts in the methamphetamine market have occurred over the past decade that are likely to have affected the magnitude of harms related to the drug’s use. These are outlined below.

A shift from amphetamine to methamphetamine

In the mid-1990s, there was a shift from the supply of amphetamine to its methylated analogue, methamphetamine (O’Brien, Darke & Hando 1996). In a pharmacological sense, amphetamine and methamphetamine have an almost identical drug effect but methamphetamine has a more potent action and this may lead to greater harms associated with its use. The shift from amphetamine to methamphetamine supply was related to a change in the use of manufacturing techniques and precursor drugs around this time (McKetin, McLaren & Kelly 2005). By the late 1990s, over 95 per cent of meth/amphetamine seizures nationally involved methamphetamine, while amphetamine seizures were becoming increasingly uncommon (Australian Crime Commission 2003, 2006).

The emergence of more potent forms of methamphetamine

The second major shift in the market was the emergence of high purity crystalline methamphetamine and so-called ‘base’ methamphetamine. These new ways of marketing methamphetamine emerged in 1999 and rapidly became popular. By 2003, 38 per cent of the injecting drug users surveyed through the Illicit Drug Reporting System, and 48 per cent of ecstasy users surveyed through the Party Drugs Initiative, in Sydney, had recently used crystalline methamphetamine. Levels of crystalline methamphetamine use have remained high since this time,

and this trend has occurred across all capital cities in Australia. A very similar increasing trend has been seen with ‘base’ methamphetamine (Stafford et al. 2005a, 2005b). Reports from users and health workers suggest that these more potent forms of methamphetamine are associated with increased harms relative to the less pure powder form of the drug, traditionally sold as ‘speed’ (Topp et al. 2002).

The emergence of crystalline methamphetamine and ‘base’ methamphetamine was also associated with two further changes. Firstly, there was an overall increase in the purity of methamphetamine from 1997, including a significant increase in the purity of the powder form of the drug, or ‘speed’ (McKetin, McLaren & Kelly 2005). Secondly, there was an increase in the smoking of crystalline methamphetamine, particularly among younger non-injecting drug users (McKetin, McLaren & Kelly 2005; Stafford et al. 2005b). Smoking methamphetamine is associated with a high level of dependence compared to other non-injecting routes of administration (McKetin, Kelly & McLaren 2006).

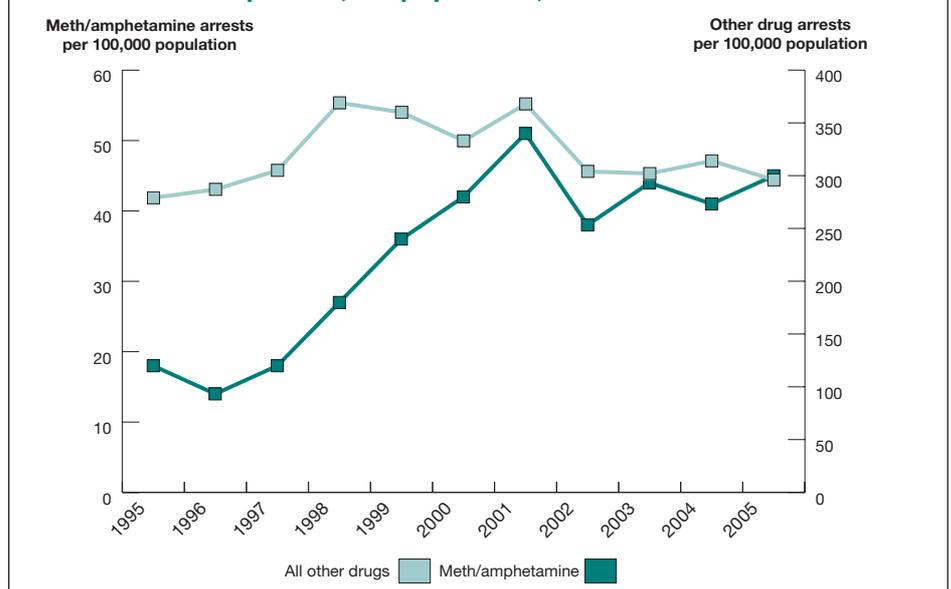
The heroin shortage

A third shift that occurred in the market for methamphetamine was an increase in injection of the drug among heroin users subsequent to the Australian heroin shortage in 2001. At this time, harms associated with the use of methamphetamine peaked, and there was a popular perception that the increased use of methamphetamine was a response to the heroin shortage. While it is true that heroin users increased their use of methamphetamine subsequent to the heroin shortage (Degenhardt et al. 2005a), this group represented only a small subset of all methamphetamine users, and their increased consumption led to only a small rise in methamphetamine indicators, which had been increasing steadily over the previous five years (McKetin & McLaren 2004). The appearance of a significant change in methamphetamine-related harms probably arose because heroin injectors have a high level of contact with health services compared to primary methamphetamine users. Their increased consumption of methamphetamine would have therefore been quite apparent to service providers (Kelly, McKetin & McLaren 2005).

Summary

In summary, it is likely that there has been an increase in the prevalence of

Figure 2: Number of meth/amphetamine and other drug arrests in NSW per 100,000 population, 1995-2005



meth/amphetamine use in Australia over the past decade, and this increase is likely to have occurred in the mid-to-late 1990s. Around this time there was also a shift from the supply of amphetamine to methamphetamine, and more recently, there was an increase in the purity of the drug available at a street level. Since 1999 there has been a dramatic increase in the popularity of crystalline methamphetamine, which has been accompanied by an increase in smoking crystalline methamphetamine among non-injecting drug users, and methamphetamine injection among injecting heroin users in the wake of the heroin shortage. These shifts in the market for the drug have primarily occurred since 2000. All of these trends are likely to have contributed to an increase in methamphetamine harms, which have become apparent over the past five years. There is little evidence that the prevalence of methamphetamine use at a population level has continued to increase during this time.

METHAMPHETAMINE USE AND VIOLENT BEHAVIOUR

Since the 1960s, much attention has been paid to the proposed causal relationship between the use of methamphetamine and violence. Over three decades later, conclusive evidence of this link is yet to be presented. This is partly because of the complexities involved in making associations between the use of any drug and subsequent human behaviour (McBride & McCoy 1982). Nonetheless, substantial evidence has accumulated around the relationship between methamphetamine use and violence which points toward a causal role for methamphetamine use in violent behaviour. The following sections will review research on the relationship between methamphetamine use and violence, focussing on: (a) whether there is a plausible neurobiological substrate for the relationship between methamphetamine use and violence; (b) experimental evidence for a

relationship between methamphetamine use and violent behaviour; (c) research on aggression and violent behaviour among populations of methamphetamine users; and (d) clinical and field observations of violent behaviour among people intoxicated with methamphetamine, particularly in the context of methamphetamine-induced psychosis.

A BIOLOGICAL BASIS FOR THE RELATIONSHIP BETWEEN METHAMPHETAMINE USE AND VIOLENT BEHAVIOUR

In order for a causal relationship to exist between methamphetamine use and violence, there must be a plausible biological pathway through which methamphetamine use can cause violence. There are a number of biological factors that increase the risk of violent behaviour (e.g. certain types of brain pathologies), but the most likely way for methamphetamine use to increase the risk of violent behaviour is by its action on neurochemical systems in the brain.

The most commonly cited neuropharmacological substrate of violent behaviour is depleted serotonin (Boles & Miotto 2003; Ferrari et al. 2005; Kramarcy, Brown & Thurmond 1984; Nelson & Chiavegatto 2001). Chronic methamphetamine use is more often cited to affect the regulation of dopamine than serotonin (Wang et al. 2004), although there is evidence from animal and non-human primate research that chronic methamphetamine dosing can lead to serotonin depletion (Ricaurte, Schuster & Seiden 1980; Hotchkiss & Gibb 1980; Woolverton et al. 1989).

Evidence for chronic use of methamphetamine increasing aggression in humans via serotonin depletion comes from a recent study by Sekine et al. (2006). Chronic methamphetamine users were found to have both higher levels of aggression than non-drug using controls and decreased levels of serotonin in areas of the brain that are involved in the regulation of aggression (e.g. orbitofrontal cortex, anterior cingulate cortex and temporal cortex). Sekine and colleagues also found that the level of

serotonin depletion in these areas of the brain correlated with the magnitude of aggression among methamphetamine users.

Although the research by Sekine and colleagues supports the view that chronic methamphetamine use may lead to aggression by depleting serotonin, it is important to recognise that serotonin depletion is not specific to aggression, nor is it specific to chronic methamphetamine users. Serotonin dysfunction has been implicated in other conditions that are common among chronic methamphetamine users (e.g. depression and impulsivity), and its role in mediating depression, for example, is clearer than its role in mediating aggression. Furthermore, serotonin depletion is more clearly documented as a long-term consequence of ecstasy use, for example, than methamphetamine use (Clemens et al. 2004), but there is little evidence of a relationship between chronic ecstasy use and aggression. Therefore, although this finding shows that serotonin depletion is common to both chronic methamphetamine use and aggression, it does not confirm a causal relationship between these two entities.

Acute meth/amphetamine intoxication could also enhance aggressive behaviour by increasing noradrenaline and dopamine activity (Bell & Hepper 1987; Haller, Makara & Kruk 1998). Of particular relevance, methamphetamine's action on noradrenaline can create a 'fight-or-flight' type response via the sympathetic nervous system which, in turn, may mediate many of the characteristics observed among hostile methamphetamine users, such as dilated pupils, sweating, threatening posture and muscle tension, increased stamina and endurance (Haller, Makara & Kruk 1998). Increased dopamine has also been implicated in aggression, although the evidence for dopamine mediating aggression is less conclusive than for the other monoamines, serotonin and noradrenaline (Haller, Makara & Kruk 1998; McEllistrem 2004; van Erp & Miczek 2000).

EXPERIMENTAL EVIDENCE FOR A RELATIONSHIP BETWEEN METHAMPHETAMINE USE AND VIOLENT BEHAVIOUR

Acute doses of amphetamine in animals

Most of the experimental research on the relationship between methamphetamine intoxication and aggression is animal-based. This area of research has produced inconsistent results from which it is not possible to conclude that acute doses of methamphetamine induce aggression (Crowley 1972; Maeda, Sato & Maki 1985; Miczek & O'Donnell 1978; Shintomi 1975). There is some research showing that low to moderate doses of methamphetamine can augment aggressive responses (Crowley 1972; Maeda, Sato & Maki 1985; Shintomi 1975), but these effects are not consistently observed across species or experimental paradigms (Miczek & O'Donnell 1978; Miczek & Tidey 1989) and may be confounded by methamphetamine's effect on vigilance and physical activity.

Very high toxic doses of amphetamine have been found to increase aggressive behaviour, including increased startle, threat and defensive responses in rats (Ellison et al. 1978), and fighting behaviour in mice (Chance 1948; Hasselager, Rolinski & Randrup 1972; Moore 1963). These aggressive behaviours occur alongside severe disruptions in normal behaviour, including social withdrawal and stereotyped behaviour (Ellison et al. 1978). It is likely that the defensive responses being observed in this context are related to toxicity from the drug, and are akin to the behaviour associated with methamphetamine-induced psychosis.

Acute doses of dextro-amphetamine in non-human primates

Smith and Byrd (1984, 1985) examined the effect of acute doses of dextro-amphetamine on social interaction among

non-human primates and found that intoxication with the drug could increase hostility, but this was contingent on the nature of the social relationship between primates, their standing within the social group, and whether all individuals in the group were intoxicated or whether only one individual was intoxicated. In all, these primate studies do not provide strong evidence for dextro-amphetamine inducing aggressive behaviour, and reflect the complexities of assessing the impact of meth/amphetamine on aggression within a social context.

Acute doses of dextro-amphetamine in humans

Most of the research on meth/amphetamine's effect on aggression in humans has been conducted using oral administration of dextro-amphetamine, particularly in the context of the drug's pharmaceutical application as a medication for narcolepsy, obesity (Laties & Weiss 1981; Leventhal & Brodie 1981) and Attention-Deficit/Hyperactivity Disorder (Allen, Safer & Covi 1975). This research indicates that acute low doses of dextro-amphetamine do not increase aggression.

The effects of low doses of dextro-amphetamine given orally include increased friendliness, increased talking, increased motor activity, decreased fatigue, anorexia and mild euphoria (Allen, Safer & Covi 1975). According to Allan, Safer and Covi (1975), aggression has not been documented as a side effect of dextro-amphetamine when used to treat obesity (Penick 1969), narcolepsy or depression (Wheatley 1969). Controlled studies have found no indication of aggressive acts following 5 to 30 mg doses of dextro-amphetamine (Cherek et al. 1987; Cherek et al. 1990). In fact, chronic medication regimes involving up to 60 mg of oral dextro-amphetamine per day in adults have not been reported to induce aggression (Ban 1969).

Contrary to the view that meth/amphetamine use increases aggression, oral dextro-amphetamine has been used

successfully to medicate aggressive behaviour among children suffering from Attention-Deficit/Hyperactivity Disorder. Within this population, dextro-amphetamine has the effect of reducing fighting within a classroom environment, and reducing the incidence of angry outbursts and defiant behaviour (Conners 1971).

Augmentation of provoked aggression

Animal-based research has shown that methamphetamine can reduce the threshold for aggressive behaviour in threatening situations (e.g. in response to an intruder animal). However, results in this area of research are inconsistent, and are confounded by the ability of methamphetamine to increase motor activity and vigilance. Of importance, methamphetamine has failed to yield a clear effect on aggression in paradigms where alcohol does yield a clear dose-response increase in aggression (Miczek & Tidey 1989).

A further observation is that amphetamine prevents habituation to threatening situations. That is, normally aggression toward a threatening stimulus (e.g. an intruder) diminishes markedly with repeated encounters. Acute doses of amphetamine block this habituation to the threatening stimulus and, in doing this, lead to a significant increase in aggression (Winslow & Miczek 1983). This effect has only been documented in one animal study, and may be related to amphetamine's anti-fatigue effect (McEllistrem 2004).

Augmentation of aggression associated with opioid withdrawal

One circumstance in which methamphetamine appears to augment aggression is within the context of opioid withdrawal. Increased aggression during opioid withdrawal has been demonstrated both in experimental animal research and in opioid dependent people (Miczek et al. 1994). Acute

intoxication with methamphetamine during opioid withdrawal augments this aggressive behaviour (Kantak & Miczek 1988). A similar increase in aggression during opioid withdrawal has also been seen following cocaine use and, in line with this, studies that have explored the impact of pharmacological agents on this augmentation of aggression suggest that it is mediated by methamphetamine-induced increases in the neurochemical dopamine (Miczek & Tidey 1989).

Chronic methamphetamine exposure

Several of the early experiments that examined the effect of amphetamine on aggression found that chronic high dosing with amphetamine could increase aggressive behaviour (Ehrich & Krumbhaar 1937; Randrup & Munkrad 1967). More recent research provides reasonably robust experimental evidence that chronic methamphetamine exposure increases aggression. Sokolov and colleagues undertook a series of research studies examining the impact of repeated injections of methamphetamine on aggressive responding to a threatening stimulus (e.g. an intruder animal). Although an acute dose of the drug had no impact on aggressive behaviour (consistent with previous research), repeated injections of the drug increased fighting behaviour (Sokolov, Schlinder & Cadet 2004; Sokolov & Cadet 2005).

Summary

Experimental evidence suggests that increased aggression is most likely to occur following chronic exposure to meth/amphetamine. Acute doses of the drug may enhance an aggressive response once a person has been provoked, or may potentiate violence associated with other conditions (e.g. opioid withdrawal), but there is little evidence that acute low to moderate doses of meth/amphetamine alone are sufficient to invoke aggressive behaviour. Acute intoxication with meth/amphetamine could enhance an aggressive response (e.g. to a threatening situation) by increasing

physical stamina and alertness, and reducing fatigue. Most of the human experimental research in this area has been conducted with relatively low doses of orally administered dextro-amphetamine. It is therefore difficult to conclude with certainty that high dosage methamphetamine injection (typical of that seen among chronic illicit users of the drug) does not increase the risk of violent behaviour.

RESEARCH ON VIOLENT BEHAVIOUR AMONG POPULATIONS OF METHAMPHETAMINE USERS

Aggressive behaviour among methamphetamine users

Several studies have found high levels of aggressive behaviour among regular meth/amphetamine users. One such study, undertaken in Sydney by Hall et al. (1996), found that almost half of the amphetamine users surveyed reported violent behaviour. Hostility was also found to be more common after the participant began using amphetamine, and among injecting users of the drug, suggesting that violence was related to amphetamine use. Wright and Klee (2001) also found that the majority (62%) of heavy amphetamine users they surveyed reported problems with aggression, which the amphetamine users related to their use of the drug.

A further study conducted in the United States of America (Zweben et al. 2004) interviewed methamphetamine users in treatment and found that almost half reported problems controlling violent behaviour in the previous month. Self-reported problems with controlling violent behaviour were correlated with the number of times the person had been charged with assault.

Sommers and Baskin (2006) examined violence among methamphetamine users during intoxication with the drug, and defined violence as '*any form of deliberate physical harm inflicted on another individual*'. These

researchers found that 27 per cent of methamphetamine users had engaged in violent behaviour while under the influence of methamphetamine, and that around half (51%) of these incidents occurred within domestic relationships, while almost one-third (29%) were drug-related. Incidents also included random acts of violence (e.g. stranger assault and road rage, 11%) and gang-related violence (9%).

Although these studies show high levels of aggressive behaviour among meth/amphetamine users, including violence while intoxicated with the drug, it is not clear from this research: (a) to what extent aggressive or violent behaviour is elevated among methamphetamine users relative to the general population; or (b) whether hostility among methamphetamine users is an artefact of personality or lifestyle factors that co-occur with illicit drug use (e.g. poverty, Anti-Social Personality Disorder, poor health, polydrug use) or violence inherent in the illicit drug market (i.e. disputes over drug-deals).

Violent crime among methamphetamine users

Other studies have examined the prevalence of violent crime among methamphetamine users. Although these studies show that a sizeable proportion of regular meth/amphetamine users have engaged in violent crime (Cartier, Farabee & Prendergast 2006; Hall & Hando 1994; Klee & Morris 1994; Sommers & Baskin 2006; Sommers, Baskin & Baskin-Sommers 2006), involvement in violent crime is relatively common among illicit drug users, and is not specific to methamphetamine users. In fact, the past year prevalence of violent crime among regular methamphetamine users in NSW (McKetin, McLaren & Kelly 2005) is roughly comparable to that seen among other populations of regular illicit drug users (Hall & Hando 1994; Lynch et al. 2003; Ross et al. 2002).

One of the few studies to compare the prevalence of violent crime among meth/amphetamine injectors with other

drug injectors was conducted by Kaye and Darke (2000). Kaye and Darke (2000) found that, although a proportion of meth/amphetamine injectors were involved in violent crime, they were less likely to commit violent crime than their heroin injecting peers. McBride (1981) also found that violent crime was more common among prisoners who had a history of narcotic use compared with prisoners who used other drugs, including amphetamine.

A Swedish population-based study of violent crime and drug use

Grann and Fazel (2004) examined the relative risk of violent crime associated with various types of drugs in Sweden by linking hospital and crime record data. This study examined the rate of violent crime among convicted criminals who had a drug-related hospital record over a 12-year period. Violent crimes included homicide, aggravated assault, common assault, robbery, threatening behaviour and harassment, arson, and any sexual offence.

Grann and Fazel (2004) found that the rate of violent convictions was far higher among people that had been hospitalised for amphetamine use than among the general population (2,052 per 1,000 persons over the study period, cf. 48.2 per 1,000 persons among the general population). The rate of violent convictions among amphetamine users was also high in comparison with other psychoactive substances (537 – 1,829 per 1,000 persons). Of interest, the rate of violent offending among people who had a hospital record for drug-induced psychosis was comparable to that seen among amphetamine users (2,026 per 1,000 persons).

Taking into account the number of convictions among amphetamine users compared to the general population, amphetamine use accounted for 3.4 per cent of all convictions for violent crimes. By way of comparison, alcohol misuse accounted for 16.2 per cent of violent crime convictions, even though the rate of

violent convictions among people with an alcohol-related hospital record was lower than for many other drug types (537 per 1,000 persons).

The Grann and Fazel study shows that the rate of violent convictions is higher among amphetamine users than among other drug users, but that amphetamine use contributes to only a small proportion of the total number of violent convictions in Sweden.

Psychostimulant use and crime in the context of opioid use

Further studies have examined the impact of psychostimulant use on violent crime among opioid users. These studies provide some evidence of an association between psychostimulant use and an increase in violent crime among heroin users. Specifically, Degenhardt et al. (2005b) document an increase in robbery with weapons among injecting drug users in Sydney in the wake of the Australian heroin shortage in 2001, which they attribute to an increase in cocaine use during this time. However, Degenhardt et al. found no concurrent increase in assaults or homicides, but a general increase in robbery incidents, suggesting that the rise in violent crime which they attributed to cocaine use was likely to be predominantly economically motivated.

Jones, Weatherburn and Freeman (2005) also provide tenuous evidence for a relationship between psychostimulant use and violent crime among injecting heroin users. Specifically, Jones and colleagues found that injecting heroin users who engaged in concurrent psychostimulant use were more likely to have recently committed violent crime. However, this observation was in the context of an overall higher level of crime among heroin injectors who were concurrently using psychostimulants, and the researchers failed to find a significant relationship specifically between psychostimulant use and assaults. Similar to the research by Degenhardt et al. described above, this study also suggests that greater economic need among poly-drug using heroin injectors is likely to be influencing violent crime.

Summary

Aggression, violent behaviour and violent crime are relatively common among chronic illicit methamphetamine users, who are more likely to engage in violent crime than the general population. However, violent crime is not specific to methamphetamine users, also being common among other illicit drug using populations. There are mixed findings about the comparative levels of violent crime among methamphetamine users compared to opioid users, and users of other drug types. The apparent conflict between research findings is likely to be related to the lack of a distinction between economically motivated violent crime (e.g. armed robbery), and aggressive or violent behaviour that might lead to assaults. A further limitation with this area of research is that it does not control for personality or life-situation factors (e.g. unemployment, Anti-Social Personality Disorder) that influence crime, and often co-occur with chronic methamphetamine use. Overall, it appears that, although methamphetamine users have high rates of violent offending compared to the general population, they are likely to comprise only a small proportion of violent offenders. Even among those who do commit violent offences, the role of methamphetamine use over other predictors of violent crime has not been established.

CLINICAL AND FIELD OBSERVATIONS

A historical perspective on methamphetamine use and violence

The strongest association between methamphetamine use and violence is evidenced by observations of seemingly irrational acts of violence, including homicides, among users of the drug. The post-World War II amphetamine epidemics in Japan and Sweden have been associated strongly with an increase in violence (Anglin et al. 2000; Fink &

Hyatt 1978; Noda 1950). In America, during the 1960s and 1970s, the media attributed a spate of homicides to amphetamine use (Greenberg 1976), while other researchers noted bizarre violence associated with amphetamine parties (Griffith et al. 1972) and the capricious manner in which people intoxicated with amphetamines turn against strangers and friends alike (Angrist & Gershon 1970). In the late 1960s, as amphetamine use gained popularity in San Francisco, the incidence of violence also increased (Smith 1970). Indeed, contemporary reports from police and emergency medical personnel in Sydney also involve severe cases of 'rage' and inexplicable hostile behaviour among people intoxicated with methamphetamine (McKetin, McLaren & Kelly 2005).

Ellinwood's (1971) study of homicides involving amphetamine abuse

The most detailed analysis of violent behaviour among meth/amphetamine users was undertaken by Ellinwood (1971), who described thirteen cases of homicide associated with amphetamine abuse. Ellinwood concluded that the '*events leading to the homicidal act were directly related to amphetamine-induced paranoid thinking, panic, emotional lability, or lowered impulse control*' (p. 1170). He also noted the importance of other factors in these homicides, including a predisposing personality, environmental circumstances, and the use of other drugs. Ellinwood examined the mind-set of those committing the homicides, and defined three stages leading to the violent act:

- (1) chronic amphetamine abuse, which may predispose the person to paranoid thinking and possibly carrying a weapon;
- (2) an acute change in the individual's state of emotional arousal (which may be precipitated by an increase in dosage of amphetamine, sleep deprivation or polydrug use) where

the individual misinterprets their environment because of their delusional thoughts; and

- (3) a situation that triggers the specific events leading up to the act of violence: the act of violence often occurring as an impulsive response to a perceived threat or danger.

Violence and psychosis

The observation that violence among methamphetamine users is related to psychosis is consistent with the broader psychiatric literature. People who suffer from psychotic disorders are more likely to exhibit violent behaviour than the general community (Marzuk 1996). The risk of violence among people experiencing psychosis is also predicted by persecutory delusions, where the person believes that someone is going to hurt them (Stompe, Ortwein-Swoboda & Schanda 2004), such as those situations described by Ellinwood (1971). This is particularly important because persecutory ideation is a core symptom of methamphetamine-induced psychosis (Angrist & Gershon 1970; Connell 1958).

Although field observations suggest that violence among methamphetamine users is related to paranoid thinking, few studies have attempted to quantify this relationship. It has been found that patients presenting with methamphetamine-induced psychosis have higher levels of aggression than patients presenting with other drug- or alcohol-induced psychiatric disorders (Szuster 1990). Research on the prevalence of hostility among methamphetamine users during psychosis suggests that around one-quarter will exhibit overt hostility. Specifically, Kalant (1966) reported on 87 cases of psychosis induced by methamphetamine and found that 19 (22%) showed symptoms of hostility. Recent research conducted in Sydney cites a similar proportion (27%) of

methamphetamine users reporting overt hostility during psychosis (McKetin, McLaren & Kelly 2005).

Not all violence committed by people experiencing psychosis is related to persecutory delusions. Within this population, substance use generally increases the risk of violence and aggressive behaviour (Soyka 2000). Violence among people with psychosis is also predicted by Anti-Social Personality Disorder (Hodgins, Hiscoke & Freese 2003), which is also prevalent among illicit drug using populations (Darke, Kaye & Finlay-Jones 1998).

Summary

In summary, methamphetamine-related violence is often observed in the context of psychotic symptoms and, within this context, violence is likely to be related to persecutory delusions. Only a proportion of people experiencing methamphetamine psychosis will show hostile behaviour, and this is thought to be influenced by polydrug use, impulsivity, a predisposition toward violence, and circumstantial factors. It is less clear from these clinical and field observations to what extent violent behaviour occurs outside the context of methamphetamine psychosis and, if this does occur, to what extent it is related to methamphetamine intoxication.

FACTORS AFFECTING THE RELATIONSHIP BETWEEN METHAMPHETAMINE USE AND VIOLENT BEHAVIOUR

Other studies have examined factors associated with violence within populations of methamphetamine users. This research, consistent with the broader research on predictors of violent behaviour, has found that a range of socio-economic, cultural and individual factors influence violence among methamphetamine users.

Polydrug Use

The influence of other drugs on the behavioural effects of amphetamine needs to be considered. Goldstein (1989) found that aggressiveness was most likely to occur when amphetamine was taken in addition to barbiturates, which also have a violence-inducing reputation. It has been argued elsewhere that most of the violence linked to amphetamine use occurs in the presence of alcohol (De La Rosa, Lambert & Gropper 1990). The link between the psychopharmacological effects of alcohol and violence has been extensively studied and is perceived to be more compelling than that between methamphetamine and violence (Collins 1990; De La Rosa, Lambert & Gropper 1990).

User's Expectation

Even if it appears that a drug directly leads to violence (on its own or in combination with other drugs), it may be the user's expectation of what that drug will do based on its reputation rather than the drug's pharmacological effects (Goldstein 1989). There have been reports of young male amphetamine users administering the drug when they were planning to perpetrate violent acts (Wright & Klee 2001). It should be noted that this type of amphetamine-induced violence is distinct from the impulsive, unpremeditated violence most often reported in the amphetamine-violence literature that is related to amphetamine psychosis (Asnis & Smith 1978; Ellinwood 1971).

Situational and personality variables

Even the early researchers who claimed that amphetamine is a violence-inducing drug accepted that the pharmacological effects of amphetamine in isolation do not necessarily lead to violence. Smith (1970) acknowledged that most of the violence associated with amphetamine occurred during drug transactions. Ellinwood (1971) acknowledged the importance of situational and personality factors in the cases he presented, as did

Asnis and Smith (1978). Bolstering the importance of pre-existing personality factors in the amphetamine-violence relationship is research that has shown that childhood aggression and conduct problems are both precursors to adolescent drug use and later violent behaviour (McCormick & Smith 1995). Having a history of aggressive or violent behaviour or a prior psychiatric condition have been identified as key determinants of whether later substance use will increase these behaviours (Reiss & Roth 1993).

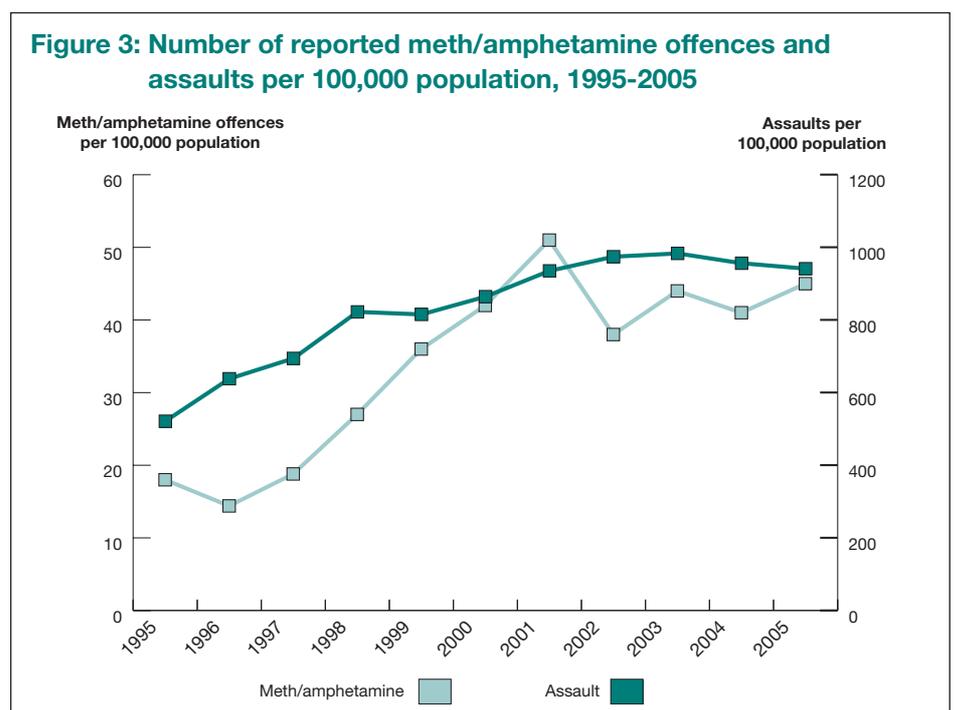
HAS METHAMPHETAMINE USE CONTRIBUTED TO THE RISE IN ASSAULTS IN NSW?

Over the past decade there has been a significant increase in the rate of assaults in NSW (Moffatt & Poynton 2006). Most of this increase occurred through the late 1990s (see Figure 3) when the number of recorded assaults in NSW increased from 522 per 100,000 persons in 1995 to 863 per 100,000 persons in 1999. The number of assaults continued to increase until 2002 (936 per 100,000 persons). There was no further increase

in the number of recorded assaults per population between 2002 and 2005 (see Figure 3).⁵

There are several reasons for thinking that methamphetamine use may have contributed to the rise in assaults in NSW over the past decade. Firstly, the evidence points toward a significant increase in methamphetamine use over this period, and historically, increases in methamphetamine use have been associated with increases in violence. Secondly, there is experimental evidence that chronic use of the drug can increase aggressive behaviour. Thirdly, acute intoxication with methamphetamine may enhance or augment an aggressive response in someone who is threatened or provoked. Finally, methamphetamine use is accompanied by a risk of methamphetamine-induced psychosis, which can be accompanied by hostile behaviour, and there has been a rise in the number of hospital admissions for stimulant psychosis over the past five years (Australian Institute of Health and Welfare 2005d).

Having said this, it is worth noting that reported meth/amphetamine offences show a distinct peak in 2001 (around the time of the heroin shortage) and a subsequent drop in 2002 before



continuing to increase from 2003 onward. This distinctive trend is observed in most methamphetamine-related indicator data (see McKetin & McLaren 2004 for a review of these data). In contrast, the rate of assaults shows a much more gradual rise, with no indication of a peak during the 2001 heroin shortage.

The lack of perfect concordance between methamphetamine and assault trends is not surprising, given the potential range of risk factors for assault. For example, previous population-based research from Sweden suggests that methamphetamine users comprise only a small proportion (3.4%) of all violent offenders (Grann & Fazel 2004). While these findings from Sweden are unlikely to generalize directly to the Australian context, they highlight the need to consider the contribution of other factors, including other drug and alcohol use, to violent offending. In particular, the Grann and Fazel study demonstrated that, although amphetamine users had a higher rate of violent offending than most other drug users, alcohol made the greatest contribution of all drugs to the number of violent offence convictions.

The contribution of alcohol use to assaults in NSW is critical because of its widespread use (Australian Institute of Health and Welfare 2005a), and because it is a well established risk factor for assault (Naranjo & Bremmer 1993). There are also a range of other medical conditions, individual personality factors, and environmental stressors that are associated with an increased risk of aggressive or violent behaviour (e.g. schizophrenia, diabetes, brain injury, Anti-Social Personality Disorder). This wide array of factors is likely to be related to the number of assaults occurring in NSW, and may have contributed to the increased assault rate seen over the past decade.

Based on current evidence, methamphetamine use is likely to be implicated in only a small proportion of assaults, and even in these situations,

the role of methamphetamine would hinge on other contextual and individual factors. For this reason, it is highly unlikely that methamphetamine use alone would be responsible for the increase in assaults in NSW over the past decade. Currently, there is insufficient data on the prevalence of assault among methamphetamine users, or to what extent methamphetamine use per se increases the risk of assault (as distinct from pre-morbid or circumstantial factors), to estimate whether, or to what extent, methamphetamine use would affect the assault rate in NSW.

CONCLUSION AND RECOMMENDATIONS FOR FURTHER RESEARCH

Violent behaviour has been observed in the context of methamphetamine use, and historical evidence suggests that methamphetamine epidemics tend to be accompanied by a rise in violent behaviour, particularly bizarre violent acts. Experimental evidence shows that acute intoxication with methamphetamine is not sufficient to induce violent behaviour, but it may exacerbate hostility in individuals who are otherwise predisposed to violence, or exacerbate violence associated with other conditions (e.g. alcohol intoxication, opiate withdrawal). Chronic use of methamphetamine may alter the regulation of the neurochemical systems responsible for regulating anger, which may also increase the risk of violent behaviour in chronic users of the drug. Although this evidence points toward a relationship between methamphetamine use and violence, currently there is insufficient evidence to claim a causal link between chronic methamphetamine use and violent behaviour in humans.

There is little doubt that chronic methamphetamine users report high levels of aggression, and they also have a higher rate of violent offending

compared to the general population. It is not clear, however, whether high levels of violent behaviour among methamphetamine users can be attributed to methamphetamine use per se, or whether they are related to factors that co-occur with methamphetamine use, such as the violence inherent in the drug market, polydrug use, or predisposing personality.

The strongest evidence for a relationship between methamphetamine use and violent behaviour is when violence occurs in the context of methamphetamine-induced psychosis. It is well established that methamphetamine use increases the risk of psychosis (Angrist & Gershon 1970; Curran, Byrappa & McBride 2004; McKetin et al. 2006) and that people suffering psychosis are at heightened risk of violence relative to the general population (Marzuk 1996). Violence is particularly related to perceived threats in the context of persecutory ideation experienced by people with methamphetamine-induced psychosis (Ellinwood 1971; Stompe, Ortwein-Swoboda & Schanda 2004; Szuster 1990). Field observations and historical reports of violent behaviour among methamphetamine users are consistent with the type of impulsive and often bizarre violence associated with methamphetamine-induced psychosis.

Overall, the evidence for a relationship between methamphetamine use and violent behaviour is broadly consistent with the hypothesis that methamphetamine use may have contributed to a rise in assaults in NSW over the past decade. However, this evidence also suggests that the contribution of methamphetamine use to assaults is likely to be minor in comparison with other factors (e.g. alcohol). Currently, there is insufficient reliable data to estimate the relative contribution of methamphetamine use, or other factors, to the rising assault rate in NSW. In order to determine the relative contribution of methamphetamine use to assaults we need improved data on:

- (a) the prevalence and incidence of assaults among methamphetamine users relative to the general population;
- (b) risk factors for assault among methamphetamine users (e.g. psychosis, personality, polydrug use);
- (c) the relative contribution of methamphetamine use to violent behaviour, over other concurrent risk factors for assault; and
- (d) trends in the number of methamphetamine users who would be at increased risk of violent behaviour from their drug use (e.g. chronic or dependent users).

Further work is also needed to translate these individual risk factors into an understanding of how methamphetamine use trends are likely to impact on population level assault rates. Data linkage methods could be used to determine the rate of assault offences among methamphetamine users and the related population attributable risk, as per the research conducted by Grann and Fazel (2004). These types of studies would benefit from a consideration of other risk factors for assault that might be prevalent among methamphetamine using populations (e.g. Anti-Social Personality Disorder).

Time-series modeling would also help to understand whether methamphetamine use patterns could account for trends in assault rates, although this would require an improved understanding of assault rates among methamphetamine users and reliable data on trends in the number of dependent methamphetamine users.

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NOTES

- 1 Amphetamine and methamphetamine are closely related synthetic drugs, which have an almost identical pharmacological action.
- 2 Based on hospital separations from public and private acute care and psychiatric hospitals where the principal diagnosis was 'Mental and behavioural disorders due to use of other stimulants including caffeine, psychotic disorder' (ICD-10 code F15.5).
- 3 Amphetamine-type stimulant drugs include amphetamine, methamphetamine and related phenethylamines.
- 4 Data represent incidents pertaining to a person of interest that were reported during the period 1995 to 2005. Year data reflect date of the incident.
- 5 The rising assault rate could reflect an increased willingness of people to report assaults. Against this argument, there has been a concurrent increase of assault according to victim surveys conducted by the Australian Bureau of Statistics, from 2.7 per cent of the NSW population in 1995 to 4.8 per cent in 2002. There has been no significant change in the reporting of assaults among victims across this time period (Moffatt & Poynton 2006) suggesting a real increase in the number of assaults in NSW between 1995 and 2002.

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