AGE OF INITIATION TO HEROIN USE: COHORT TRENDS AND CONSEQUENCES OF EARLY INITIATION FOR SUBSEQUENT ADJUSTMENT

Michael Lynskey & Wayne Hall

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Michael Lynskey & Wayne Hall

National Drug and Alcohol Research Centre
University of New South Wales

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Executive Summary

Recently there have been heightened concerns in Australia about reports of increased heroin use amongst youth, and suggestions that the age at which heroin use is initiated has declined. Despite these concerns, there has been little empirical information examining either the prevalence of heroin use among youth or time trends in age of initiation to heroin use.

This report examines whether there has been a decrease in the age of initiation to heroin use using two data sources: a combination of the Sydney component of the ANAIDUS and the ASHIDU, and the 1995 National Household Survey. Analyses of the ANAIDUS and ASHIDU data, which contained information from 1,292 heroin users, indicated that the age of initiation to heroin use has declined steadily in recent years: amongst individuals born in 1940-1949 the average age of initiation was 20.5 years (CI = 19.3-21.6) while amongst those born in 1970-1979 it was only 16.5 years (CI = 15.1-17.9). Individuals born in the intervening years had average ages of heroin initiation which were between these extremes (18.8 (CI = 17.8-19.9) for those born in 1950-59 and 18.3 (CI = 17.3-19.2) for those born in 1960-69).

These findings were confirmed by analyses of the National Household Survey. While this survey identified only 54 individuals for whom information on age of initiation to heroin use was available, it was possible to detect a significant association ($p<.005$) between decade of birth and age of initiation to heroin use: the mean age of initiation amongst individuals born during 1970-1979 was 17.7 years (CI = 16.0-19.3); amongst those born in 1960-69 it was 20.8 years (CI = 18.9-22.8) and amongst those born in 1950-59 it was 23.4 years (CI = 20.3-26.5).

Further analysis of the ASHIDU data indicated that younger age of initiation to heroin use was associated with polydrug use, overdose and crime, after the effects of duration of heroin use had been statistically controlled.

While the two data sets analysed above have different strengths and weaknesses (a small random sample versus a large non-random sample), the convergence of their findings is impressive. Both analyses lead to the conclusion that there has been a decline in the average age of initiation to heroin use in recent decades. These findings suggest that there has been both an increase in the willingness of young people to experiment with heroin and an increased availability of the drug over this time. In combination with evidence that there has been an increase in the amount of heroin being imported into Australia, and an increased demand for treatment for opiate dependence, these data suggest that Australia is experiencing a rapid increase in the use of heroin, particularly amongst youth.

1.0 Introduction

1.1 Cohort Trends in Age of Initiation to Heroin Use

Recently there have been heightened concerns in Australia about the use of heroin and the harms associated with its use. These concerns have been motivated, at least in part, by evidence of a dramatic increase in the rate of fatal opiate overdoses in recent years (Hall & Darke, 1997) and concern that this reflects an increase in the prevalence of heroin use and dependence within the community. There is, however, relatively little evidence to support the conjecture that there has been an increase in the prevalence of heroin use. This lack is due in part to the difficulties associated with obtaining accurate estimates of the prevalence of behaviours which have a relatively low base rate, are illegal and therefore liable to be concealed. Heroin use is also concentrated in sectors of society who, for a number of reasons, are likely to be excluded from participation in household surveys such as that conducted as part of the National Drug Strategy (Commonwealth Department of Health and Family Services, 1996).

While it is difficult to obtain accurate estimates of the prevalence of heroin use through the use of large population based surveys, an issue of closely related interest concerns the age of initiation to heroin use. Many of the publicly expressed concerns about heroin use, and substance use in general, centre on the use of these substances by youth. These concerns can be justified on a number of grounds:

1. Young people, through lack of experience and immaturity, may be more vulnerable to the negative effects of drug use.

2. Precocious substance use may disrupt the completion of various developmental tasks, such as the completion of education.

3. Finally, increasing access to heroin amongst youth may indicate a greater availability of heroin and prevalence of heroin use within society.

The first aim of this report is to examine cohort trends in the age of initiation to heroin use amongst participants in a series of studies conducted over the past 10 years. Two of these studies - the Australian National AIDS and Injecting Drug Use Study (ANAIDUS; Australian National AIDS and Injecting Drug Use Study, 1991) and the Australian Study of HIV and Injecting Drug Use (ASHIDU; Loxley, Carruthers & Bevan, 1995) collected data from convenience samples of injecting drug users while the third, the National Drug Strategy Household Survey (Commonwealth Department of Health and Family Services, 1996) interviewed a random sample of Australia's adult population. This data can be used to examine trends over time in the reported age of first heroin use and, specifically, whether there has been a decline in the age of first heroin use over the past several age cohorts.

1.2 The Effects of Early Initiation to Heroin Use

A closely related issue is whether younger age of initiation to substance use is a risk factor which, independently of extent and duration of use, predicts an increased risk of escalating drug use, poor mental health, criminal activity and reduced life opportunities. This issue has been explored in a number of studies (Chen & Kandel, 1995; Fergusson & Horwood, 1997; Fergusson, Lynskey & Horwood, 1996; Kandel, Davies, Karus & Yamaguchi, 1986; Newcomb & Bentler, 1988; Robins & Przybeck, 1985; Schuckit & Russell, 1983; Yamaguchi & Kandel, 1984; Yu & Williford, 1992). These studies have typically focussed on either use of licit drugs (tobacco, alcohol) or, in some cases, cannabis and have concluded that an earlier age of initiation to substance use is associated with increased risks of a range of adverse outcomes.

For example, Robins and Pryzbeck (1985) examined cross-sectional data collected during the course of the Epidemiologic Catchment Area (ECA) program and found that earlier age of initiation to illicit drug use (15 years or less) was associated with significantly increased risks of drug abuse and dependence. More recently, Anthony and Petronis (1996) examined the association between age of initiation to illicit drug use and risks of experiencing drug related problems. They used methods of survival analysis to examine this issue in a sample of 1525 18-24 year old illicit drug users who had been interviewed across the five sites of the ECA. Their results indicated that earlier age of onset of illicit drug use was associated with increased risks of drug related problems. Importantly, this analysis also indicated that the association between age of onset and drug related problems was not simply due to early onset users having had a longer history of illicit drug use in which to experience drug related problems.

There appear to have been no published studies which have specifically focussed on the relationship between age of initiation to heroin use and subsequent adverse outcomes. The best way of examining this issue would be use a longitudinal design in which an unselected group of young people were interviewed before the risk period for onset of heroin use (e.g., 12 years) and then followed at regular intervals until they were past the age of maximum risk of initiation to heroin use. However, the feasibility of such a design for studying heroin use is questionable. Because of the low base rate of heroin use within the general community, with typical estimates suggesting that only 2% of the adult population have ever used heroin, it would be necessary to study 10,000 or more individuals to have sufficient statistical power to examine this issue with any precision. Cost and logistic considerations clearly preclude such a study.

An alternative, more practical research strategy uses a cross sectional design in which a group of known heroin users are assessed on a range of measures including their age of initiation to heroin use and a range of outcomes including current drug use, health risk behaviours and criminal activity. The influence of age of initiation to heroin use on subsequent outcomes would then be examined by a series of regression analyses in which the association between age of initiation and outcomes was assessed after controlling for the effects of duration of heroin use.

The second aim of the current study is therefore to examine the extent to which age of initiation to heroin use is associated with increased risks for a range of outcomes, including extent of drug use, poly drug use, overdose and crime, after the effects of duration of heroin use have been taken into account. This issue will be examined using data obtained as part of the ASHIDU as comprehensive data on a range of outcomes is available in this data set.

2.0 Method

The data reported in this paper were collected as part of three separate studies: The Sydney component of the Australian National AIDS and Injecting Drug Use Study (ANAIDUS; Australian National AIDS and Injecting Drug Use Study, 1991); the Australian Study of HIV and Injecting Drug Use (ASHIDU; Loxley et al, 1995), and the 1995 National Drug Strategy Household Survey (Commonwealth Department of Health and Family Services, 1996). Each study included a number of questions on the individual's history of heroin use including the age at which they first used heroin. A brief description of each of these studies is given below.

2.1 The Australian National AIDS and Injecting Drug Use Study

The Australian National AIDS and Injecting Drug Use Study (ANAIDUS; Australian National AIDS and Injecting Drug Use Study, 1991) conducted interviews with a total of 2482 injecting drug users from throughout Australia. The analyses presented in this report are based on the Sydney sample of this study in which a total of 1245 injecting drug users from throughout Sydney were interviewed between May and December, 1989. Respondents were recruited through advertisements placed in a number of locations including needle and syringe exchange programs, pharmacies and in a popular central city magazine. All interviews were anonymous and respondents were paid $20 for participating. Interviews lasted an average of 1.25 hours and covered a range of topics including demographics, sexual behaviour, drug use and needle sharing behaviour, knowledge and attitudes about HIV/ AIDS and HIV/ AIDS prevention, treatment history and prison history.

Of the 1245 participants in the Sydney component of the ANAIDUS 845 were identified as heroin users and the analyses presented in this report are based on these individuals. Age at first heroin use amongst these respondents was assessed by asking them to report how old they were (in years) when they first used heroin. Amongst these individuals the mean age of initiation to heroin use was 18.2 years and reported age of initiation ranged from 6 to 47 years.

2.2 The Australian Study of HIV and Injecting Drug Use

The Australian Study of HIV and Injecting Drug Use (ASHIDU; Loxley et al, 1995) was a cross-sectional study of 872 individuals from Adelaide, Melbourne, Perth and Sydney. Broadly speaking, the aims of the study were investigate exposure to and risks for infection with blood borne infections amongst injecting drug users. Interviews were conducted during the interval from July to December, 1994 and included questioning on a variety of topics including drug use and injecting behaviour, history of overdose, sexual behaviour, knowledge and attitudes to HIV, Hepatitis B and Hepatitis C, treatment history and criminal and prison history. Respondents were recruited by advertising and snowballing from a variety of start

points including needle and syringe exchange programs, treatment agencies, sexual health clinics, youth work agencies and interviewer networks.

Many of the 872 participants in this study were amphetamine users and had not, in fact, used heroin. Thus, the analyses presented in this paper are based on the 447 respondents who reported ever having used heroin. Each of these respondents was asked: "How old were you when you first used heroin?". Amongst those individuals who had used heroin the mean age of initiation to heroin use was 19.5 years with a range from 8 to 48 years.

Finally, to examine the extent to which age of initiation to heroin use was associated with a range of adverse outcomes, a number of outcomes assessed in the ASHIDU study were also included in the present analyses. These measures were:

1. The number of times that the individual reported injecting drugs in the past month. Respondents were asked to describe their frequency of injecting during the past month on a five point scale: 1 = once a week or less; 2 = more than once a week (but less than once a day); 3 = once a day; 4 = 2-3 times a day; 5 = more than 3 times a day.

2. The number of different illicit drugs or drug classes that the individual reported having used in the past month. Respondents were asked whether they had used any of the following drugs during the last month: amphetamines; heroin; other opiates; homebake; cocaine; hallucinogens; designer drugs; tranquillisers; barbiturates; inhalants or cannabis. From answers to this questioning a continuous measure of the number of different illicit drugs used in the past month was constructed.

3. The amount of money (in dollars) that the individual reported having spent on illicit drugs during the past week. Respondents reported spending an average of $275 (range = 0 - 8,500) on illicit drugs in the past week. As this measure was highly skewed, responses to this questioning were used to construct a five level variable in which: 0 = respondent reported spending no money on illicit drugs in the past week (20.6% of the sample); 1 = respondent reported spending $1-$99 on illicit drugs in the last week (17.7% of the sample); 2 = respondent reported spending $100-$174 on illicit drugs in the last week (21.9% of the sample); 3 = respondent reported spending $175-$350 on illicit drugs in the last week (19.6% of the sample); 4 = respondent reported spending more than $350 on illicit drugs in the last week (20.2% of the sample).

4. The number of times that the individual reported ever having overdosed. This was a continuous measure which ranged from 0 for those who had never overdosed to 6 for those who had overdosed on six or more occasions.

5. The amount of money (in dollars) that the individual reported having earned from criminal activity, including fraud, theft and the sale of illicit drugs, during the past week. Respondents reporting earning an average of $181 (range = 0 -13,000) from criminal activities in the past week. As this measure was highly skewed, responses to this questioning were used to construct a four level variable in which: 0 = respondent reported earning no money from crime in the past week (74.8% of the sample); 1 = respondent reported earning $1-$149 from crime in the last week (7.6% of the sample); 2 = respondent reported earning $150-$500 from crime in the last week (9.3% of the

sample); 3 = respondent reported earning more than $500 from crime in the last week (8.4% of the sample).

To control the associations between age of initiation to heroin use and each of these outcomes for the effects of the duration of heroin use a composite variable was constructed by subtracting each subject's age at initiation to heroin use from their age at the time of the interview to obtain a measure (in years) of their length of heroin use. As the main purpose of these analyses were to determine whether there was an association between age of initiation to heroin use and later outcomes, no further measures were included in these regression analyses. Thus, while factors such as the concurrent use of other drugs may have been associated with risks of overdose, they were not included in the current analyses as we were not interested in developing models to predict overdose but rather, with estimating the association between age of initiation to heroin use and later outcomes. To the extent that any association between factors such as the concurrent use of other drugs and risks of overdose would mediate rather than confound the association between age of initiation and overdose, their exclusion does not alter the substantive conclusions of the analyses reported in this paper.

2.3 The 1995 National Drug Strategy Household Survey

Since 1985 a series of National surveys have been conducted to monitor tobacco, alcohol and illicit drug use as part of the National Drug Strategy. These surveys were conducted in 1985, 1988, 1991, 1993 and, most recently, in 1995. A central aim of these surveys has been to gather information about drug use and the consequences of drug use amongst the Australian population and to monitor the extent to which there may have been changes in the prevalence of drug use over time.

The 1995 survey, on which the present analyses are based, was conducted by AGB McNair who conducted personal interviews with a total of 3,850 respondents aged 14 years or over from throughout Australia. Interviews were spread across all States and Territories and were conducted during the interval from May to June, 1995. The survey instrument included two separate interviews:

An interviewer administered questionnaire covering awareness of and attitudes towards drugs, perceptions of the drug problem and awareness of National Drug Strategy and related campaigns.

A confidential, sealed section completed personally by the respondent which contained questions on their own drug use.

The methods and procedures used in this survey have been described in detail elsewhere (Commonwealth Department of Health and Family Services, 1996).

All respondents in the National Household Survey were asked whether they had ever used heroin and, if they had, they were also asked the age at which they first used it. The survey identified only 61 individuals (1.6% of the survey population) who reported ever having used heroin. The analyses reported in this paper are based on a subsample of 54 individuals: three subjects were excluded from the analyses as they had incomplete data on current age

and/ or age at initiation to heroin use, three further respondents were excluded because they were born during the interval 1940-1949 and one further subject, born in 1980, was also excluded from the analyses. Thus the final analyses were based on a total of 54 respondents: 14 of whom were born during the interval from 1950-1959; 24 of whom were born during the interval from 1960-69 and 17 of whom were born during the interval from 1970-1979.

2.4 Data Analyses

As the data from the ANAIDUS and the ASHIDU were collected from similar subject groups and using virtually identical interview procedures, it was decided to combine the data from these two surveys for the purposes of the present analyses. Combining these data resulted in a total sample of 1292 individuals who reported having used heroin and for whom there was data available on age of initiation to heroin use.

To allow the data from the ANAIDUS and the ASHIDU to be compared data on the subjects' age was used to calculate the decade in which each individual was born. Thus, for example, individuals in the ANAIDUS study, which was conducted in 1989, who reported being between the ages of 40 and 49 were born during the decade from 1940-1949 while respondents in the ASHIDU study, which was conducted in 1994, who were between 45 and 54 years old at the time of the interview would have been born during this period.

While it would have been possible to further combine the data from the ANAIDUS and ASHIDU with that from the National Household survey, the decision was made to conduct the two analyses separately as the two data sources have a number of differences. In particular, while the ANAIDUS and ASHIDU data has the advantage of providing a large data set for analysis, the sample respondents were not randomly selected. On the other hand, respondents in the National Household Survey were randomly selected but there were few of them.

3.0 Results

3.1. Cohort Trends in Age of Initiation to Heroin Use

Pooling the data from the ANAIDUS and the ASHIDU resulted in a total sample size of 1,292 heroin users and the distribution of these sample members across the four birth decades is shown in Table 1. It can be seen from this Table that the majority of sample members were male (70.4%) but that the relative proportion of the sample who were female increased with decreasing age: amongst sample members born during the period 1940-1949 20% were female while, amongst those born during the interval from 1970-1979 44% were female. These results imply that there may have been gender differences in the age of samples. Indeed, additional analyses indicated that females in both the ANAIDUS and ASHIDU studies were significantly ($p<.001$) younger than male respondents: In the ANAIDUS the mean age for females was 31.9 compared with 33.9 for males and in the ASHIDU the average age for females was 28.5 while the average age for males was 31.0 years.

Table 1: Sample Size by Gender and Decade of Birth

Decade of Birth	Numbers Included in Analyses

	Males	Females	Persons
1940-1949	235	59	294
1950-1959	282	91	367
1960-1969	280	154	432
1970-1979	112	87	199

The average self-reported age at initiation to heroin use for respondents from the ANAIDUS and the ASHIDU studies is shown in Table 2. The results in this Table clearly show that there was a consistent and approximately linear decrease in the age of initiation to heroin use amongst later cohorts: across the two studies the average age of initiation amongst cohort members born during the decade from 1940-1949 was 20.5 (CI = 19.3-21.6) years, the average age amongst those born during the interval from 1950-1959 was 18.8 (CI = 17.8-19.9) years, the average age amongst those born during the interval from 1960-1969 was 18.3 (CI = 17.3-19.2) years and the average age amongst those born during the interval from 1970-1979 was only 16.5 years (CI = 15.1-17.9).

To more formally examine the extent to which the observed differences in the age of initiation to illicit drug use were statistically significant a multivariate analysis of variance model was fitted to the data in which age at initiation to heroin use was modelled as a function of: the individual's decade of birth; gender and survey (ANAIDUS versus ASHIDU). The results of this analysis lead to the following conclusions:

1. Firstly, in confirmation of the trends displayed in Table 2, there was a highly significant association ($p<.001$) between decade of birth and age of initiation to heroin use: survey respondents born in earlier decades had a higher mean age at initiation to heroin use than those born more recently.

2. There was no evidence of any significant gender differences in age of initiation to heroin use ($p>.50$). The mean age of initiation to heroin use amongst males (for all age cohorts) was 18.7 (CI = 18.0-19.4) years and the corresponding mean age of initiation to heroin use amongst females was 18.6 years (CI = 17.5-19.6).

3. There was a significant ($p<.001$) difference between respondents in the two surveys (ANAIDUS and ASHIDU) with respect to the age at which they reported initiating heroin use. The average age of initiation to heroin use amongst respondents from the ASHIDU was 19.5 (CI = 19.1-19.9) years while amongst respondents from the ANAIDUS it was 18.2 (CI = 17.9-18.5) years. These differences in the average age of initiation to heroin use amongst respondents from the two surveys mirror differences in the average age of the two samples: the average age of respondents in the ASHIDU was 28.5 years while among respondents from the ANAIDUS it was 27.4 years.

4. There was, however, no evidence of significant ($p>.10$) two- or three-way interactions between decade of birth and gender or survey, indicating that the observed reduction in mean age of initiation to heroin use was constant both for males and females and for respondents from the two surveys.

Together, these results support the general impressions conveyed by the data displayed in Table 2 that there has been a steady decline in age of initiation to heroin use and that this reduction has occurred equally for both males and females.

Table 2: Mean Age at First Heroin Use for Respondents Born in Different Decades

Decade of Birth	Mean Age at First Heroin Use					
	ANAIDUS			ASHIDU		
	Males	Females	Persons	Males	Females	Persons
1940-1949	20.1	20.5	20.2	26.1	26.0	26.1
1950-1959	18.4	17.6	18.2	20.2	20.8	20.3
1960-1969	16.7	17.5	17.0	19.4	20.5	19.8
1970-1979	14.8	14.7	14.7	17.5	17.5	17.5

To examine the extent to which the results reported above were robust to choice of sample recruitment, a series of secondary analyses was conducted on data collected as part of the 1995 National Drug Strategy Household Survey. While this survey only identified 54 individuals for whom information on age of initiation to heroin use was available, it was possible to detect a significant association ($p<.005$) between decade of birth and age of initiation to heroin use: the mean age of initiation amongst individuals born during 1970-1979 was 17.7 years (CI = 16.0-19.3); amongst those born in 1960-69 it was 20.8 years (CI = 18.9-22.8) and amongst those born in 1950-59 it was 23.4 years (CI = 20.3-26.5).

3.2. The Effects of Age of Initiation on Subsequent Outcomes

A series of multiple regression analyses was conducted to examine the extent to which an earlier age of initiation to heroin use was associated with increased risks of a range of negative outcomes. In these analyses the risks of each outcome were modelled as a function of the individual's age of initiation to heroin use after controlling for their duration of heroin use. Control for duration of heroin use was considered necessary as a number of the outcomes may have been partly determined by duration of heroin use. Thus, to the extent that there is a negative association between age of initiation to heroin use and duration of heroin use, it could be argued that any observed bivariate association between age of initiation and outcome was not due to age of initiation *per se* but rather, to the duration of heroin use.

The results of this analysis (see Table 3) lead to the general conclusion that, independently of the effects of duration of heroin use, earlier age of initiation to heroin was associated with increased risks of a range of adverse outcomes including poly drug use ($p < .005$), unintentional overdose ($p < .05$) and money earned from crime ($p < .001$). There was also a marginally significant association ($p < .10$) between age of initiation to heroin use and the amount of money spent on illicit drugs in the past month. However, there was no significant association ($p > .80$) between age of initiation and the number of times that heroin had been used in the past month.

Table 3: Regression Coefficients (Standard Errors) Between Age of Initiation to Heroin Use and Selected Outcomes after Controlling for Duration of Heroin Use.

Outcome	Regression Coefficient	Standard Error	Probability
Number of times used heroin in past month	-.003	.013	>.80
Number of different drugs used in past month	-.050	.016	<.005
Money spent on illicit drugs in past week	-0.027	0.016	<.10
Number of overdoses	-.057	.023	<.05
Money earned from crime in past week	-0.039	0.011	<.001

4.0 Discussion

4.1 Summary of Findings

This report has presented data collected in a series of studies to examine two issues: 1) Whether there are cohort differences in age of initiation to heroin use and; 2) Whether age of initiation to heroin use is associated with increased risks of a range of adverse outcomes independently from the effects of duration of heroin use. The results of these analyses lead to two major conclusions:

1. Firstly, there appears to have been a steady decline in the average age of initiation to heroin use in recent years.

2. Secondly, a younger age of initiation to heroin use was associated with significantly elevated rates of a range of adverse outcomes including polydrug use, experience of overdose and rates of criminal activity. Furthermore, this association was independent from the effects of duration of heroin use.

4.2 Cohort Trends in Age of Initiation to Heroin Use

The major conclusion of this study was that the age of initiation to heroin use has declined steadily in recent years: analyses of the combined ASHIDU and ANAIDUS data revealed that amongst individuals born in 1940-1949 the average age of initiation was 20.5 years while amongst those born in 1970-1979 the average age of initiation was only 16.5 years. Individuals born in the intervening years had average ages of initiation to heroin use which were between these extremes. There was no evidence to suggest gender differences in the age of initiation to heroin use: for the entire sample studied the average age of initiation to heroin use amongst males was 18.7 years while amongst females it was 18.6 years. Finally, there was no evidence to suggest that the rate of decline in the age of initiation to heroin use varied with gender. These general findings were supported by analyses of data from the National Household Survey which also revealed a significant decline in the age of initiation to heroin use: from 23.4 years for individuals born in 1950-59 to 17.8 years for those born in the period 1970-79.

Before discussing the implications of these findings there is an important caveat that should be placed on these results. Firstly, a potentially serious threat to the validity of these findings comes from potential "right censoring" of the samples studied: members of more recent cohorts will not all have completed the period of maximum risk of initiation to heroin use. For example, it is not possible for be younger because those who have not yet initiated heroin use can not be sampled. In particular, it would not be possible for drug users born during the 1970s and interviewed in the ASHIDU to have an age of initiation greater than 24 years. It could be argued that if individuals born during the 1970s were studied over a longer period their average age of initiation might be greater than that reported here if, for example, a large percentage of injecting drug users in that cohort did not commence injecting drug use until after the age of 25 years.

While this may exaggerate the rate of decline, it is unlikely to wholly explain it. The literature on initiation to substance use (e.g., Chen & Kandel, 1995) suggests that typically initiation to heroin use occurs during the late teens and early twenties. This means that it is unlikely that many people born in the early 1970s who have not already commenced heroin use will do so in the future. While some individuals born in the late 1970s are likely to initiate within the near future it is probable that they will do so within the next five years or so. To further examine the extent to which the results reported here may have been influenced by right censoring of the data supplementary analyses of the ASHIDU and ANAIDUS data were conducted in which those sample members born in the most recent cohort (1970-1979) were excluded from the analyses. In confirmation of the results described above, these reanalyses revealed the presence of a statistically significant ($p<.05$) association between decade of birth and age of initiation to heroin use in which the more recent cohorts still had a younger mean age of initiation to heroin use.

The utility and validity of retrospective estimates of age of initiation has recently been questioned by Engels, Knibbe and Drop (1997). These authors conducted a study of the reliability of retrospective reports of age of initiation to alcohol and tobacco use. On the basis of the results of that study they concluded that unreliability in the reporting of age of first use meant that such research should be interpreted with caution.

There are a number of points that Engels et al (1997) failed to consider. Firstly, retrospective reports of age of initiation to substance use are not any less reliable than other commonly used measures in behavioural research. For example, in a highly influential review of cross-informant correlations in child psychopathology, Achenbach, McConaughy and Howell (1987) concluded that correlations between behavioural reports collected from different sources (parent, teacher, child) are typically only in the region of .30-.40. Secondly, a number of studies have shown that reported age of first use increases with increasing age, these reports still retain the relative rank order of age of first use (Hawkins et al, 1997; Henry et al, 1994). Thirdly, provided that errors in the reporting of age of first use are uncorrelated with the outcomes of interest, unreliability in the reporting of age at initiation will attenuate of the observed associations between age of initiation to substance use and outcomes rather than producing spurious associations. In other words, if it were possible to assess age of initiation with greater reliability it is probable that the current study would have found a *stronger* association between age of initiation and adverse outcomes.

Problems with the reliability of retrospective reporting of initiation to substance use do not affect prospective study designs. One such study has been reported by Fergusson, Lynskey and Horwood (1994) who assessed age of first alcohol use during the interval from 11 to 13 years and subsequently examined drinking outcomes at age 15 years. It found that, even after control for a wide range of potentially confounding social, family and individual factors assessed from birth, earlier age of initiation to alcohol use was associated with significantly higher levels of alcohol consumption and alcohol related problems at age 15 years.

4.3 Age of Initiation to Heroin Use and Subsequent Outcomes

The evidence presented above suggests that individuals are commencing IV drug use at increasingly younger ages. This raises the question: is early initiation of substance use associated with increased risks of a range of substance related harms? While there appears to be no published literature focussing specifically on the influence of age of initiation to heroin use, there is a large and growing literature which has explored the effects of early initiation to substance use in general on later outcomes. This research has consistently reported that younger age of initiation to substance use is associated with greater risks of a wide range of negative outcomes, including more prolonged and problem substance use, greater risks of criminal offending, poorer mental health and reduced life opportunities (Chen & Kandel, 1995; Chou & Pickering, 1992; Fergusson & Horwood, 1997; Fergusson et al, 1996; Kandel et al, 1986; Newcomb & Bentler, 1988; Robins & Przybeck, 1985; Schuckit & Russell, 1983; Yamaguchi & Kandel, 1984; Yu & Williford, 1992)[1].

For example, in a recent paper Hawkins et al (1997) examined the effects of age of initiation to alcohol use on subsequent alcohol misuse in a sample of 808 10-11 year olds who were followed prospectively to age 17-18. Their results indicated that age of initiation was highly associated with subsequent alcohol misuse. Additional analyses indicated that the influence of a range of other variables, including parental drinking, parenting style, school bonding, peer alcohol initiation and ethnicity were mediated by the effects of age of initiation. The authors concluded that delaying initiation to alcohol use was an appropriate target for prevention programs.

Using the current data it was possible to conduct a preliminary investigation of this issue. Specifically, a series of multiple regression analyses was conducted in which a series of outcomes assessed at the time of the interview (drug use, experience of overdose, criminal activity) were modelled as a function of the individual's self reported age of initiation to heroin use after control for duration of illicit drug use. The results of these analyses indicated that a younger age of initiation to heroin use was associated with a greater risk of various negative outcomes independently of the respondent's duration of heroin use. It may be that the association between age of initiation and later outcomes is not causal but arises from the effects of confounding factors which are associated with an earlier age of initiation to heroin use and independently with increased risks of a range of negative outcomes in adulthood. This hypothesis can not be ruled out but the convergence of these findings with those of other studies clearly suggests that early initiation of illicit drug use is associated with increased risks of a range of adverse outcomes.

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[1] There is one recent study which concludes that age of initiation to alcohol or illicit drug use is not associated with increased risks of long term substance misuse (Labouvie, Bates & Pandina, 1997). Its conclusions should, however, be treated with extreme caution as the authors appear to have made a fundamental error in fitting the regression models to the data on substance use at age 30 years. Specifically, they controlled the associations between age of first use and outcomes at age 30 years *for the effects of alcohol and drug use at age 20 years*. As this measure was an intervening variable, it was inappropriate to include it in the analyses as a confounding covariate. When use at age 20 was omitted, age of first use emerged as a significant (albeit weak) predictor of outcomes at age 30 years.

In summary, the results reported in this paper indicate that, even after controlling for the effects of duration of heroin use, the early initiation to heroin use is associated with increased risks of a range of adverse health and social outcomes. Although there are few reports of an association between age of initiation to heroin use and later harms, there are clear parallels with previous findings that an early age of initiation to alcohol, tobacco and cannabis is associated with increased risks of a range of adverse outcomes. The present analyses can not rule out the possibility that the observed association arises from the effects of third or confounding factors that are associated with both an earlier age of initiation to heroin use and with increased risks of substance related and other harms. However, previous studies which have been able to examine this issue (by including a large number of potentially confounding social, family, individual and peer factors in their analyses) have concluded that an early age of initiation independently predicts risks of adverse outcomes (Fergusson et al, 1994; Hawkins et al, 1997).

Thus, it would appear that early age of initiation to substance use is a risk factor for the development of substance related harm and other negative outcomes which is independent of the effects of confounding social, family and individual factors. These findings clearly suggest that current interventions designed to delay the onset of substance use (both licit and illicit) are worth pursuing. Even if they are unsuccessful in preventing the onset of substance use, any delay in the onset of these behaviours is likely to be associated with decreased risks of a range of adverse outcomes, including escalation of drug use, mental health problems and risks of physical ill health associated with illicit drug use.

4.4 Other Supporting Data

Other data consistent with both an increasing prevalence of heroin use and a decreasing age of initiation to heroin use includes the following.

1. *Police and Customs reports of increased amounts and availability of heroin in Australia.* The annual reports on illicit drug use published by the Australian Bureau of Criminal Intelligence in 1996 (Australian Bureau of Criminal Intelligence, 1996) and 1997 (Australian Bureau of Criminal Intelligence, 1997) both indicate that there has been a rise in the number of heroin seizures and heroin related arrests. For example, the most recent edition of this report (Australian Bureau of Criminal Intelligence, 1997) concludes that: a) the worldwide production of heroin has increased in recent years; b) there has been an overall increase in the amount of heroin detected at the customs barrier over the past five years and; c) heroin was widely available during 1996-1997. A further finding from the most recent Illicit Drug Report is that, corresponding to an increase in the number of heroin related arrests, there has been a steady decline in the age of people being arrested for heroin related offences: the average age of people arrested for heroin possession in the first quarter of 1995 was approximately 28 years but this had decreased to just over 25 years by the second quarter of 1997. During the same time the average age of those arrested for supplying heroin fell from just over 30 years to approximately 25 years (Australian Bureau of Criminal Intelligence, 1997).

2. *Additionally, results from the Illicit Drug Reporting System suggest that there has been a decline in the average age of injecting drug users in Sydney* (Hando et al, 1997).

This conclusion was also supported by reports from key informants in the IDRS. While, because of the selected nature of the samples studied as part of the IDRS, these results do not conclusively prove either that there has been an increase in the number of young people using heroin or that there has been a decline in the average age of initiation to heroin use, they do provide tentative support for both these conclusions.

3. *A decrease in the age at which overdose mortality peaks.* Analyses of data on overdose mortality during the period from 1979 to 1995 have indicated that more recent birth cohorts have experienced higher rates (per 1,000,000 population) of opioid overdose mortality than older birth cohorts (Hall and Darke, 1997). Additionally, these data have indicated a decline in the average age at which overdose deaths have increased across birth cohorts. For example, among those born in 1960-64 the age at which overdose accounted for 10% of all deaths was 33 years while it was only 23.5 years among those born in 1970-74. While an increase in opioid overdose could be attributed to factors other than an increase in the number of people using heroin, these results, which mirror the reported decline in the age of initiation to heroin use, support the view that there has been an increase in the numbers of people using heroin.

4. *International evidence of an increase in the prevalence of heroin use and heroin related harm.* Specifically, there is evidence to suggest that the rise in overdose fatalities described above has been paralleled by similar increases in the rate of opioid overdose in a number of countries including the Nordic countries (Steentoft et al, 1996), Spain (de la Fuente, 1995; Sanchez et al, 1994), Italy (Davoli et al, 1997), Austria (Risser & Schneider, 1994) and the United States (United States Department of Health and Human Services, 1997a). For example, annual medical examiner data reported as part of the Drug Abuse Warning Network indicates that the number of deaths attributed to heroin/ morphine (but not other opiates) rose from 2,868 in 1992 to 3,976 in 1995. Similarly, further evidence from the United States suggests that that country has recently experienced an increase in the use of heroin (Office of National Drug Control Policy, 1996) and in the number of hospital admissions related to heroin use (United States Department of Health and Human Services, 1997b).

Together, this convergence of national and international evidence leads to the tentative conclusion that there has been an increase in heroin use in recent years and a concurrent decline in the average age of initiation to heroin use. The apparent rise in heroin use is paralleled by a general rise in rates of many psychosocial disorders amongst youth (Rutter & Smith, 1995). Specifically, in a comprehensive review of this issue, Rutter and Smith (1995) documented a rise in the prevalence of a number of psychosocial disorders (including substance use and misuse, juvenile offending, depression, suicidal behaviours and eating disorders) over the last fifty years. From their discussion of possible causal mechanisms underlying this rise in psychosocial disorders the one thing that becomes clear is that this rise can not simply be attributed to one specific social condition, such as unemployment or media influences. Rather, it reflects the combination of societal changes that have occurred since the end of the Second World War.

An additional finding from these analyses which merits further comment is the finding, discussed on page 8, that the relative proportion of females varied from cohort to cohort. Specifically, while only 20% of those subjects born in the interval from 1940-1949 were

female 44% of those born in the interval 1970-1979 were female. This finding may suggest that there has been a disproportionate increase in the number of females using heroin over the past three decades or so. While this conjecture may seem speculative, given that the findings are based on convenience samples of injecting drug users, there are parallels between this finding and other findings in the literature. For example, in a review of time trends in substance use amongst youth, Silbereisen, Robins and Rutter (1995) note that there has been a trend towards convergence of female and male rates of substance use over the last 20 years or so. Smith and Rutter (1995) note that this trend is part of a broader convergence between male and female rates of a number of psychosocial disorders including substance use, crime, depression and suicidal behaviours (but not suicide).

4.5 Concluding Comment

The finding that there has been a steady decline in the age of initiation to heroin use in recent years has a number of important public health implications. In particular, this evidence may suggest that there has been both an increase in the willingness of young people to experiment with heroin use, probably as a consequence of an increased availability of the drug in recent years. This, coupled with related evidence that there has been an increase in both the amount of heroin being imported into Australia (Australian Bureau of Criminal Intelligence, 1997) and the demand for treatment for opiate dependence (Hall, 1996), suggests that Australia may currently be facing another increase in the use of heroin, particularly among youth, similar to that experienced in 1985.

This expected outcome has clear implications including: a) the potential for increased spread of infectious diseases and particularly HIV/ AIDS and Hepatitis; b) a probable need to increase the provision of treatment services and; c) a probable increase in the number of opiate related deaths over the next ten years as research has shown that those most at risk of fatal overdose are those individuals who have been using opiates for a prolonged period (Hall & Darke, 1997).

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