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NACD An Overview of Scientific and other Information on Cannabis

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Designed by **first impression**

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Dr Mark Morgan is Head of the Education Department at St. Patrick's College, Drumcondra, Dublin, Ireland. His research has mainly been in the areas of literacy, educational disadvantage and substance use, particularly the evaluation of prevention programmes.

Foreword – Minister of State

I am happy to welcome this overview of the available information on the effects of cannabis use. The report is primarily concerned with the consequences of cannabis use for the individual and society in terms of the physical, psychological, educational and mental health consequences, as well as implications for public health for society and for law enforcement. As the overview notes, cannabis is the most widely used illegal drug in Ireland. Knowing as much as possible about its health and social consequences is, therefore, essential. In recognition of this, the Government asked the National Advisory Committee on Drugs (NACD) to undertake this research in order to improve our overall knowledge in this area

As the report points out, the vast body of research on the consequences of cannabis use does not lend itself to simple and easy conclusions. However, the report provides an invaluable service in bringing together the available evidence and drawing conclusions, where possible. I believe the report shows that cannabis is a complex substance and, notwithstanding the fact that it is not as dangerous as some other drugs, it can have many damaging effects on the physical and mental health of the user, particularly the young and those who are heavy users of the drug. The consequences of much wider use of cannabis on the health of the general population have to be considered by those who advocate such a move. The approach we have adopted in Ireland is, I believe, appropriate for our circumstances and our society and we have to refute the notion promoted by some that cannabis is harmless.

As I have said on many occasions, I am always grateful for the research and analysis provided by the NACD and for all the on-going work of all of the members of the National Advisory Committee on Drugs, in particular, its Chairperson - Dr Des Corrigan, its Director - Ms Mairéad Lyons and its Research Officer - Ms Aileen O'Gorman. Finally, I would like to congratulate the authors Claire Collins, Johnny Connolly, Dominique Crowley and Mark Morgan, who also served as editor, on this excellent and comprehensive report.

Noel Ahern TD
Minister of State with responsibility for the National Drug Strategy

Foreword – Chairperson NACD

We know from our general population survey that Cannabis drugs are the most widely used of the illegal drugs in Ireland. This report on the scientific evidence about the drugs produced from the Cannabis plant also demonstrates that they are among the most complex consumed by human beings. This complexity extends from the chemical mixture produced by the plant through the diversity of their effects on so many different parts of the human body. The varied pharmacological and psychological effects of Cannabis drugs give them a unique place in any listing of psychoactive drugs. Not only are the drugs and their effects difficult to categorise, there are also many individual and societal factors which interplay with them and influence their impact on those who use them and on the broader community.

Dr Mark Morgan and his co-contributors Claire Collins, Johnny Connolly and Dominique Crowley have done a remarkable job in capturing the complexities of the Cannabis drugs in all their manifestations. The NACD is grateful to them for performing such a mammoth task and in particular for highlighting broader gaps in our knowledge of these drugs. The authors have also pinpointed more specific areas where we in Ireland need to improve our information base relating to Cannabis.

It is noteworthy that many of the broader areas to which attention is drawn in this report are similar to those mentioned in a Draft Resolution on Cannabis being debated at present at EU level. For instance, the Resolution refers to the need for research on Cannabis within the EU's Sixth Framework Programme especially regarding dependency and health risks and calls on the EMCDDA, as the EU's Drugs Agency to analyse how changes in those using Cannabis intensively and/or in high dose are reflected in the number of people experiencing problems and/or becoming dependent.

With respect to areas where national work is necessary, some of the points noted in the report are addressed by the detailed analysis of Cannabis use in Ireland published as Bulletin 3 of the NACD's general population survey. While that survey does provide us with some insights into Cannabis use in Ireland, the NACD, as a result of its analysis of this report on Cannabis decided to draw attention to the need to monitor the potency of Cannabis products on the Irish market; as well as establishing the extent of Cannabis dependence, and whether there are links between Cannabis use and mental ill-health and respiratory illnesses in particular. Other significant areas where work is needed include a study of what happens when Cannabis users come into contact with the legal system and an investigation of Cannabis use as one of the factors in early school leaving.

By highlighting what is known about the Cannabis plant and the drugs produced from it, but more importantly indicating what is yet unknown about its effects on individuals, families and communities, the four authors have made an invaluable contribution to our understanding of Cannabis.

I would like to thank all those who have contributed to making this publication happen, in particular, Dr Mark Morgan for editing; to Ms Barbara Connolly for proof reading the report and to the staff and members of the NACD for their comments on each draft.

Dr Des Corrigan
Chairperson
NACD

Executive Summary

Overview

Cannabis is the most frequently used illegal substance in Ireland and elsewhere. The recently published findings of a survey of 8,442 people aged between 15 and 64 in Northern Ireland and the Republic of Ireland showed that close to one-fifth of the population in the island as a whole had tried cannabis at some time in their lives (NACD & DAIRU, 2003).

This study is concerned with the consequences of cannabis use for the individual and society. It is concerned with the physical, the psychological, the educational and the mental health consequences, as well as the implications for public health, for society and for law enforcement. The study draws on relevant research from Ireland and abroad with a view to presenting a balanced account of how this illegal, but widely used substance affects a range of outcomes. This document draws on literature published up to early 2003. The intended readership of this report includes not only policy makers but also professionals in the public health area and journalists, as well as the general reader.

It should be said at the outset that the vast body of research on the consequences of cannabis use does not lend itself to simple and easy conclusions. This is partly because the substance is itself a very complex one in terms of its chemical composition. In addition, cannabis use is often associated with use of other substances (legal and illegal) so that the exact part played by cannabis is difficult to pinpoint. Even more complex is the issue of other factors (personality, social factors) which are frequently associated with beginning to use cannabis and which may have an influence on the very outcomes that are sometimes attributed to cannabis use. What we have tried to do is to present the evidence even when it is contradictory. Wherever it was warranted we have given our conclusions based on the broad consensus of the evidence available.

Pharmacology and Toxicological Effects

Chapter 1 examines the pharmacological and toxicological effects of cannabis. Cannabis is a generic term which refers to the psycho-active preparations that derive from the plant *Cannabis sativa*. The major concentration of the active constituents are located in the flowering buds of the plant. Cannabis contains 483 chemicals of which the most important is delta-9-THC, which is largely responsible for the psychological and physical effects. There is some evidence that the potency of cannabis has increased over recent years and this merits monitoring.

Medical Uses

The chapter examines the evidence on legitimate uses of the product, particularly with regard to the development of cannabinoid-based drugs. For some years there has been a discussion on the potential therapeutic value of cannabis compounds, which in turn has led to an increase in research devoted to therapeutic applications. Among the difficulties in establishing outcomes is that in addition to containing harmful substances such as those found in tobacco smoke, there are problems in establishing with certainty how a specific 'dose' of cannabis can reliably be administered.

With regard to mood disorders, anxiety and depression, there is only anecdotal evidence to suggest that cannabis may have beneficial effects. However, scientific studies are inconclusive, and the anecdotal reports cannot be reliably confirmed on the basis of evidence currently available. On the other hand, cannabis and its derivatives seem to have beneficial outcomes for certain types of pain relief, treatment of nausea and vomiting and appetite stimulation.

Cannabis Receptors

Many recent developments in the toxicology and pharmacology of cannabis have resulted from laboratory studies which have concentrated on examining the effects of cannabis on the brain. The discovery of two cannabis receptors, and chemicals that act to block or mimic the actions of cannabis on these receptors, has resulted in a better understanding of cannabis effects on human subjects. Two types of cannabis receptors have been discovered to date. CB1 receptors are found predominantly in the brain and in some peripheral tissues. The highest concentration of these receptors within the brain is in areas linked to learning and memory, movement and coordination, pain perception and the reward system. CB2 is not found in the brain but is located in the spleen and in blood-producing cells in the bone marrow and other sites. The role of CB2 receptors is less certain and may have effect on the immune function.

The existence of specific cannabis receptors and their associated endocannabinoids is extremely significant in that it distinguishes the substance from alcohol, which does not have specific receptors. The effects of alcohol depend on non-specific interactions with a whole range of receptors including those for cannabis.

Cannabinoids are highly fat-soluble – something that also distinguishes these drugs from alcohol. The result is that absorption into the body occurs quickly and levels fall slowly as the drug is distributed to fatty tissues. The liver breaks down cannabis to compounds which are eliminated in the urine and faeces. These breakdown products may be detectable in urine up to four weeks after use in those who are relatively heavy users. The effects of cannabis usually wear off four to six hours after use. Although chronic users metabolise cannabis more quickly, it may also take longer for them to eliminate cannabis and its metabolites from their system.

Acute Effects

The acute effects of cannabis use include an altered state of consciousness characterised by mild euphoria and relaxation, perceptual alterations and the intensification of ordinary sensory experiences. As well as the cognitive effects to be discussed in Chapter 3, a loosening of associations also results, enabling the user to become lost in pleasant daydreams and fantasy. In occasional users, the feeling of euphoria can be replaced by anxiety and panic reactions and this is a common reason for discontinuation of use.

Cannabis and Mental Illness

It has frequently been suggested that heavy use of cannabis can induce serious mental illness. 'Cannabis psychosis' involves symptoms that include a sudden onset of confusion, hallucinations, disorientation and paranoia. However, a major weakness of some studies is that patients' mental health prior to the apparent onset has not been well-documented. Furthermore, there is no consistency in what is regarded as 'cannabis psychosis'.

The association between cannabis use and schizophrenia is remarkably strong and seems to survive when controls are applied for confounding factors. Recent research gives a more precise indication of how cannabis influences the condition. There is strong evidence that cannabis may precipitate the illness among vulnerable individuals. Furthermore, cannabis use seems to increase the risk of relapse

among those who already have developed the disease and may be more likely to lead to dependence in persons with schizophrenia. The evidence is quite strong that continued and persistent cannabis use tends to exacerbate the condition of schizophrenia and to prevent recovery.

People with a depressive condition are many times more likely to be heavy users of cannabis than are people without such a diagnosis. However, the extent to which depression is a result of cannabis use is not clear and the evidence for a causal role is less clear than in the case of schizophrenia. There are strong indications that cannabis use can come about as a result of depression, particularly during adolescence. Part of the explanation may be that the cannabis use may be a result of the other features of adolescents' lives, although it may well be that there is a reciprocal relationship (being unhappy brings about cannabis use which in turn results in further unhappiness).

Effects on Epileptic Conditions

Cannabinoids have complex actions on seizure activity and exert both anticonvulsant and proconvulsant effects. Cannabis use can transiently impair short-term memory, and like alcohol use, may increase non-compliance with anti-epileptic medications. Cannabis use or sudden withdrawal could potentially trigger seizures in susceptible patients.

Cardiovascular Effects

There are indications of cardiovascular effects in susceptible individuals. These include a profound decrease in blood pressure and heart rate with chronic use. Conversely, an increase in heart rate occurs as an immediate effect of use. A number of deaths from cardiac problems have been linked to cannabis use.

Respiratory Effects

The smoke from herbal cannabis preparations contains all the same constituents (apart from nicotine) as tobacco smoke, including carbon monoxide, bronchial irritants and cancer stimulating agents. It has been estimated that up to four times the amount of tar can be deposited on the lungs of cannabis smokers as cigarette smokers if a cigarette of comparable weight is smoked.

It is of particular interest that, in addition to the risks for heavy cannabis smokers who also smoke tobacco, there are strong indications that people who are regular users of cannabis, but not tobacco, have more symptoms of chronic bronchitis than non-smokers. Specifically respiratory symptoms and decreased respiratory function are found in young cannabis smokers, independent of tobacco use.

The evidence on the cancer risks of cannabis use is still too weak to warrant strong conclusions. The epidemiological evidence is conflicting. One view is that the similarities between cannabis and tobacco smoke are sufficiently strong to warrant advising regular cannabis smokers, especially those who also smoke tobacco, that they may be at increased risk of developing cancer. Further studies are required to assess more effectively the cancer risks of cannabis use.

Effects of Cannabis During Pregnancy

Reports of the effects of cannabis on the developing foetus have yielded conflicting results. Some studies have suggested that cannabis smoking in pregnancy may reduce birth weight, including one

well-controlled study that found that this relationship remained after controlling for any confounding variables. However, this has not been found in other studies and where such an effect is found, it is small compared to tobacco. There is little evidence that gestation is shorter except for adolescent mothers and controlled epidemiological studies have found no evidence that cannabis causes birth defects.

On balance, there is insufficient evidence to support an association between reduced birth weight, congenital anomalies, or sudden infant death syndrome. It remains difficult to distinguish the influence of other concurrent factors such as nutrition and socio-economic status from the influences that might be attributable to cannabis use.

Dependence Potential

The criteria for dependence on a psycho-active substance include increased tolerance, withdrawal symptoms, difficulty in controlling consumption and a pattern of use that influences other significant activities in the user's life. Some studies indicate that frequent users (more often than once a week) run a significant risk of cannabis dependence. *The Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)* (American Psychiatric Association, 1994) presents criteria for the diagnosis of psychoactive substance dependence based largely on the concept of the dependence syndrome including tolerance, a withdrawal syndrome, difficulty in controlling consumption and a pattern of use which leads to a reduction in other important activities. Some researchers have identified what they called 'unequivocal markers' of such dependence while other research fails to find such outcomes. It is clear that while frequent users run the risk of dependence, the current research does not provide a clear picture of withdrawal patterns as is found for some other drugs e.g. opiates.

Public Health Implications: Prevalence

Chapter 2 addresses the public health risks related to cannabis use and includes a review of the epidemiological studies of health outcomes of cannabis use. The evidence in this chapter reveals that cannabis is the most easily accessible, the most widely used, and is the illicit drug most often seized in Ireland. Its use is increasing, particularly among adolescents and young adults.

Among the adult population, just over 1 in 20 report having used cannabis in the last year in Ireland (NACD & DAIRU, 2003). The prevalence rates are higher among those in the 15-24 age group, with 11.1% indicating that they had used the substance at some time in the last year. However, the rates are much lower for older age groups; only a half of one percent of those in the 55-64 age group indicated that they had used cannabis in that period. It is worth noting that while the rates of cannabis use are substantially higher than for other illicit substances, they are much lower than for alcohol and cigarettes.

Perceived Availability and Risk

A high proportion of youth in Ireland (over three quarters of 16 year olds) say they know where to obtain the drug and relatively low proportions perceive cannabis use as risky behaviour. It is of particular interest that in the ESPAD (European Schools Project on Alcohol and other Drugs) study (Hibell et al., 2001) regular use of cannabis was perceived to be a much greater risk than was occasional use, in all countries including Ireland.

Gender

Cannabis use is more prevalent among males than females. This difference is found in lifetime prevalence, recent usage (last year), and in problems associated with use. Furthermore, girls have an older age of initiation to cannabis than boys. It is interesting that this pattern of gender differences is different from that for alcohol and cigarettes where gender differences have tended to decline over the years.

Initiation to Cannabis

In about 80% of cases, young people try out cannabis for the first time with friends. This is a consistent finding from Ireland and Europe. This ties in with the finding that friends' use of cannabis is a significant predictor of the likelihood of a young person experimenting with the substance. Close friends are a much more significant influence than are peers, even those in the same school. It is also significant that only a minority of young people are introduced to cannabis by a stranger.

Cannabis and Use of Other Drugs

With regard to the relationship between cannabis use and the subsequent use of other substances a number of matters are clear. Firstly, among young people who have used a variety of illegal substances, the vast majority have begun with cannabis. Secondly, there is a strong statistical association between cannabis use during adolescence and subsequent use of other illicit drugs. Thirdly, it is known that many young people try out cannabis and do not progress to either heavy use of cannabis or to other illegal substances. Fourthly, it is known that heavier users of cannabis are more likely to progress to other drugs than are occasional users.

One view of these findings was that cannabis use provided 'stepping-stones' to the use of other drugs including opiates. Sometimes it is argued that the pharmacological properties of the drug lead inevitably to use of other substances. Emerging evidence suggests that cannabinoids not only affect brain reward and withdrawal processes in exactly the same way as other addictive drugs but also that cross-sensitisation with amphetamine and morphine can be induced when animals are repeatedly exposed to THC suggesting that long-term use of cannabis might enhance vulnerability to addictive substances in certain individuals.

Some views of the link between cannabis and other drugs favour a 'gateway' theory over the 'stepping-stone' hypothesis. The 'gateway' hypothesis acknowledges cannabis primes the user for taking other substances but holds that the mediating influences are not direct including the concept of 'exposure opportunity', i.e., cannabis users are more likely to be exposed to other drugs and thus have an opportunity to use them.

One elaboration of the 'gateway' hypothesis is that social disadvantage and low levels of parental attachment are associated with early cannabis use and that these factors are themselves influential in progression to other drugs. There are indications that this may be part of the story but not the complete picture. There is also some indication that genetic susceptibility to drugs may be at least a contributory factor in the progression from cannabis to other substances. An important environmental factor may be the social context in which cannabis is used and obtained. It may be that access to cannabis reduces perceived barriers and inhibitions against the use of other drugs and the perceived

access to such drugs. Another factor that may be involved in progression is personality make-up. There is some indication that non-conforming adolescents may initially try out cannabis as part of a broader propensity to use drugs, i.e they may be more novelty-seeking or ready to take risks than their peers; they may have such positive experiences with cannabis that they start to underestimate the risk of other illicit drugs.

At the moment it is not clear which of these factors contributes to the progression from cannabis to other drugs. It may be that the 'gateway' findings reflect the operation of a variety of factors including genetic, environmental and personality factors.

Public Health Consequences

There are no indications that cannabis is involved in deaths due to overdose. While cannabis is sometimes found in the post-mortem results of drug users, it is always secondary to other substances like opiates.

The evidence indicates that cannabis is not an important direct factor in drug-related accidental deaths but there is one important exception viz. road accidents. However, assessment of the causal role of cannabis in road traffic deaths is complicated by the fact that alcohol is also present in the majority of cases. There are indications that when mixed with alcohol, cannabis is much more likely to be a risk factor than when consumed alone.

There are serious issues in field studies regarding satisfactory ways in which the concentration of levels of cannabis should be determined. Consequently the most convincing evidence is from experimental work. This evidence shows that drivers under the influence of cannabis are often aware of their impairment but are unable to compensate for the loss of capability in some psychomotor skills such as staying in lane. It is likely that this area, and related matters like accidents in the workplace, will be more actively researched in the future.

Psychological and Educational Effects

Chapter 3 reviews the major psychological consequences of cannabis use including effects on cognitive functioning, motivation, educational performance, occupational achievement and social behaviour. There are strong associations of a pattern of outcomes for many of these factors but the interpretation is difficult for many findings.

Cognitive Functioning

With regard to cognitive functioning as measured by IQ and similar types of tests, there is little evidence that cannabis produces severe impairment of broad cognitive functions, something which may relate to the failure to find gross structural changes in the brains of users. However, there is a considerable body of evidence that heavy cannabis use produces subtle cognitive impairments of memory, attention and the organisation of complex information. It is also of interest to note that the indications are that at least in some cases, the impairment can be reversed with a prolonged period of abstinence.

The indications are therefore that impairments of memory, attention and the organisation of complex information are associated with heavy cannabis use but that these differences do not reflect

permanent physiological changes. However, these cognitive impairments may be very important in mediating the educational and occupational differences that are also shown to be associated with frequent cannabis use.

Cannabis and Motivation

It has often been suggested that cannabis users appear to be apathetic, lethargic and unmotivated (the 'amotivational syndrome'). Recent studies however, have failed to find clear-cut evidence for this syndrome. The research shows that even in controlled studies, cannabis users suffered from a variety of negative effects including having a poorer employment record, being less likely to gain promotion and being more likely to be in debt. However, it is not clear whether the controls that are applied are sufficient to rule out other differences that may have existed in addition to, and prior to, cannabis use.

Early School Leaving and Exclusion from School

A strong association between cannabis use and poor educational outcomes, and especially early school leaving is one of the best established findings in the literature on the consequences of cannabis use. It is likely that part of this relationship is due to other factors. However, the association still remains even when controls are applied to a range of factors like social background, parental expectations and supervision.

Why this association is found so consistently is an important question. As noted above, cannabis can affect cognitive capacity but this effect comes about only after intense and prolonged usage. It is doubtful if any of the studies included many young people whose level of use was such as to damage their cognitive skills. Another factor might be motivation; the evidence on the damaging effects of prolonged use of cannabis on motivational processes is especially relevant. However, the effect of cannabis on motivation again applies only to very heavy use. It is likely that the mediating links are complex involving personality factors, embracing an alternative lifestyle and rejection of conventional values including, possibly school success.

One interesting point emerging in recent research is that cannabis use is involved in a large number of suspensions/expulsions from school. Those who were suspended or expelled were found to be much more likely than their peers to use cannabis, alcohol and other drugs. It is also of interest to note that students suspended from school are less likely to have access to further education, thus contributing to the relationship between poor educational achievement and cannabis use.

Occupational and Employment Effects

Given the differences with regard to educational achievement, it is hardly surprising that cannabis use tends to be associated with somewhat poorer occupational and employment performance, specifically lower income, greater job instability, and lower job satisfaction.

These differences are found fairly consistently but there are indications that this difference may be due to personality differences between cannabis users rather than cannabis use per se. For example, it may be that cannabis users are less willing to persist with boring and uninteresting tasks. As in many other outcomes there is evidence of a reciprocal relationship, i.e. certain personality differences lead to cannabis use which in turn sharpens the differences that led to the use in the first place.

Suicide

There is consistent evidence that young people attempting suicide are more likely to have a history of heavy cannabis use than are others. However, two important qualifications must be entered. The first is that other substance misuse (legal and illegal substances) is almost invariably found in these cases, so that the precise role of cannabis per se is hard to pinpoint. The other point has to do with personality make-up. There is a considerable body of evidence that people using cannabis tend to be high risk-takers which in turn is associated with a variety of other behaviours involving danger, including self-injurious behaviour. Thus, while cannabis use is associated with self-injury, the precise pathway of this relationship is not entirely clear and requires further study.

Anti-social Behaviour and Victimisation

An analysis of the ESPAD data for Ireland (Hibell et al., 2001) shows that cannabis users are more likely to report having been involved in a range of anti-social behaviours (including bullying, starting a fight and damaging property) than were young people who were not involved in cannabis use. It is also worth noting that while legal forms of substance use (cigarettes and alcohol) are also correlated with anti-social behaviour, the correlations are higher in the case of cannabis.

Since the factors that are associated with anti-social behaviour are also those that are associated with victimisation, it is hardly surprising that there is a weak but positive correlation between some forms of victimisation and cannabis use. It is worth stressing that the association is not as strong for cannabis (or indeed for legal substances) as is found for anti-social behaviour. Related criminological issues are examined in Chapter 4.

Criminological and Sociological Effects

Chapter 4 examines the research on the criminological and sociological effects of cannabis use with a focus on the relationship between cannabis, crime and anti-social behaviour. The 1961 United Nations Single Convention on Narcotics Drugs obliges each party to the convention to ensure that the cultivation, manufacture, possession and distribution of cannabis extracts – marijuana, hashish and cannabis oil – are punishable. These obligations are reinforced by the 1988 UN convention against the Illicit Traffic in Narcotic Drugs and Psychotropic Substances.

Legal Situation in Ireland

In Ireland since 1977, possession of cannabis or cannabis resin has been treated differently to other drugs. Possession for personal use is punishable by a fine on first or second conviction. From a third offence, possession for personal use incurs a fine and/or a term of imprisonment up to 1 year on summary conviction and up to three years and/or a fine if convicted on indictment. This contrasts with the penalties associated with possession of any other drug which incurs a term of imprisonment for up to 1 year and/or a fine on summary conviction and up to 7 years imprisonment following conviction on indictment.

Range of Consequences of Cannabis Use

A variety of educational and employment problems come about as a result of a conviction for cannabis possession, depending on the country involved. There are indications from some countries that while a cannabis conviction had little impact on subsequent cannabis use, a significant minority have further problems with the law and problems with employment, accommodation, relationships and travel opportunities.

Cannabis-related Crime

There is evidence that male drug users, particularly, are likely to commit several times more property offences than are others males of the same age and background. However, with regards to the link between cannabis use and acquisitive crime, it has been difficult to identify, in the case of cannabis, those offences committed as a result of the use of the drug as distinct from those which would have been committed anyway. Many longitudinal studies suggest that criminality may precede the use of cannabis rather flow from it. Cannabis use is also found to be higher among students who participate in other high risk behaviours such as binge drinking, cigarette smoking and having multiple sexual partners, and among students who perceive religion and community service as not important. These characteristics are especially important when the consequences of cannabis use are being interpreted.

Seizures of Cannabis in Ireland

Cannabis is the most widely trafficked drug globally. In Ireland, as in most other countries, there are more seizures of cannabis than any other drug. In 2002, cannabis-related seizures accounted for 54 percent of the total number of drug seizures for that year. Figures reported by An Garda Síochána show that the total number of cannabis-related offences in which criminal proceedings commenced has increased steadily from 4,185 in 1999 to 4,880 in 2000 to 5,143 in 2001 to 5,500 in 2002 (An Garda Síochána 2000, 2001, 2002, 2003). Cannabis-related offences accounted for 64 percent of the total number of offences in which criminal proceedings commenced in 2002.

Cannabis Use and Violence

There are conflicting views on the association of cannabis use with violence. A benign view is that cannabis reduces aggressive impulses and has a calming effect on the user. Another view suggests that users may become excitable and irrational as a result of drug use or may be involved in violence associated with crime to gain possession of the necessary resources to continue to acquire the substance. There are indications that cannabis users are more likely to be involved in criminal activities than are nonusers, and indeed are also more likely to be victims of crime (see Chapter 3). However, this may be partly due to predisposing factors that caused them to be involved with cannabis or to being an active participant in the illegal economy of a drug market.

Although there is clear evidence of violence associated with the drug trade, in the absence of any adequate studies into Irish drug markets, it is impossible to state with any clarity the extent to which violence is associated specifically with the trade in cannabis. However, the evidence suggests there is a significant overlap between trades in different drugs and that a substantial level of violence is associated with this trade.

'Normalisation' of Cannabis Use

There have been suggestions that because cannabis use has become such a routine feature of many young people's lives, it is no longer regarded by such young people as a deviant form of behaviour. As evidence of this 'normalisation', some people point to the relatively high prevalence rate and the perception that such behaviour is common among their friends and peers. There is evidence, particularly in certain social contexts, that cannabis use is an accepted feature of social events and does not meet with outright rejection. However, such acceptance should be seen in the context of the views of the general public, especially older age groups, which are dramatically at variance with 'normalisation'.

Factors Increasing Probability of Harm

The issue of the relationship between cannabis use and the subsequent use of other illegal substances (the 'gateway' theory) was mentioned above. It is well established that some people who use cannabis go on to use other substances, while some do not. There are some indications as to what factors increase the probability of such 'progression'. Part of the problem may be that cannabis use brings the user into contact with dealers selling more harmful substances. Family problems and involvement with deviant peers are also involved in the progression to other drugs.

Value Conflicts Surrounding the Use of Cannabis

Concerns with limiting the effects of cannabis by implementing policies which bring about a separation in markets for cannabis from markets in other drugs have combined with a number of other factors to bring about a debate on the legislative approach to cannabis. On the other hand, strong arguments have been made to maintain the law as it is at present. The debate over cannabis law reform remains one of the most contested areas of international drug policy. While it is beyond the scope of this publication to consider this debate in detail, some of the relevant contributions are listed in the final chapter.

Many countries have responded to this debate by introducing changes in cannabis law enforcement practices or through legal reforms. While the legal statutes that exist are important, it is also very important to know how such laws are applied. Although some studies have considered the impact of various legal changes, this remains an important area for further investigation.

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Chapter One

The Pharmacological and Toxicological Effects of Cannabis

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Overview

This chapter initially sets out the basic chemical and pharmaceutical information on cannabis. The second and third sections of the chapter are concerned with toxicology/pharmacology in animals and in humans respectively. The final section of the chapter examines research on the effects of cannabis on brain function with particular focus on mental illness including schizophrenia and depression. Other effects considered include those on the respiratory system, the reproduction system and reproduction itself. Issues relating to cannabis dependence are also examined in this last section.

Chemical and Pharmaceutical Information

Chemical Description

Cannabis is a generic term used to denote the several psychoactive preparations of the plant *Cannabis sativa*. The plant is originally from the Caspian and Black Sea areas and was taken to Persia and India eight centuries ago. It is cultivated in North, Central and South America, in Asia, Europe, and North and Central Africa. Major producers include Mexico, Brazil, Paraguay, Colombia, Peru, New Zealand and Morroco. The Indian variety is cultivated in the Orient, Asia and North Africa.

Although the active constituents are located in the whole plant, the major concentration is in the flowering buds. The "seed" or fruit has a lower concentration. The dried leaves and buds (less rich) are called "bhang". The resin from the buds is called "hashish" and this can be scraped from the plant. The common "street" cannabis is usually a mixture of dried flowers, leaves and occasionally seeds. It has a brownish green colour, depending on dryness and maturity of the plant. The unpollinated female plants are referred to as "sinsemilla". Cannabis oil (hashish oil) is a concentrate of cannabinoids obtained by solvent extraction of the crude plant material or of the resin followed by distillation.

Although a crude plant product, cannabis contains a complex mixture of 483 chemicals. It contains more than 60 cannabinoids including: cannabinol, cannabidiol, cannabinolic acid, cannabigerol, cannabicyclol, and various tetrahydrocannabinol isomers, the most important being delta-9-tetrahydrocannabinol (delta-9-THC) (El Sohly, 2002) (Table 1).

Cannabinoids also occur in the plant in the form of carboxylic acid derivatives, e.g. tetrahydrocannabinolic acid. The THC content and the cannabinoid composition are known to vary widely depending upon the variety and growing conditions.

Table 1. Properties of Some Natural Cannabinoids (Adapted from Ashton 2001)

Cannabinoid	Main properties
Delta-9-tetrahydrocannabinol Natural plant cannabinoid. Available in synthetic form as dronabinol	Main psychoactive cannabinoid, largely responsible for psychological and physical effects.
Delta-8-tetrahydrocannabinol Natural plant cannabinoid, also available in synthetic form	Slightly less potent than Delta-9-THC but otherwise similar. Only small amounts present in plant.
Cannabinol Arising from decomposition of THC	Little or no psychoactive properties.
Cannabidol Natural plant cannabinoid	Does not interact with cannabinoid receptors. Lacks psychotropic and most other effects of Delta-9-THC, but has anti-epileptic activity. May diminish some unwanted side effects of Delta-9-THC.
Cannabichromene Natural plant cannabinoid	Does not interact with cannabinoid receptors. Not psychoactive but may enhance some effects of THC.
11-hydroxy-Delta-9-THC Natural metabolite of Delta-9-THC in the body	Psychoactive and may be responsible for some of psychological effects of cannabis.
Delta-8-THC-11-oic acid Natural metabolite of Delta-8-THC in the body	Does not interact with cannabinoid receptors. Not psychoactive but has analgesic activity.
Anandamine (arachidonyl ethanolamide) Endogenous ligand for mammalian cannabinoid receptors	Not structurally similar to cannabinoids. Related to prostaglandins. Appears to mimic actions of THC and other cannabinoids that interact with cannabinoid receptors

Legitimate Uses of the Product

In a 1991 report, the World Health Organisation Expert Committee on Drug Dependence recommended that THC and related compounds be rescheduled from schedule 1 to schedule 2 of the Convention on Psychotropic Substances 1971. This effectively recognised the therapeutic value of cannabis compounds, permitted their wider use in the treatment of organic diseases, and has led to an increase in research devoted to therapeutic applications.

In addition to its known active constituents, cannabis smoke also delivers harmful substances, including most of those found in tobacco smoke. Another important factor is that plants contain a variable mixture of biologically active compounds and do not provide a consistent dose or response. As a result, developments in cannabinoid-based drugs have strived to isolate the therapeutic effects of cannabis for controlled delivery whilst avoiding, to some degree, the uncertainty attached with consumption of cannabis.

Recent advances in the understanding of the ways in which cannabis affects the body have given rise to new opportunities for the development of such cannabinoid-based drugs. These drugs could have potential indications, such as for pain relief, treatment of vomiting and appetite stimulation. As outlined in a recent review of the medical value of marijuana by the American National Academy of Sciences (NAS) (1999), for patients such as those with AIDS or who are undergoing chemotherapy, and who suffer simultaneously from severe pain, nausea, and appetite loss, cannabinoid drugs may provide broad-spectrum relief not found in any other single medication. Less promising categories, as described in the NAS review, are muscle spasticity, movement disorders, epilepsy, and glaucoma. Animal data are moderately supportive of a potential for cannabinoids in the treatment of movement disorders.

Systematic reviews of the literature for the use of cannabinoids as analgesics and anti-emetics have recently been published (Campbell et al., 2001, Tramer et al., 2001) In relation to management of pain, Campbell and his colleagues found that cannabinoids were no more effective than Codeine as analgesics and had CNS depressant effects that limited their use. The authors concluded that their introduction into clinical practice for pain management was not indicated. In acute post-operative pain they should not be used. Further studies were needed for spasticity and neuropathic pain.

In their review of the effectiveness of cannabis in the treatment of chemotherapy induced nausea and vomiting Tramer et al. (2001) concluded that cannabinoids may be useful as mood-enhancing adjuvants for controlling chemotherapy-related sickness in selected patients. However, potentially serious adverse effects such as dizziness, dysphoria, hallucinations, paranoia and low blood pressure were likely to limit their widespread use.

Muscle spasticity, with recurrent painful muscle cramps and various combinations of weakness, tremor and dystonia (abnormal muscle tone), occurs in a number of chronic and debilitating neurological conditions including multiple sclerosis, cerebral palsy and spinal cord injuries. It is somewhat paradoxical that cannabinoids are reported to be of therapeutic value in neurological disorders associated with spasticity, ataxia and muscle weakness, because very similar symptoms can be caused by cannabis itself. There is only limited evidence, mainly from anecdotal reports, that cannabis (smoked or oral) benefits spasticity from multiple sclerosis or spinal cord injury. The weight of evidence is not great and more recent, though small, randomised trials show absolutely no positive effect, with some adverse effects (Bandolier Extra, 2002).

A double blind, randomised, placebo-controlled crossover study using the synthetic cannabinoid Nabilone showed no significant reduction in dystonia (Fox et al., 2002).

A large UK-based study of cannabis use in multiple sclerosis will look specifically at the question of whether cannabis, as either whole plant extract or one of its active components, can help the muscle stiffness and spasms that affect multiple sclerosis sufferers. Results are likely to be available later in 2003 (BMJ, 2001).

As reported by the House of Lords Science and Technology Select Committee (1998), in addition to the above uses, there is a great deal of anecdotal evidence to suggest that cannabis may have a beneficial effect on mood disorders such as mild anxiety or depression. The evidence from scientific studies is inconclusive, and the anecdotal reports cannot be reliably confirmed at the present time. The report stated that the human studies which have been cited in support of such psychological benefits either used synthetic cannabinoid homologues, or failed to use the double-blind experimental methodologies now required to eliminate possible bias in the experimenters or subjects.

Other possible medical uses include in the treatment of asthma, and as an adjunct to the treatment of opiate and alcohol withdrawal syndromes (The House of Lords Science and Technology Select Committee, 1998).

In relation to its use in the treatment of asthma, small-scale controlled studies in volunteers with asthma show that oral, smoked and aerosolised THC has comparable airway dilation activity (bronchodilation) to salbutamol, although onset is quicker with the latter. Dose-related increases in heart rate occurred in some individuals, and subjective intoxication with higher doses. A THC aerosol was free of systemic unwanted effects, but was irritant to the lungs (Robson, 2001). Nabilone does not produce bronchodilation. It has been proposed that the action of THC may involve suppression of the release of endogenous substances causing asthma (e.g. SRS-A), rather than inhibiting their activity (The House of Lords Science and Technology Select Committee, 1998).

Anecdotal reports suggest that cannabis may relieve glaucoma symptoms and individuals have successfully argued in the USA for legal access to the drug (Robson, 2001). Randomised controlled trials in volunteers suggest that oral, injected or smoked cannabinoids produce dose-related reductions of intra-ocular pressure (Robson, 2001). Conjunctival engorgement and tear reduction were often noted. THC, delta-8-THC and 11-hydroxy-THC are more effective than cannabinol, while cannabidiol was without effect. Tolerance may develop on multiple dosing. A randomised control trial in patients showed intra-ocular pressure reductions of similar magnitude following smoked THC along with "alterations in mental status" and rapid heart rate (Robson, 2001). THC eye drops produced dose-related pressure reduction with minimal side effects, though parallel reductions in the untreated eye (also seen in animal models) suggested a systemic rather than local mode of action.

Optimal doses and routes of delivery have not been established for any therapeutic application. Absorption by the oral route is unreliable. Smoking the drug is generally not a viable option since advantages such as rapid onset, accurate titration of effects and reliability in patients who are vomiting have to be set against the likelihood of lung irritation or damage. In addition, it may not be acceptable to most patients. Sublingual sprays or tablets, nebulisers and aerosols and rectal administration may all prove to be feasible routes of delivery in the future.

In summary, cannabis and its derivatives could have potential indications such as for certain types of pain relief, treatment of nausea and vomiting, and appetite stimulation. The evidence of benefit for the treatment of muscle spasticity is less certain, while its use in the treatment of multiple sclerosis is currently being evaluated. Therapeutic use of cannabis in the treatment of glaucoma or asthma and in mild anxiety and depression is not indicated.

Pharmaceutical Form

The forms of cannabis have been described above in the section 'Chemical Description' and are presented below in Table 2.

Table 2. Forms of Cannabis (Ashton 2001)

Form	Source	THC content (variable)
Marijuana (USA) Cannabis (UK) (Both of the above terms refer to herbal cannabis)	Dried leaves/flowers/stalks/seeds Traditional cigarette (reefer) of the 1960s and 1970s Modern cigarette (joint) of 1980s and 1990s	 1-3% THC (10mg/reefer) 6-20% THC (60-100mg/joint)
Hashish (USA) Cannabis resin (UK)	Resin secreted by plant Bricks, cakes, slabs	10-20% THC
Hashish oil	Product of extraction by organic solvents	15-30% THC (sometimes up to 65%)

Route of Administration and Dosage (e.g., Oral, Inhalation, Intravenous, etc.)

Inhalation remains the commonest way of consuming cannabis (Hall & Solowij, 1998). As outlined in the House of Lords Select Committee Report (1998), the preference for smoking may be due to several factors. Smoking cannabis produces noticeable effects far more immediately than when it is eaten or drunk. It is also consumed in small, discrete amounts over a period of time. The dosage is easily controlled by self-titration. In contrast, eating cannabis, whether raw or in preparations, may lead to the consumption of the entire uncertain dosage at once. This can easily result in the consumption of less or more than required to achieve the desired effects.

Cannabis can be smoked directly or through small pipes or "bongs". They are similar to those used with opium, where refrigeration by air or water reduces the irritative effects on the respiratory airways, allowing a deeper and prolonged inhalation. The usual technique consists of inhaling very deeply and maintaining the smoke in the lungs for 20 or 30 seconds to maximise the absorption of cannabinoids; the extraction is about 50% of the cannabinoid content.

A recent study of water pipes and other smoking paraphernalia found that an unfiltered cannabis cigarette was as effective a method of delivery as any of the devices tested. However, one of the vaporisers tested did perform similarly. Most water pipes absorbed too much THC, leading the user to smoke more to achieve the desired "high" (House of Lords Science and Technology Select Committee, 1998). Other methods of smoking without tobacco include "hot knives" where cannabis is

crushed between red-hot blades and the vapours inhaled, or a coal is left to smoulder and the smoke collected in a glass, bottle or bucket before inhalation. There are some reports of experimental intravenous injection of cannabis solutions and of cannabinoids in clinical trials (IPCS, 1989).

Cannabis oil when smoked is commonly smeared on to a cigarette paper and tobacco then enclosed, or a drop is mixed with tobacco before the material is rolled in the paper. As it is inconvenient to smoke, many users of oil prefer to use it in cooking.

Use in oral preparations is limited by the lipid (fat) solubility of THC and other cannabinoids, requiring use of fats or alcohol to emulsify the drug into an edible form. The main problem is the risk of overdose, as the effects are slow to develop but can be intense (The House of Lords Science and Technology Select Committee, 1998).

The THC content in cannabis plant is typically in the range of 0.5 to 4 per cent (Huestis et al., 1992). It is highest in the flowering tops, declining in the leaves, lower leaves, stems, and seeds of the plant. Herbal cannabis (termed marijuana in the USA) is prepared from the dried flowering tops and leaves and has a THC content of 6 to 20%. The THC content in hashish, which consists of dried cannabis resin, ranges from 2-8 per cent, although it may be as high as 10 to 20%. Sinsemilla, the unpollinated female plants, may have a THC content of up to 20%. Hashish oil may contain between 15% and 50% THC (Adams & Martin, 1996). Concerns regarding THC content in cannabis have been renewed because of recent developments in indoor cultivation techniques. These developments have enhanced the THC content in Dutch cannabis, so-called 'nederwied', to concentrations as high as 20%. The health implications of this are unclear. Those who use these high potency products may increase their risks of developing dependence, having accidents while driving or experiencing psychotic symptoms (Hall, 1998). However, regular users may be able to titrate their dose and decrease the risks of respiratory disease and naïve users who experience adverse effects may be deterred from further cannabis use (Hall, 1998).

A typical joint contains between 0.5 and 1.0 g of cannabis plant matter, which may vary in THC content between 5 and 150 mg (i.e. typically between 1 per cent and 15 per cent). The actual amount of THC delivered in the smoke has been estimated at 20 to 70 per cent, the rest being lost through combustion or sidestream smoke (Adams & Martin, 1996). The bioavailability of THC (the fraction of THC in the cigarette which reaches the bloodstream) from herbal cannabis cigarettes in human subjects has been reported from 5 per cent to 24 per cent. Given all of these variables, the actual dose of THC absorbed when smoked is not easily quantified.

A single joint may be sufficient for two or three individuals, but a regular smoker may consume five or more joints per day. In terms of THC dosage as little as 2-3 mg of available THC will produce a "high" in occasional users while heavy users may consume up to 420 mg THC per day.

Smoking cannabis results in the formation of a large number of combustion products. The vapour phase consists of nitrogen oxides, carbon monoxide, hydrogen cyanide and nitrosamines, and the particulate phase contains many known cancer-causing agents including phenols, cresols and polynuclear aromatic hydrocarbons (PAHs). During smoking, tetrahydrocannabinolic acid, which lacks psychoactivity, is converted to THC, thus adding to cannabis potency.

It has recently been proposed that the harmful effects of consumption may be reduced with the use of more potent cannabis. Users normally regulate their doses based on how profound an effect they achieve rather than on the amount of cannabis consumed. Therefore, if a greater degree of "high"

were obtained from a smaller amount of cannabis then the amount smoked would decrease proportionally. This reasoning has resulted in the suggestion that the higher the potency of the cannabis smoked the lower the amount smoked (House of Lords Science and Technology Select Committee, 1998).

In summary, inhalation remains the most frequent mode of administration of cannabis, with oral ingestion being also favoured, particularly for cannabis resin or oil. The concentration of active ingredients in the product consumed by the user is dependent on the parts of the cannabis plant used, with the flowering tips having the highest concentration. The potency of cannabis has increased in recent decades mainly due to improved cultivation techniques. The effect of cannabis varies from individual to individual and dose is difficult to quantify.

Toxicology and Pharmacology in Animals

The toxicology and pharmacology of cannabis and cannabinoids has been the focus of much research in both animal and human subjects. Two recent reviews describe the pharmacology of cannabinoids in detail (Kumar et al., 2001; Ameri, 1999). Most research has concentrated on establishing the mechanisms of action of these drugs. Recent advances in this research have been facilitated by the discovery of cannabinoid receptors and substances that mimic and block the actions of cannabis (termed agonists and antagonists respectively) (Pertwee, 1997). Much remains unknown about the mechanisms of action of these substances.

The acute effects of cannabinoids as well as the development of tolerance are mediated by cannabinoid receptors, CB1 and CB2 (Felder & Glass, 1998). CB1 receptors are found predominantly in the brain and some peripheral tissues. The distribution of CB1 receptors in the brain has been determined by receptor-binding studies and autoradiographic studies using the cannabinoid receptor ligand [3H]CP 55,940. Within the brain, these sites are not distributed homogeneously, being densest in those areas in which cannabinoids are thought to produce many of their characteristic effects. For example, actions at CB1 receptors in the cortex and hippocampus are thought to mediate the actions of cannabinoid on learning and memory. The actions of cannabinoids at CB1 receptors localised in the basal ganglia, substantia nigra, and cerebellum are thought to mediate their effects on motor activity and their actions at CB1 receptors in the frontal cortex and nucleus acumbens may account for the reinforcing properties of cannabinoids (Nakamura-Palacios et al., 1999). Elevated levels of CB1 receptors, like opioid receptors, are also found in areas that modulate nociceptive (pain) processing, including the periaqueductal gray (PAG) and the dorsal horn of the spinal cord. However, unlike opioid receptors, CB1 receptors are relatively sparse in the brainstem, which may explain the lack of respiratory depression associated with these compounds.

In contrast to CB1 receptors, CB2 receptors are not found in the central nervous system (CNS), but are distributed in peripheral tissues (Pertwee, 1997, 1999). The CB2 receptor is found predominantly in the spleen and in blood-producing cells in the bone marrow and other sites. The CB2 receptor is quite different in make up to the CB1 receptor in the brain. The existence of this receptor provides the molecular basis for the immunosuppressive actions of marijuana (Ameri, 1999). The functions of both receptors are not fully understood. For a detailed review of the possible mechanisms of action through these receptors, refer to Pertwee (1997).

Certain cannabinoid receptor agonists such as nabilone and delta-9-THC are already used clinically against nausea and vomiting resulting from chemotherapy and against AIDS-related loss of appetite (Hollister, 1986; Beal et al., 1995; Pertwee, 1997). The ongoing increase in the variety of available cannabinoid receptor ligands could well have a significant impact on the development of therapeutic uses of cannabinoids. Results from rat and mouse experiments already have led to the suggestion that the CB1 receptor antagonist SR141716A may have therapeutic potential in the management of memory deficits associated with ageing and/or neurological diseases (Terranova et al., 1996). The opportunity to modulate extracellular concentrations of endogenous cannabinoid receptor ligands also exists.

Effects on the Central Nervous System

The role of cannabis in inhibiting learning and memory has been investigated in several studies of the rat hippocampus (part of the brain). The inhibitory effects of cannabinoid receptor agonists on the formation of new synapses between rat hippocampal nerve cells in cell culture were reported (Kim & Thayer, 2001). These effects were reversed by a selective CB1 receptor antagonist.

Nutt and Nash (2002), in their update of the scientific evidence, report recent developments in animal studies on the effects of cannabis and cannabinoids. They report on studies examining the mechanisms of tolerance, reward and withdrawal following cannabis exposure. Recently Nava et al. (2001) found that rats did not become tolerant to the effects of chronic (2 weeks) administration of delta-9-THC on hippocampal Ach concentration, or on the altered performance in the T-maze. The effects seemed to be independent of time of onset, and both were blocked by CB1 receptor antagonists.

Lawston et al. (2000) demonstrated morphological changes in the rat hippocampus following chronic administration of WIN 55,212-2, a synthetic CB1 receptor agonist. The changes were similar to those seen after ischaemic or toxic damage. Interactions have been observed between cannabinoids and other neurotransmitter systems. Dynorphin-deficient mice do not show negative motivational effects with tetra hydrocannabinol, suggesting that these effects are mediated by endogenous opioids (Zimmer et al., 2001). Endogenous opioid receptors were also shown to be implicated in modulating reward pathways for repeated THC administration (Ghozland et al., 2002). Repeated exposure to THC induces behavioural sensitisation not only to cannabinoids, but also to opioids in rats (Cadoni et al., 2001). Co-administration of nicotine facilitates the acute response to THC in mice, and also enhances tolerance and dependence (Valient et al., 2002).

The development of differential responses to delta-9-THC in rats following chronic exposure may help to explain the observation that humans develop tolerance to many of the physiological effects of cannabis, but not its euphorigenic actions (Wu et al., 2000).

Nutt and Nash (2002) reviewed recent studies of endogenous cannabinoids. These substances facilitate retrograde communication across hippocampal synapses to modulate GABA release. Additionally it has recently been proposed that anandamide and 2-arachidonylglycerol are the key endocannabinoids involved in this process. The Lancet (2001) reported anandamide as being a probable mediator of the analgesic effects of the endocannabinoid system. Mice bred without the CB1 receptor show behavioural effects similar to those seen in cannabis intoxication and dopamine D2 activation, and it has been suggested that this could provide a model for schizophrenia (Fritzsche, 2001).

In conclusion, many recent developments in the toxicology and pharmacology of cannabis have resulted from laboratory studies and have concentrated on examining the effects of cannabis on the brain. The discovery of two cannabis receptors, and chemicals that act to block or mimic the actions of cannabis on these receptors, has resulted in a better understanding of their effects on human subjects. Two types of cannabis receptors have been discovered to date, CB1 receptors are found predominantly in the brain and in some peripheral tissues, whereas CB2 is not found in the brain but is located in the spleen and in blood-producing cells in the bone marrow and other sites. The highest concentration of CB1 receptors within the brain occurs at sites responsible for memory, learning, pain perception and motor activity. The role of CB2 receptors is less certain. The discovery of cannabis receptors is of particular significance in making comparisons with alcohol since no specific alcohol receptors have been identified.

Human Pharmacology

A summary of the effects of cannabinoids is provided in a recent review of cannabis and cannabinoids (Kumar, 2001) and is presented in Table 3 below. As outlined by Hall and Solowij (1998), the acute toxicity of cannabinoids is very low and the dose of THC required to produce 50% mortality in rodents is extremely high compared with other commonly used drugs.

Table 3. Summary of the Effects of Cannabinoids

System	Effect
Central Nervous System	
Psychological effects	Euphoria, dysphoria, anxiety, de-personalisation, aggravation of psychotic states
Effects on perception	Heightened sensory perception, distortion of space and time sense, misperceptions, hallucinations
Sedative effects	Generalised CNS depression, drowsiness, sleep, additive effect with other CNS depressants
Effects on cognition and psychomotor performance	Fragmentation of thoughts, mental clouding, memory impairment, global impairment of performance
Effects on motor function	Increased motor activity followed by inertia and uncoordination, ataxia, dysarthria, tremulousness, weakness and muscle twitching
Analgesic effects	Similar in efficacy to codeine
Anti-emetic effects	Inacute doses, effect reversed with larger doses or chronic use, increased appetite
Tolerance	To most behavioural and somatic effects including the "high" with chronic use
Dependence, abstinence syndrome	Rarely observed but has been produced experimentally following prolonged intoxication or administration of antagonists

Table 3. (continued) Summary of the Effects of Cannabinoids

System	Effect
Cardiorespiratory System	
Heart rate	Increased with acute dosage, decreased with chronic use
Peripheral circulation	Vasodilation, conjuctival redness and postural hypotension
Cardiac output	Increased output and myocardial oxygen demand
Cerebral blood flow	Increased in the short term and decreased with chronic use
Breathing	Small doses stimulate, larger doses depress coughing but tolerance develops
Airways obstruction	Due to chronic smoking
Eye	Decreased intra-ocular pressure
Immune system	Impaired activity of bactericidal macrophages in lung and spleen
Reproductive system	Decreased sperm count and sperm motility in males, suppression of ovulation, complex effects on prolactin secretion, increased obstetric risks

Interactions with Other Drugs and Medicines

Delta-9-THC enhances the metabolism of barbiturates, antipyrine, and ethanol. The combination of cocaine and cannabis reportedly significantly increases heart rate and arterial pressure. This combination in a non-controlled situation and in high doses may cause severe cardiovascular toxicity (IPCS, 1989).

Effects on Ability to Drive and Use Machinery

Cannabis produces a dose-related impairment in cognitive and behavioural functions that may impair driving or the operating of machinery. These effects are potentiated with concomitant alcohol intake (Kumar et al., 2001) (see chapter 2).

Pharmacokinetics in Humans

Absorption

Absorption from the gastrointestinal tract is almost complete. Peak blood levels and maximal effects occur later after oral administration than after inhalation (Cone, 1988). Symptoms become apparent within 30-120 minutes, reaching a peak after 2-3 hours (Schwartz, 1987; IPCS, 1989).

THC is absorbed more quickly when delivered by smoking. In comparison to oral administration, with inhalation peak plasma concentrations are achieved within 7-10 minutes; subjective effects appear in 20 or 30 minutes but rarely persist for more than 2-3 hours.

Each puff represents a small bolus of the drug that is delivered to the circulatory system via the capillary bed surrounding the alveolar sacs of the lungs. Huestis et al. (1992) reported measuring

detectable amounts of THC (7 to 18 mg/ml) following a single puff of cannabis smoke in individuals smoking cannabis cigarettes (1.75 per cent to 3.55 per cent THC content). When experienced users smoked cannabis cigarettes containing 1.32, 1.97 and 2.54 percent THC, peak concentrations developed in excess of 100 mg/ml, although there was considerable inter-subject variability (Ohlsson et al., 1980; Perez-Reyes et al., 1982; Huestis et al., 1992).

The dynamics of smoking substantially influence how much of the drug is absorbed. The number of puffs, spacing, hold time, and lung capacity, contribute to this variance. When cannabis is smoked by non-tolerant individuals, physiological and behavioural effects appear rapidly. Huestis et al. (1992) found that peak effects occurred at 17.4 +/- 4.8 and 13.8 +/- 4.2 minutes after initiation of smoking of a low (1.75 per cent) or high (3.55 per cent) dose cigarette. Maximum effects were recorded within 4 to 6 minutes after the last puff of cannabis smoke.

Distribution

Plasma levels of THC fall rapidly as the drug redistributes into fatty tissue due to its high fat solubility. The delay between peak blood concentrations and peak drug effects are likely related to delays in penetration in the central nervous system, and to subsequent redistribution of THC following rapid uptake by fatty tissues (Barnett et al., 1982; Barnett et al., 1985). Generally, behavioural and physiological effects return to baseline levels 4 to 6 hours after usage. Blood concentrations of THC peak prior to drug-induced effects, leading to a dissociation between blood concentrations of THC and pharmacological effects. This observation has led investigators to improve the technology for measuring THC and its metabolites in biological fluids and tissues (King et al., 1987; Gjerde, 1991), and to develop pharmacokinetic/pharmacodynamic models that establish a relationship between concentrations of THC and the physiological, behavioural and performance changes produced by cannabis (Chiang & Barnett, 1984).

Metabolism

Delta-9-THC is metabolised by the liver. It is intensively fat soluble and high concentrations accumulate in fatty tissues. These are subsequently liberated slowly into the circulation (IPCS 1989). After oral administration but not after inhalation, delta-9-THC undergoes first-pass hepatic metabolism, firstly to the active metabolite 11-hydroxy-delta-9-THC, then to the more inactive metabolite, 11-nordelta-9-THC acid. Around 80 cannabinoid metabolites can be identified from a similar metabolic pathway; the most important one is 11-hydroxy-delta-9-THC which is metabolised to non-cannabinoid metabolites. Delta-9-THC and its metabolites persist in human plasma for several days or weeks (IPCS, 1989) but repetitive ingestion or smoking over weeks is not followed by clinically-apparent accumulation; this suggests that the persistent metabolites are inactive. Chronic marijuana smokers metabolise delta-9-THC more rapidly than non-smokers.

Excretion

Thirty-five per cent of delta-9-THC and its metabolites are eliminated in the urine compared with 65% in the faeces. Metabolites can be detected in urine even 2-3 days after one exposure and, in cases of chronic use, after 4-5 weeks of abstinence. The half-life (amount of time required to eliminate half of all the substance present from the body) of delta-9-THC is 3 days. Plasma concentrations of delta-9-THC

and 11-hydroxydelta-9-THC fall rapidly (in a few minutes) due to their redistribution in the fatty tissues; afterwards there is a slow decline with a half-life of 30 hours due to the metabolism and gradual elimination of the drug. The half-life may be increased in chronic users to 4.1 days (range 2.9 and 5.0 days) (Johansson et al., 1988).

Passive inhalation has been suggested as a reason for the presence of urinary cannabinoids. However, Adams and Martin (1996) reported that huge efforts were required in order for passive inhalation to produce detectable urinary levels of cannabinoids. The authors concluded that measurement of urinary levels of cannabinoids should be conducted solely for the purpose of determining whether an individual has used cannabis. Attempts at assessing impairment would require considerable knowledge of the circumstances surrounding the last use.

In summary, in contrast to alcohol, cannabis is highly fat-soluble. Absorption into the body occurs quickly and levels fall as the drug is distributed to fatty tissues. The liver breaks down cannabis to compounds which are eliminated in the urine and faeces. These breakdown products may be detectable in urine up to four weeks after use, in those who are heavy users. The effects of cannabis usually wear off four to six hours after use. Although chronic users metabolise cannabis more quickly, it may also take longer for them to eliminate cannabis from their system.

Clinical Experience

Acute Effects

The acute effects of cannabis use have been well described and include an altered state of consciousness characterised by mild euphoria and relaxation, perceptual alterations, including time distortion, and the intensification of ordinary sensory experiences, such as those associated with eating, watching films and listening to music (Hall et al., 1994). Infectious laughter and talkativeness also commonly occur. There are also pronounced cognitive effects, such as impaired short-term memory and a loosening of associations, enabling the user to become lost in pleasant daydreams and fantasy. Motor skills and reaction time are also impaired so that skilled activity of various kinds is frequently disrupted (Hall et al., 1994). In occasional users, the feeling of euphoria is replaced by anxiety and panic reactions and this is a common reason for discontinuation of use. Effects on the cardiovascular system include rapid heartbeat, with heart rate increasing by 20±50% within a few minutes; this effect lasts for up to three hours. Blood pressure decreases when standing but not in the sitting position.

Effects of Cannabis Use on Immune Function

Although animal studies have reported that cannabinoids impair immune function in rodents, the relevance of these findings to human health is uncertain (Hollister, 1992). This is because of the very high dose of the THC used in the animal studies (Kumar et al., 2001). A few reports have pointed to the adverse effects of cannabis on human immunity but have not been replicated. Two prospective studies of HIV-positive homosexual men have shown that cannabis use is not associated with an increased risk of progression to AIDS complications.

A recent review by Roth et al. (2002) examined evidence that delta-9-THC can regulate and suppress human immune responses. The authors reported that leukocytes express both cannabinoid receptor

type 1 (CB1) and cannabinoid receptor type 2 (CB2), and levels of mRNA encoding for them are increased in peripheral blood leukocytes obtained from cannabis smokers. This suggests cannabinoid receptor activation in vivo. The authors reported that habitual exposure to THC appears capable of impacting on human cell-mediated immunity and host defence.

Cannabis and the Brain

Recent studies of the effects of cannabis on aspects of brain function are described below. This includes effects on mental health, cognitive functioning and behaviour. (See chapter 3.)

Cannabis Use and Mental Illness

The relationship between cannabis use and a variety of forms of mental illness is examined below. Firstly, the evidence regarding a 'cannabis psychosis' is examined. Secondly, the possible role of cannabis use in precipitating schizophrenia is reviewed. Finally, the relationship between depression and cannabis use is described.

It is worth noting that in nearly all studies that have examined the issue, cannabis use has been shown to be associated with mental health problems. It is also remarkable that the association is quite strong. For example, a recently-published study by Graham & Maslin (2002) sought information from key workers on substance use among people with severe mental health problems in inner city areas of the UK. It emerged that next to alcohol, cannabis was the substance most commonly used problematically. This was especially the case amongst males of median age 30 years. While a precise estimate was hard to make, somewhere between 10-15% of the sample were heavy users of cannabis.

This conclusion is supported in a study by Duke et al. (2001) which sought to establish the extent and nature of co-morbid non-alcohol substance misuse among people with serious mental health problem in central London. Rather than being based on key-worker information however, the data came from an epidemiological census in an inner city area which utilised a standardised assessment. What was interesting was that the number using cannabis in a serious way was similar to that for the Graham and Maslin study.

However, the matter of the cause and effect remains. In the Graham and Maslin study, many people used cannabis as a way of coping with their mental health problems, in the view of the key workers. Furthermore in the Duke at al. study there was no relationship between severity of symptoms and level of cannabis use.

Schizophrenia and Psychosis

Cannabis use may increase the risk of psychotic disorders and result in a poor prognosis for those with an established vulnerability to psychosis.

Cannabis Psychosis

One of the first studies describing a cannabis psychosis was that of Chopra & Smith (1974), who described 200 patients who had been admitted to hospitals in Calcutta over a five-year period. All had used cannabis and had symptoms that included a sudden onset of confusion, hallucinations, disorientation and paranoia. The authors took the view that this syndrome was due to the cannabis consumption on the grounds that many had no previous psychiatric symptoms. They also pointed to

the similarity between the symptoms in the patients and noted that the users of the most powerful forms of cannabis had the most severe problems.

While the Indian study contains the largest number of cases, other studies in other cultures have described broadly similar outcomes as a result of cannabis use. There have been reports of psychotic disorders in studies of patients in the Caribbean (Harding & Knight, 1973) and New Zealand (Eva, 1992).

In more recent times, these studies of cannabis psychosis have been criticised on several grounds. Attention has been drawn to the fact that patients' condition prior to the apparent onset has not usually been well documented. Another criticism is that there is no consistency in what is regarded as 'cannabis psychosis'. If such a condition exists it may account for a very small percentage of cases of 'psychosis'.

Nevertheless, some recently well-controlled studies in the general population have yielded results that are more convincing. Van Os et al. (2002) report on a three-year longitudinal general-population study of 4045 psychosis free persons and of 59 people in the Netherlands with a baseline diagnosis of psychotic disorder. Substance use was assessed at baseline, one-year follow-up and three-year follow-up. The study showed that baseline cannabis use predicted the presence of any level of psychotic symptoms as well as clinical assessment of the need for care for psychotic symptoms. A number of other points emerged in the Van Os et al. study. Firstly, more than half of the diagnoses could be attributed to cannabis use. Another point was that cannabis use had apparently a much stronger effect among those with a baseline diagnosis of psychotic disorder than in those without such a diagnosis. Results confirm previous suggestions that cannabis use increases the risk of both the incidence of psychosis in psychosis-free persons and a poor prognosis for those with an established vulnerability to psychotic disorder. This is one of the most consistently found and important findings relating to the effects of cannabis consumption.

The possible causal role of other drugs, and prodromal symptoms of schizophrenia that might have led to the use of cannabis, rather than cannabis triggering the psychosis have all been suggested as possible confounding factors (McKay & Tennant, 2000; Hall & Dagenhardt, 2000). However, a longer follow-up and re-analysis of the Swedish cohort (Zammit et al., 2002) confirmed earlier findings that cannabis, and not other drugs, is associated with later schizophrenia. In the New Zealand cohort mentioned earlier, individuals who had used cannabis three times or more by age 15 or 18 were not more likely to have schizophreniform disorder at age 26, although they showed an increase in "schizophrenia symptoms" (but not schizophrenia) (Arseneault et al., 2002).

Schizophrenia

A related set of studies have examined the association between cannabis use and the onset of schizophrenia. Two major studies can be used to illustrate this. A study of over 50,000 Swedish soldiers by Andreasson et al. (1987) examined the relationship between self-reported cannabis use at age 18 years and being diagnosed with schizophrenia in the next 15 years. The results indicated that those who had tried cannabis at age 18 years were more than twice as likely to be diagnosed with schizophrenia. Furthermore, the more frequent the use of cannabis at age 18 years, the greater the likelihood of being diagnosed with schizophrenia.

An investigation by Hambrecht et al. (2000) into the relationship between cannabis use and the onset of schizophrenia described twice the rate of cannabis use as in matched normal controls. Being male and early symptom onset were risk factors for cannabis use. A literature review (Soyka, 2000) described an association between the use of various substances and violence in patients with schizophrenia. An association has been reported between a cannabinoid receptor type 1 polymorphism and a subtype of schizophrenia (Leroy et al., 2001).

A recent study Bersani et al. (2002) started with diagnosed schizophrenics tried to establish whether cannabis had a role in any of their life histories. They concluded that cannabis played a role in some forms of schizophrenia – a form that was distinguishable from those in which its use does not play a part.

There is a consensus that continued and persistent cannabis use tends to exacerbate the condition of schizophrenia and to prevent recovery. For example, Caspari (1999) followed up 39 schizophrenic patients with a history of cannabis use and compared them with a similar number without such a history. His results showed that those with a history of cannabis misuse were more likely to relapse and were also less likely to comply with drug treatment.

More recently, Buhler et al. (2002) studied the precipitation of the onset of schizophrenia among 232 people with a first diagnosis of the disease. People with the diagnosis were twice as likely as controls to have a lifetime history of substance abuse at the age of first admission (14% vs. 7%). The sequence of substance abuse and schizophrenia was studied and suggested that they tended to coincide in very many instances. They concluded that a small proportion of schizophrenias are precipitated by substance (mainly cannabis) misuse. Outcome measures including treatment compliance, utilisation of rehabilitative measures and rate of employment were poorer for patients with, than without, early substance use.

The literature in this area has recently been reviewed by Degenhardt & Hall (2002). They conclude that common factors do not explain the co-occurrence of use and illness. They also conclude that it is unlikely that cannabis use causes mental illness among those who would otherwise not have developed the disorder. The evidence is more in line with the view that cannabis may precipitate illness among vulnerable individuals, increases the risk of relapse among those who already have developed the disease and may be more likely to lead to dependence in persons with schizophrenia.

On the other hand Zammit et al. (2002) conclude that cannabis use is associated with an increased risk of developing schizophrenia, consistent with a causal relation and that this association is not explained by use of other psychoactive drugs or personality traits relating to social integration.

One study which suggests that the association between cannabis use and schizophrenia reflects common influences was carried out by Mueser et al. (1999). The study examined the relationship between childhood disorders and subsequent substance use disorders among schizophrenic patients. The study showed that people who subsequently were diagnosed as schizophrenics and who had experienced childhood conduct disorder or anti-social personality disorder were much more likely (up to 10 times) to have a problem with cannabis use than were those who did not have such disorders in childhood. The authors draw attention to the implication of the finding for the association between cannabis use and schizophrenia and they suggest that conduct/personality disorders may reflect a factor that independently increases both patient's vulnerability to mental illness and also to substance abuse disorders.

Cannabis Use and Depression

The coexistence of cannabis abuse and anxiety and depression is reported to be relatively common in clinical and community populations (Thomas, 1996). However, the degree to which psychiatric disorders such as depression are predisposing risk factors for substance abuse, or vice versa, is not certain (Frances, 1997). These associations have been recently studied in both adolescents and adults (Rey et al., 2001, Troisi et al., 1998) although not all studies have found an association in male participants (Green & Ritter, 2000). Degenhardt et al. (2001) found that cannabis use was associated with mood disorder, but the association was explained by demographic factors, levels of neuroticism and use of other drugs. Individuals may use cannabis to self-medicate their dysphoria.

One of the few studies that attempted to examine the reciprocal relationship between depression and cannabis use is a recent study by Bovasso (2001). This longitudinal study sought to examine the extent to which cannabis use at Time 1 predicted subsequent depressive symptoms at Time 2 (15 years later) and also the extent to which being depressed at Time 1 predicted cannabis use at Time 2. While the results are not absolutely clear-cut, it emerged that those participants who had a diagnosis of cannabis abuse at baseline were four times more likely to have depressive symptoms at the follow-up even when controls were applied for age, social background, and anti-social behaviour. In contrast, depressive symptoms at Time 1 did not predict cannabis use at the follow-up. While this design is not without problems, the results of this particular study are much more in line with the view that cannabis is a risk factor as opposed to the self-medication view.

The effect of cannabis use in adolescence was recently examined by Patton et al. (2002). Cannabis use in adolescence, particularly girls, was reported to predict later depression and anxiety, with daily users carrying the highest risk. This was reflected in higher rates of anxiety or depression according to the frequency with which cannabis was used. Baseline depression did not predict later marijuana use and therefore, the results do not support the self-medication hypothesis.

In a recent cohort study in New Zealand, the investigators did not find an association between cannabis use at the age of 15 and depressive disorder at the age of 26 (Arseneault et al., 2002). However, young people who had used cannabis three times or more by the age of 18 were more likely to have a depressive disorder at the age of 26, even after use of other drugs was controlled for. Considerable attention has also been given to the effects of long-term use of cannabis on depression. For example, in the US National Longitudinal Alcohol Epidemiology Survey (Grant, 1995), it was shown that persons with a major depression in the past year were more than six times more likely to have a cannabis abuse or dependence syndrome.

This association between cannabis and depression also emerges in a recent Australian study by Rey, Sawyer, Raphael, Patton & Lynskey (2001) of the association between cannabis use and mental health problems among adolescents. In the study parents completed a psychiatric interview while the adolescents completed questionnaires. Among the findings that emerged was that there was a particularly strong association between cannabis use and depression as well as some other health problems. The authors describe the outcome as indicating that cannabis use shows a 'malignant pattern of co-morbidity' with other conditions. However, the issue of causal relationships is not addressed in that survey.

A recent major study by Chen, Wagner & Anthony (2002) examined the possible causal role of cannabis in the development of a 'Major Depressive Episode' (MDE). Data was gathered from an American national sample of nearly 7,000 aged 15-45 years. The results indicated that risk of MDE was moderately associated with the number of occasions of cannabis use and with more advanced stages of such use. Relative to non-users, cannabis users had a 1.6 times greater risk of MDE even when statistical adjustment for gender, social background and cigarette smoking were taken into account. It should be noted however, that the confidence interval is so large (1.1 to 2.2) that this estimate is only barely outside the area of chance. Female versus male variation in the extent of the association was also examined but no substantial differences emerged from that analysis.

However, studies that control for other variables and longitudinal studies are less certain about the causal role of cannabis misuse in depression. A study by Green & Ritter (2000) of young adult males in the US found that while there was a weak relationship between early initiation to cannabis use and depression, this association was not significant when controls were applied for educational attainment, alcohol and tobacco use. The same implication emerges in a study by McGee, Williams, Poulton & Moffitt (2000) of a birth cohort between ages 15 and 21 years in Dunedin, New Zealand. An important finding in this study is that cannabis use at age 15 years did not predict mental health problem at age 18 years, but having mental health problems at age 15 years modestly predicted cannabis use at age 18 years. McGee et al. took the view that cannabis use was not a form of self-medication but rather reflects a 'willingness to contravene the law'.

An interesting question concerns why cannabis and depression are associated, assuming that the relationship is not mediated by uncontrolled factors. One suggestion is made in a recent publication by Simons & Carey (2002) who take the view that the critical factor is 'affect dysregulation' which creates a vulnerability to cannabis use among users. They claim to have found evidence for such a risk factor in a study of nearly 600 undergraduates about half of whom were frequent cannabis users.

Other studies indicate that at least in some circumstances cannabis use can come about as a result of depression, particularly during adolescence. A study by Field, Diego & Sanders (2001) identified a group of high school adolescents who were clinically depressed. What was interesting was the pattern of association with other negative features of their lives including poor parent and peer relationships, less happiness and more frequent suicidal thoughts. Furthermore, they used more cannabis and cocaine. The line taken by the authors is that the substance misuse seems more of a result of the other features of their lives, although it may well be that there is a reciprocal relationship (unhappiness brings about cannabis use which in turn results in unhappiness).

One idea that has been put forward is that drug abuse is driven by attempts to alleviate psychological distress. This is sometimes referred to as the self-medication hypothesis. Based on this idea, it has been suggested that particular patient subgroups are likely to be attracted to certain drugs because of their pharmacological properties. This idea was examined in a study by Aharonovich, Nguyen & Nunes (2001) who examined the extent to which three groups of substance abusers (cannabis, cocaine and opiates) had different levels of anger and depression as defined by measures in the Beck Depression Inventory and the State-Trait Anger Expression Inventory. What emerged is that compared to controls, when anger and depression were raised among all three groups of substance abusers, there were no substantial difference between the groups thus contradicting the specificity hypothesis. However, the general idea of self-medication as a means of reducing distress is plausible and remains

an important consideration when considering the association between cannabis and various forms of mental illness. (The relationship between cannabis use and suicide is considered in Chapter 3.)

Neurocognitive Functioning

(The effects of cannabis on cognitive functioning is considered in chapter 3). The **neurocognitive** changes that may be attributed to chronic cannabis use are subtle and may depend on prolonged and heavy levels of consumption. Studies over the past two decades have only provided weak evidence of persistent neurocognitive deficits (Rodgers & Robbins, 2002). However recent data indicate that chronic and heavy use of cannabis may be associated with quite subtle changes in cognitive, particularly attentional, function. The long-term effect of these changes is not known. Recently, Ehrenreich et al. (1999) reported that deficits in human visual scanning (which undergoes maturation between 12–15years of age) are best predicted by earlier onset of cannabis use (before 16 years of age, versus after 16 years). This suggests that early use is associated with later cognitive dysfunction. These results are also consistent with the theory that attentional processing may be particularly affected (Solowij, 1998).

Establishing the neural basis for any cognitive changes associated with chronic use of cannabis remains difficult. PET scanning was used to study regional blood flow in cannabis users performing an auditory attention task, before and after smoking cannabis (O'Leary et al., 2000, 2002). After smoking, blood flow increased in a number of paralimbic brain regions (orbitofrontal lobes, insula, temporal poles) and in the anterior cingulate and cerebellum. Blood flow decreased in temporal lobe regions sensitive to auditory attention effects. Voruganti et al. (2001) report a case of a patient with schizophrenia who surreptitiously smoked cannabis during a SPECT study of dopaminergic function in the brain. There was an immediate 20% decrease in striatal D2 receptor binding, indicating increased synaptic dopamine activity. Wilson et al. (2000) reported PET findings indicating that early onset of cannabis use (<17years) is associated with structural changes including reduced whole brain volume and percentage of grey matter, but higher global cerebral blood flow; whereas Block et al. (2000), using magnetic resonance imaging, reported that frequent use of marijuana in younger subjects is associated only with lower ventricular cerebrospinal fluid volume.

Volkow et al. (1996), extending earlier work, reported lower baseline cerebellar metabolism in chronic users than in controls, but greater increases in prefrontal (orbitofrontal) areas and the basal ganglia after administration of delta-9-THC. The latter finding suggests that alterations in the processing of fronto-striatal circuitry may mediate the clinical manifestations of cannabis use involving behavioural dysregulation.

In summary, cannabis use is strongly associated with increased risks of mental illness, including depression, psychosis and schizophrenia. Use of cannabis, particularly when onset is in younger age groups may be associated with neuro-cognitive defects involving attentional dysfunction and learning.

Cannabis Use and Epilepsy

Cannabinoids have complex actions on seizure activity and exert both anticonvulsant and proconvulsant effects. In some animal models, marijuana or its constituents can lower the seizure threshold. However, there are currently insufficient data to determine whether occasional or chronic cannabis use influences seizure frequency. Conversely, some evidence suggests that marijuana and its

active cannabinoids have anti-epileptic effects, but these may be specific to partial or tonic-clonic seizures. Cannabis use can transiently impair short-term memory, and like alcohol use, may increase non-compliance with anti-epileptic medications. Cannabis use or withdrawal could potentially trigger seizures in susceptible patients (Gordon & Devinsky, 2001).

Cardiovascular Effects

Cannabinoids and their synthetic and endogenous analogues may cause not only neurobehavioural, but also cardiovascular effects in susceptible individuals. These include a profound decrease in blood pressure and heart rate with chronic use. Conversely, an increase in heart rate occurs as an immediate effect of use. Although scientific evidence indicates that the heart rate and blood pressure lowering effects of anandamide and other cannabinoids are mediated by peripherally - (outside the central nervous system) located CB1 cannabinoid receptors, anandamide can also elicit vasodilation in certain vascular beds, which is independent of CB1 or CB2 receptors (Kunos et al., 2000). This suggests the possibility of other cannabinoid receptors, as yet unidentified.

A cerebellar infarct was reported in a 15 year old male related to heavy cannabis use (White et al., 2000). A recent case series of young adults has reported an association between cannabis ingestion and sudden cardiovascular death, as in the absence of any other toxic substances, tetrahydrocannabinol was found in postmortem blood samples (Bachs & Moreland, 2001). Another fatality occurred in a young man with rheumatic heart disease after ingestion of bhang, a cannabis preparation (Gupta et al., 2001). Herning and colleagues (2001) used Doppler sonography to demonstrate increased cerebrovascular resistance (comparable to normal 60-year olds) in young people who were frequent cannabis users. Two cases of atrial fibrillation are reported following cannabis smoking, suggesting that delta-9-THC may have effects on adrenergic systems (Kosior et al., 2001). Mittleman et al. (2001), in a case-crossover study design, calculated a relative risk for heart attack of 4.8 in the hour after smoking cannabis.

Respiratory Effects

The smoke from herbal cannabis preparations contains all the same constituents (apart from nicotine) as tobacco smoke, including carbon monoxide, bronchial irritants, tumour initiators (mutagens), tumour promoters and carcinogens (British Medical Association, 1997). As much as four times the amount of tar can be deposited on the lungs of cannabis smokers as cigarette smokers if a cigarette of comparable weight is smoked. This difference is probably the result of differences in administration. Cannabis cigarettes usually do not have filters and cannabis smokers usually develop a larger puff volume, inhale more deeply and hold their breath several times longer than tobacco smokers (Joy et al., 1999). In addition, cannabis has a higher combustion temperature than tobacco. The tar from a cannabis cigarette contains higher concentrations of benzanthracenes and benzapyrenes (both of which are carcinogens) than tobacco smoke. It has been estimated that smoking a cannabis cigarette results in an approximately five-fold greater increase in carboxyhaemoglobin concentration (arising from carbon monoxide in smoke), a three-fold greater amount of tar inhaled, and retention in the respiratory tract of one-third more tar than smoking a tobacco cigarette (Ashton, 2001).

Chronic smoking effects are similar to those of tobacco smoking. The effects of cannabis on the lungs have been summarised in a recent review by the British Lung Foundation (2002). Chronic heavy use of

cannabis is associated with increased symptoms of chronic bronchitis such as coughing and wheezing. Cannabis use has been reported to be associated with bullous lung disease in young people, that is, watery blisters (Johnson et al., 2000). Lung function is impaired and there are greater abnormalities in the large airways of cannabis smokers than non-smokers. Cannabis smoking is associated with changes in bronchial tissue. Many cannabis smokers have increased redness and swelling of the airway tissues (Roth et al., 1998; Joy et al., 1999). In addition to the risks previously reported for heavy cannabis smokers who also smoke tobacco (Hall, 1998), studies have recently shown that people who are regular users of cannabis but not tobacco have more symptoms of chronic bronchitis than non-smokers (Hall, 2001). Significant respiratory symptoms and decreased respiratory function were reported by Taylor et al. (2000) in young cannabis smokers, independent of tobacco use, and equating to smokers of 1-10 cigarettes per day. Contamination of cannabis with fungal spores has been reported which adds the risk of respiratory and systemic infection, particularly in those with a compromised immune system (Verweij et al., 2000).

It has been calculated that smoking 3-4 cannabis cigarettes a day is associated with the same evidence of acute and chronic bronchitis and the same degree of damage to the bronchial mucosa as 20 or more tobacco cigarettes a day (Ashton, 2001). Prospective studies of the long-term effects on the lungs of chronic cannabis smoking are lacking, but some authors suggest that chronic airways disease and bronchogenic carcinoma may be as great a risk as with tobacco smoking.

Cannabis and Cancer

Several publications have recently suggested a relationship between cannabis use and certain types of cancer. Given the high rates of tobacco use among regular cannabis users, it will be difficult to obtain definitive evidence that cancers observed among cannabis users are due to cannabis rather than to tobacco smoking.

Animal studies have demonstrated that cannabis smoke may be carcinogenic; it is **mutagenic** in laboratory studies of cells (in vitro) and in studies of live animals (in vivo). Cannabinoids impair immune function in rodents, decreasing resistance to infection, and non-cannabinoids in cannabis smoke impair alveolar macrophages involved in local immune response (IPCS, 1989). The relevance of these findings to human health is uncertain because the doses of THC used in animal studies have been very high, and tolerance may develop to the effects on immunity in human beings.

A review of cannabis use and risk of cancer by the World Health Organisation International Agency for Research on Cancer (IARC, 1990) reported that in users under 40 years of age, cannabis increases the risk of squamous-cell carcinoma of the upper aerodigestive tract, particularly of the tongue and larynx, and possibly of the lungs. Other possible tumours linked to cannabis use include non-lymphoblastic acute leukaemia and astrocytoma. In head and neck cancer, carcinogenicity was observed for regular (i.e. more than once-a-day for years) cannabis smokers. In addition, cannabis increases the risk of head and neck cancer in a dose-response manner for frequency and duration of use. Interaction has been observed with cigarette smoking and alcohol use. Delta-9-THC seems to have a specific carcinogenic effect different from that of the combustion products (Carriot & Sasco, 2000). Furthermore Dorrell (2000) reviewed the possible carcinogenic effects mediated by the immunosuppression of delta-9-THC.

Some case studies have found an increased risk of child cancers in children born to mothers who reported using cannabis during their pregnancies. However cannabis was one amongst several factors considered in the analysis of the data from these studies and this area requires further study (Hall and Solowij, 1998).

As outlined in a recent review by Hall and MacPhee (2002), experimental and epidemiological evidence on the cancer risks of cannabis use is still too weak to warrant strong conclusions. The epidemiological evidence is conflicting. There are case reports of upper respiratory and gastrointestinal tract cancers among relatively young adults who have been daily cannabis users and one case-control study has found an association between cannabis smoking and head and neck cancer. The only prospective study to date did not find an increased incidence of head and neck or respiratory cancers (Sidney et al., 1997). This study did find, unexpectedly, an increased rate of prostate cancer, a finding that needs to be further examined. The relative youth and the low prevalence of regular cannabis use among participants in this cohort study may have reduced its ability to detect an increase in respiratory cancers. Further follow-up of this cohort and additional case-control and prospective epidemiological studies are required to assess more effectively the cancer risks of cannabis use.

It has been suggested that while awaiting the results of these studies, the similarities between cannabis and tobacco smoke are sufficiently strong to warrant advising regular cannabis smokers, especially those who also smoke tobacco, that they may be at increased risk of developing cancer (Marselos & Karamanakos 1999).

Effects on Reproduction System

Studies have reported a reduction in fertility to be associated with cannabis use. On the basis of research on animals it has been argued that cannabis would probably decrease fertility for both men and women in the short term (Joy et al., 1999), particularly in males, in the presence of a pre-existing low sperm count (Hall et al., 1994).

Effects of Cannabis During Pregnancy and Infancy

In a US Community survey, 4.1% of pregnant women tested positive for cannabis (Finch et al., 2001). The effects of smoking cannabis in pregnancy are unclear as results of research in this area have been inconsistent. This may be largely due to the numerous other factors in utero that may also influence birth outcome. Fried and Smith have provided recent reviews of the effects of cannabis use in pregnancy (Fried & Smith, 2001; Fried, 2002).

Birth Weight and Congenital Anomalies

Some studies have suggested that cannabis smoking in pregnancy may reduce birth weight. A controlled study has found this relationship has remained after controlling for any confounding variables but this link has not been found in other studies (Zuckerman et al., 1989; Hall and Solowij, 1998; Joy et al., 1999). The effects of cannabis smoking, where the study has found an association, has been small compared to tobacco (Fried, 1998). There is little evidence that gestation is shorter except for adolescent mothers (Cornelius et al., 1995). Large well-controlled epidemiological studies have found no evidence that cannabis causes birth defects (congenital anomalies) (Zuckerman et al., 1989).

Data on cannabis use was collected during the Avon Longitudinal Study of Pregnancy and Childhood (Fergusson et al., 2002). 5% of mothers smoked cannabis before or during pregnancy. There was no increased risk of perinatal death or the need for special care, but birth weight was reported to be lower.

Behavioural and Developmental Effects

Cannabis may have behavioural and developmental effects on infants exposed in utero during the first few months after birth. Between the ages of 4 and 9 children who have been exposed to cannabis in utero have shown deficits in sustained attention, memory and cognitive functioning. However, the effects were small compared to tobacco and their clinical significance is unclear. The underlying causes might be the cannabis exposure or might be more closely related to the reasons underlying the mothers' use of cannabis during pregnancy (Fried, 1998; Hall and Solowij, 1998; Joy et al., 1999; Fried and Smith, 2001).

Although there is no evidence for reduced IQ, a negative effect of executive function resulting from in utero exposure has been reported (Fried, 2002). A prospective study showed a relationship between prenatal exposure and various behavioural problems (hyperactivity, impulsivity, inattention) in 10 year old children (Goldschmidt et al., 2000).

Sudden Infant Death Syndrome

Scragg et al. (2001) suggested maternal cannabis use could be a weak risk factor for Sudden Infant Death Syndrome, even after controlling for maternal smoking. This is in contrast to reports by Klonoff-Cohen and Lam-Kruglick (2001) that paternal use at conception and in the postnatal period, but not maternal use, was reported to increase the risk of Sudden Infant Death Syndrome.

In summary, reports of the effects of cannabis on the developing foetus have yielded conflicting results. To date there is insufficient evidence to support an association between reduced birth weight, congenital anomalies, or sudden infant death syndrome. It remains difficult to distinguish the influence of concurrent factors such as nutrition and socioeconomic status from the influences that might be attributable to cannabis use. Recent studies of the effect on behavioural development suggest a possible link, but this would need further study.

Dependence Potential in Humans

The *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV; American Psychiatric Association, 1994) presents criteria for the diagnosis of psychoactive substance dependence, based largely on the concept of the dependence syndrome. The key features of DSM-IV substance dependence are cognitive, behavioural and physiological symptoms, indicating that the individual continues to use the substance despite significant substance-related problems. The criteria include tolerance, a withdrawal syndrome, difficulty in controlling consumption and a pattern of use which leads to a reduction in other important activities. In an empirical study, Morgenstern et al. (1994) found the DSM concept of cannabis dependence at least as valid as those for dependence on alcohol, opiates, stimulants and sedatives.

A DSM diagnosis is made on the basis of the Composite International Diagnostic Interview (CIDI), and while this instrument has good reliability and validity, it is a lengthy instrument requiring accreditation

to administer. Swift, Copeland & Hall (1997) describe three shorter instruments which were shown to have good psycho-metric properties and which would allow for more widespread study of cannabis dependence.

Three recent studies are worthy of attention. A study by Swift et al. (2001) found that almost one-third of Australian cannabis users met criteria for cannabis dependence. Rosenberg & Anthony (2001) examined cannabis dependence in a community sample and found that of 599 cannabis users, 37 had become dependent while a further 41 had developed symptoms without dependence. In a study of 1601 young adults (mean age 20.7 years) from an Australian longitudinal cohort study (N=2,032) Coffey at al. (2002) reported that 59% reported lifetime use of cannabis, 17% used at least weekly and 7% (11% males, 4% females) met criteria for cannabis dependence. Symptom prevalence in dependent cannabis users was: persistent desire 91%; unintentional use 84%; withdrawal 74%; excessive time obtaining/using 74%; continued use despite health problems 63%; tolerance 21%; and social consequences 18%. The combination of withdrawal, persistent desire and unintentional use was reported by 57%. Dependent cannabis users reported compulsive and out-of-control use more frequently than dependent alcohol users, withdrawal similarly and tolerance considerably less often. The authors concluded that progression beyond weekly use of cannabis carries a significant risk of dependence.

In a recent review, Johns reported that one in ten people who have used cannabis are at risk of dependence (2001). On the basis of a review of more than 15 years of electrophysiological and biochemical evidence, Gardner (2002) reported that cannabinoids appear to enhance brain reward processes in similar fashion to other addictive drugs. In addition, cannabinoid withdrawal appears to activate the same brain withdrawal processes as activated by withdrawal from other addictive drugs.

The Genetics of Susceptibility to Dependence

A microsatellite polymorphism (AAT) at the cannabinoid CB1 (brain) receptor gene (CNR1) consists of 9 alleles. Since the cannabinoid system is part of the reward pathway the hypothesis that genetic variants of the CNR1 gene might be associated with susceptibility to alcohol or drug dependence was examined by Comings et al. in 1997. The study consisted of 92 subjects on an Addiction Treatment Unit (ATU) and 114 controls. All were non-Hispanic Caucasians. The ATU subjects were screened for all types of substance dependence using the Diagnostic Interview Schedule (DIS), and for a variety of substance abuse symptoms using the Addiction Severity Index (ASI). Since inspection of the distribution of alleles in controls versus intravenous drug users showed a decrease in the frequency of the 4th allele, and the < 4 alleles were rare, the alleles were divided into two groups, < 5 and < or = 5, and three genotypes < 5/< 5, heterozygotes, and > or =/> or = 5. When all variables were subjected to factor analysis, factor 1 showed a clustering of drug dependence variables and factor 2 of alcohol dependence variables. By ANOVA only factor 1 showed significant differences by genotype consistent with a model where homozygosity for the > or = 5 repeat alleles showed the greatest effect. The number of intravenous drugs used was significantly greater for those carrying the > or =/> or = 5 genotype than for other genotypes. The association with specific types of drug dependence was greatest for cocaine, amphetamine, and cannabis dependence. The results are consistent with a role of cannabinoid receptors in the modulation of dopamine and cannabinoid reward pathways. The authors concluded that independent studies should be designed to further confirm the hypothesis that cannabinoid receptors may contribute to the susceptibility to drug abuse.

Striking individual differences in responsiveness to cannabinoids have been observed that might involve mutations in the gene encoding the brain-expressed cannabinoid receptor. In a preliminary study by Hoehe et al. (2000), the human CB1 cannabinoid receptor coding region was comparatively sequenced in different groups of individuals: one group showed acute psychotic symptoms after cannabis intake, while another group did not develop any psychopathology after longterm heavy cannabis abuse. No evidence for structural mutations was obtained, which might provide some insight into the molecular basis of individually-different responsiveness to cannabinoids.

Tolerance

Animal studies suggest that cannabinoids may affect the same reward systems as alcohol, cocaine, and opioids. Heavy smokers of cannabis also develop tolerance to its subjective and cardiovascular effects, and some report withdrawal symptoms on the abrupt cessation of cannabis use (Hall & Solowij, 1998).

Conclusions

As noted above, the criteria for cannabis dependence in the DSM-IV include tolerance, a withdrawal syndrome, and difficulty in controlling consumption. Some reviews of the literature in this area have concluded that the cannabis-withdrawal syndrome has now been unequivocally demonstrated (Johns, 2001). In contrast Smith, in a more recent review of the literature on withdrawal symptoms (2002), suggested that the studies conducted to date do not provide enough evidence on which to draw any conclusions as to the existence of a cannabis withdrawal syndrome in human users. It is evident from the studies reviewed here that there is little on the percentage of users who may be at risk of becoming dependent.

On the basis of current research cannabis cannot be said to provide as clear a withdrawal pattern as other drugs of abuse, such as opiates. This is to be expected of the long half-life and the slow elimination of metabolites.

Gaps in Knowledge

Obviously the research on the pharmacology and toxicology of cannabis continuing and the international literature is likely to provide the beginnings of answers to some of the questions raised in this chapter. In the Irish context, there is a need to give consideration to the following important matters:

- There is a need to monitor the potency of cannabis available on the Irish market;
- There is a need to establish the extent and significance of cannabis use among people with mental health problems in Ireland;
- There is a need to study the extent of cannabis use among people with respiratory illnesses.

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Chapter Two

Public Health Risks of Cannabis Use: Epidemiological Evidence

Claire Collins

Overview

This chapter addresses the public health risks related to cannabis use including a review of the epidemiological studies of health outcomes of cannabis use. The material in the chapter is presented under seven main headings as follows:

- The availability and quality of product on the market;
- Knowledge, perceptions and availability of information;
- Prevalence and patterns of use;
- Characteristics and behaviour of users;
- Indicators of health consequences;
- Context of use;
- Implications for the non-using population.

Availability and Quality of Product on the Market

Availability at Consumer Level (Extent/Quantities)

The availability of cannabis at consumer level is largely unknown and difficult to evaluate from an epidemiological standpoint. Most studies rely on self-reports by consumers of *perceived* availability. Further analysis of this area is warranted because availability is often cited as a primary reason for using the drug (Brinkley et al., 1999).

Brinkley et al. (1999) conducted a large study on the experience of drug use among secondary school students in Dublin. Seventy-one per cent of students in this sample said they could obtain a "joint", with 45% reporting that they could easily obtain cannabis and approximately 25% answering that they could probably find the drug. Less than 10% said they definitely could not find cannabis. In comparison to all illicit drugs in this study, cannabis was most easily accessible. Fifty-four per cent of students reported that they were offered the drug on at least one occasion.

The 1999 European Schools Survey Project on Alcohol and Other Drugs (ESPAD) Report targetting 15-16-year olds in schools across the European Union noted similar findings concerning the relatively easy access to cannabis. Twenty-eight per cent of the sample reported the drug as "very" or "fairly easy" to obtain. The percentage of 15-16-year olds in Ireland who reported easy attainment was well above the average for other ESPAD countries (59%). Denmark and the United Kingdom followed Ireland, respectively. The figure for the United States (78%) is well above the European average.

Sources at Consumer Level

Sources for users, namely adolescents, was a frequently overlooked area of research until the ESPAD Report (1999). Approximately 50% of European students know a place where they could buy cannabis. In Ireland, this figure rises to 78% with "street, park etc." being mentioned by 40% and "school" by 23%. Brinkley et al. (1999) examined the same variables and found similar results to the question

"where was the drug offered". The most common place was "on the street" followed by "at a rave or disco" and "at friend's home". Only 6% said they were offered cannabis at school compared with a much higher percentage in the previously mentioned study. When asked how they obtained cannabis, 62% of pupils who had reported use of cannabis said that it was shared around a group of friends. In addition, 15% said they received the drug from a sibling, 6% said they stole it from home, and 25% said they bought it from a stranger. Interestingly, of those who have used cannabis, only 38% report ever having purchased it.

(See chapter 4 for information on the retail market relevant to cannabis.)

Trends in Availability

Drug availability trends are difficult to measure. There are two main indicators of availability trends and neither is completely reliable. One is through data for offences for cannabis possession and supply and the other is based on the self-reports of those who buy drugs. Figures for cannabis possession may reflect law enforcement policies, rather than actual availability, or the drugs may not be intended for the country in which they are seized (Sinclair et al., 2001). Data on drug seizures are available from the Annual Reports of Garda Síochána records (e.g. An Garda Síochána, 2004). The total number of offences for possession of cannabis has increased steadily from 4,186 in 1999 to 4,880 in 2000 to 5,083 in 2001. However, both the number and the quantity of seizures are important to identify trends, as the number alone many also reflect Garda and Custom activity.

Another method employed to determine availability trends is surveying those adolescents who buy cannabis. The ESPAD Report (1999) found that in most countries, the proportion of students who perceive cannabis as "very easy" or "fairly easy" to obtain has increased in the period from 1995 to 1999. The top five countries in 1999 where cannabis was perceived to be easily obtained were Ireland (59%), Denmark (57%), the United Kingdom (52%), the Czech Republic (50%) and Slovenia (47%).

Average Dose and Degree of Variability

There are four noted types of cannabis. "Bhang" which is the least potent of the types, comes from the tops of uncultivated plants. Herbal cannabis (ghanga, marijuana), the most widely used form in the United States, is taken from the dried leaves and flowers. Cannabis resin, also known as hashish, is most popular in Ireland and most of Europe. It comes in the form of a solid block scraped from the cannabis plant. Cannabis oil is prepared by extraction and subsequent distillation and is consumed by dipping in tobacco and then smoking. In Ireland, cannabis is usually smoked in home-made cigarettes ('joints') but can also be smoked in pipes, made into a drink or cooked into cakes or biscuits (Corrigan, 1994).

(Further chemical and pharmaceutical detail on the different types of cannabis is contained in Chapter 1 of this report.)

There is little data on average doses and concentration levels in Ireland and the rest of Europe. The *lowest* dose producing behavioural responses when cannabis is smoked is two milligrammes of delta-9-THC. If the drug were consumed orally, it would take substantially more than this amount to produce cause and effect. An analysis in Ireland from 1980 to 1996 found that the weight of cigarettes containing cannabis varied substantially, but on average, cigarettes made from cannabis resin

contained 102 milligrammes of resin and cigarettes made from herbal cannabis contained 260 milligrammes on average (Buchanan & O'Connell, 1998). There is no indication of amounts used in pipes or 'bongs'.

Purity Levels and Presence of Adulterants

The potency of cannabis is based on its tetrahydrocannabinol (THC) content. The international research indicates that the THC content of marijuana, or herbal cannabis, is on the rise – El Sohly et al. (2002) report that potencies of confiscated samples rose from 1.5% in 1980 to 4.2% in 1987. Cannabis resin has remained fairly stable at around 4% to 5% for many years in the UK (House of Lords Report, 2000). In New Zealand, THC concentrations have also remained relatively stable between 2% and 4%.

In the Irish context Maguire (2001) has examined the THC content of cannabis available in Ireland. His conclusion is that '…high potency varieties of cannabis herb are being traded on the black market in Ireland' (p. 231). What was especially interesting about Maguire's findings was the variation in THC content, with the implication that the difference in dose is very large. He found that while the average THC content in a joint prepared using herbal cannabis was 4.3 mg, it could range from 0.4 to 8.2 mg. This compares with a value of 16.2 mg THC in a joint containing cannabis resin.

The international literature has also shown that concentrations vary considerably depending on the product, its source and the route of administration (Niesink, 2000). El Sohly (2002) points out that reports suggesting that concentrations have increased 10-20 fold are false and compares changes in average concentrations of THC of commercial-grade marijuana (2.84% in 1985; 4.72% in 2001) and high-grade sinsemilla (7.17% in 1985; 9.03% in 2001). Hall and Swift (1999) point out that usage practices among heavier users and their more regular use of more potent types is the most significant factor in changes consumption.

As noted in Chapter 1, cannabis contains more than 400 chemical compounds. In addition, adulterants, including pesticides, as well as naturally occurring contaminants such as microbes and fungi, may also be present, and these could pose a risk to immuno-suppressed patients such as people with AIDS (House of Lords Report, 2000). In the same report it was observed that the overall quality of imported cannabis resin appeared to have fallen in recent years; "many users perceive cannabis resin as adulterated and forensic analysis frequently confirms that this is the case, with the addition of caryophyllene, a constituent of cloves, being particularly common". However, one of the experts contended that the concern about herbicide contamination was unfounded, and that case history evidence of health problems from microbial contamination was limited. A need for more research in this area was identified.

One early study identified contamination of marijuana by spraying with defoliants as the clearest danger to health (Hollister, 1986). More significant are concerns about the possible health effects of the use of cannabis contaminated by herbicides (such as paraquat) that were used to control illicit cannabis cultivation in the US in the 1970s (WHO, 1995). There have also been concerns about the microbial contamination of cannabis leaf but there has been little evidence (other than a small number of case histories) that this has adversely affected the health of cannabis users (Hollister, 1986).

Typical Prices and Range

The Garda National Drugs Unit provides most of what is known about street prices of cannabis in Ireland (reported by Moran et al., 2001). The indications are that the average price of cannabis resin (per gram) has remained steady at €13 for the years 1995 through 1999. Likewise, the average price of cannabis leaves per gram was consistently reported at €3 for the same period. These figures are only averages. In Dublin, street prices vary greatly according to demand and various areas of the city itself (O'Brien & Moran, 1998).

Knowledge, Perceptions and Availability of Information

Availability of Scientific Information on Product

There is a dearth of general population surveys on prevalence rates conducted in Ireland. The Centre for Health Promotion Studies, National University of Ireland (NUI) in Galway have conducted two population studies – Survey of Lifestyle, Attitudes and Nutrition (SLÁN) – in 1998 and 2002 which collected some information on drug usage (Kelleher et al., 2003). A survey of usage among the general population in Ireland, commissioned by the National Advisory Committee on Drugs, and the Drug and Alcohol Information and Research Unit of Northern Ireland has recently been published (NACD & DAIRU, 2003).

Hall & Babor (2000) call for heightened attention in the neglected area of cannabis addiction research. Although chronic cannabis use is an experience of a small minority and consequences of use appear innocuous, they express concern about increasing prevalence rates among young people. Societal acceptance of the drug will exacerbate the problem, as was seen with tobacco.

Spruit (2002) summarising the findings of an International Scientific Conference on Cannabis (2002) notes the following questions regarding cannabis: Why is cannabis use associated with the progression to other drugs; in other words, is the gateway hypothesis valid? What is the threshold of cannabis consumption that is acceptable for driving? *Who* uses and *why* (as opposed to simply, *how* many users)?

Availability of Information on Effects of Product

Although the proportion of THC in cannabis preparations has increased significantly since the first wave of use in the 1960s and 1970s, the effects on one's health as a result are largely unknown (International Scientific Conference on Cannabis, 2002). It is difficult to determine how one particular dosage will affect a user due to factors such as variability in individual smoke inhalation (chapter 1) and tolerance. This highlights the need for an accepted measure of exposure to cannabis similar to the concept of 'pack-years' for cigarettes and 'units' for alcohol.

The House of Lords Report on Cannabis (2000) contends that consuming the drug by smoking has more harmful consequences than most believe. The authors write that it is likely that smoking cannabis will soon be causally linked to lung cancer. They compare the delay of this discovery to the one in which tobacco was eventually found to cause lung cancer. Although evidence of pulmonary effects is

beginning to emerge, the epidemiological evidence in relation to cancer is conflicting. However, advising regular users of an increased risk of cancer has been suggested by a recent review (Hall & MacPhee, 2002). A more detailed discussion of the health effects of cannabis use is contained in Chapter 1.

Level of Awareness of Product Amongst Drug Consumers in General

When Irish 16-year olds were asked their reasons for first illicit drug use, the number one reason was curiosity. Twenty-two per cent named the desire to "get high" as the second most important reason for experimenting with drugs. A much lesser proportion referred to peer pressure and related reasons for first illicit drug use (ESPAD, 1999). Brinkley et al. (1999) found similar results – 80% of students said they took illicit drugs for the first time because "they wanted to try" and 44% gave the reason "I like the effects".

Level of Knowledge of Product, Effects and Perceptions among Consumers of Product

Irish students typically report relaxation and pleasure as the effects of cannabis (Brinkley et al., 1999). Similarly, participants in the "Three Cities" study name relaxation and pleasure as well as enhancement of activities as reasons for cannabis use (Cohen et al., 2001). A higher proportion of pupils in the Brinkley et al. study could cite the effects of cannabis compared to any other illicit drug. Those that knew the effects of other illicit drugs typically attributed negative effects to heroin and cocaine and neutral effects to ecstasy. Alcohol was perceived in the most favourable light and cannabis and tobacco were close behind. Fifty-nine per cent of students attributed positive effects to cannabis and only 11% perceived cannabis as producing mainly negative effects. A small percentage reported that cannabis did not produce any effects.

Much debate has been given to the issues of the 'normalisation' of cannabis. Hall & Babor (2000) note its social tolerance and widespread acceptance, equating it to a legal drug, tobacco. With high prevalence rates especially in youth populations, it may just be considered a part of growing-up. Von Sydow suggests that for adolescents in the USA, UK, Germany, and New Zealand, cannabis experimentation is a "normative life-event" (p49). Wibberly & Price (1998) report that there is no strong evidence indicating that the use of cannabis has become normalised among adolescents. However, one study among a group of adult friends in London indicates that cannabis and cocaine are "accepted as a normal and routine aspect of daily life" (Pearson, 2001, p1). However, only further investigation into the issue can ascertain whether normalisation truly exists, and if so, in what groups. In regards to the social and legal perceptions of risk, participants in a longitudinal study in New Zealand saw few social problems resulting from cannabis use and held a laissez-faire attitude about legal consequences (Poulton et al., 2001). These feelings may not generalise to Europe given the much higher prevalence rates in New Zealand.

General Population

The ESPAD Report (1999) found that European adolescents aged 15-16 perceived the occasional use of cannabis to be less injurious than regular use. Between 21% and 24% of students in Denmark, France, and the United Kingdom believed occasional cannabis use to be a great risk. A much higher percentage of students in Romania, FYROM, Lithuania, and Portugal perceived it to be a very risky

behaviour. Regular use of cannabis was perceived as carrying a much greater risk. As many as 88% to 94% of students in some countries, such as Romania, Cyprus, and Sweden, considered regular use a great risk. Ireland had one of the lowest figures, with only 63% perceiving regular cannabis use as risky behaviour. Countries with lower rates of risky perceptions had correspondingly higher prevalence rates of use.

Interestingly, youths who use cannabis and other drugs most commonly cite curiosity and wanting to feel the effects as reasons for first use, while the majority of non-users do not take drugs because of the negative effects they know to be true (Brinkley et al., 1999). Seventy-nine per cent of students that refuse drugs did so because it is bad for health, 56% gave "risk of dependency" as a reason, and not liking the effects was a reason for 40% of the students. Brinkley et al. (1999) found that cannabis users were more likely to cite positive effects of the drug than non-users. Likewise, only 5% of users cited the negative effects of cannabis compared to 14% of non-users. According to the 2002 Young Persons' Behaviour and Attitudes Survey carried out in Northern Ireland, nearly one-third of students reported having adequate knowledge on the effects and risks of drugs in general (reported by DrugPrevention.net).

Over a quarter of young people in Dublin did not know the effects of cannabis (Brinkley et al., 1999). Moreover, 73% of boys and 57% of girls expressed dissatisfaction with drug information in their schools. This higher percentage in boys' dissatisfaction with drug knowledge is interesting when the demonstrated (but small) differences in gender are taken into account. Boys used drugs more frequently, in larger quantities, and began at an earlier age when compared with girls.

Cannabis was rated as the least harmful illicit drug by 14-17-year olds in Northern Ireland. Drug awareness and ability to identify different drugs increased with age. High levels of awareness of cannabis were expressed both by those in the 10-13 and the 14-17-year old categories. Just as adults had difficulties differentiating between the effects of various drugs, young people failed to distinguish the accompanying feelings of different drugs. Typically female students perceive drugs more negatively than their male counterparts (reported by DrugPrevention.net, 1997).

While a number of studies have assessed both the usage patterns and attitudes of students and young people to drugs, there is limited availability of information relating to all age groups. The Drug Misuse Research Division (Bryan et al., 2000) have published a report on drug-related knowledge and attitudes of the general population in Ireland. The authors generated four conclusions regarding the public's perception of drugs in general, which can be applied to cannabis in particular:

1. The majority of the public are aware of the many illicit drugs in existence. However, they fail to make distinctions between the different effects of different drugs;
2. Attitudes towards illicit drugs are mostly negative. Over 97% of Irish people had heard of cannabis, yet nearly 80% believed all drugs to produce equally harmful health effects. Although this may act as a deterrent to use, this belief is embraced more by adults than youth, where drug education and prevention is most focused;
3. Over half (53.1%) of the population believe drug experimentation to be typical in adolescence. In the case of cannabis, this unease may be slightly exaggerated. In a review on youth studies pertaining to drug use, figures of students using cannabis ranged from 12% to 37% (Moran et al., 2001). Less than half agreed that the occasional use of cannabis was not hazardous to health and

54.7% believed regular cannabis use is as harmful as that of heroin. Overall, drug use among young people in Ireland in general was of grave concern to the study's respondents. However, alcohol abuse in this country warranted more concern than drug abuse;

4. The authors concluded that the Irish hold fairly intolerant attitudes towards those who use drugs in general. They cite feelings of fear and apathy towards addicts and blame the person, not the social context for the addiction. Despite the public's negative attitudes towards drug users, most of the respondents were in favour of drug prevention and rehabilitation programmes.

Bryan et al. (2000) also reported that 66% of the general population in Ireland agreed that cannabis use should be against the law and would therefore not be in favour of changing the current legislation which criminalises the possession of cannabis.

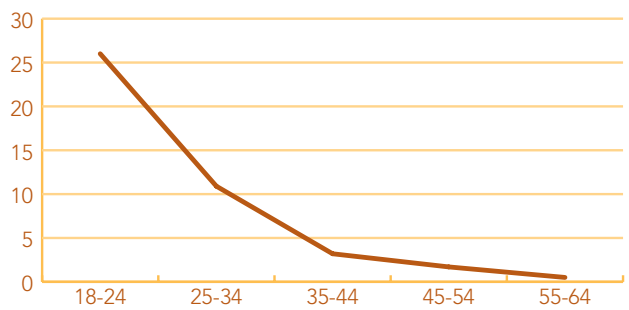
Prevalence and Patterns of Use

Extent of Use of Product

Cannabis is the most commonly used illicit drug in Ireland and elsewhere (Moran et al., 2001; ESPAD, 1999; Brinkley et al., 1999; NACD & DAIRU, 2003) and the third most widely used drug, after alcohol and tobacco. Studies conducted throughout Ireland confirm the popularity of cannabis (O'Brien et al., 2000). Selected studies in Dublin, the Midland Heath Board region, Kildare/Wicklow, Cork, Kilkenny, Longford, and the North Eastern Health Board Region found cannabis to be the most common illicit drug (North Eastern Health Board region included solvents).

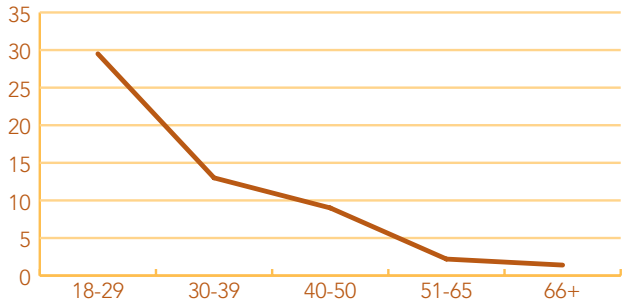
General population: The Surveys of Lifestyle, Attitudes and Nutrition (SLÁN) in 1998 and 2002 by the Centre for Health Promotion Studies, National University of Ireland (NUI) in Galway are the most comprehensive studies on the prevalence of cannabis use in Ireland's general population to date. Only the preliminary results of the 2002 study were available at the time of writing (Kelleher et al., 2003), hence the results here concentrate on the 1998 results reported by Moran et al. (2000). The study's sample was selected from electoral registers for those 18-years-of-age and older. Overall 9% of respondents in 2002 and 11% in 1998 reported using cannabis in the past twelve months. A clear gender balance was evident with 12% of men and 7% of women in 2002 reporting cannabis usage in the past twelve months (11% and 6% respectively in 1998). In 1998, the last 12 months (recent use) prevalence rates for cannabis consumption by age groups were 18-24 years (26%), 25-34 years (10.9%), 35-44 years (3.2%), 45-54 years (1.7%), and 55-64 years (0.5%).

Figure 2.1: Recent Cannabis Use
Source: SLÁN Survey 1998 reported by Moran et al., 2000



Lifetime cannabis use reflects the same inverse relationship with age, with 33.4% of adults aged 18-24 having used cannabis at least once compared to 2.1% of the 55-64 age group. Cannabis consumption is clearly concentrated among the younger populations; 17.7% of 18-34-year olds are current cannabis users, but only 9.4% of all adults aged 18-64 are current cannabis users. Similarly, lifetime prevalence rates for 18-34-year olds reached 30%, while rates for all adults was nearly 20%. In a study on Irish attitudes and beliefs on cannabis, lifetime use of cannabis was reported by 12.4% of the population sample aged over 18 years. Percentages of use by age ranges were 18-29 years (29.5%), 30-39 years (13%), 40-50 years (9%), 51-65 years (2.2%), 66 years + (1.4%) (Bryan et al., 2000).

Figure 2.2: Lifetime Use of Cannabis
Source: Irish Social Omnibus Survey 1998 reported by Bryan et al., 2000



More recently, the preliminary results of a national survey (Ireland, north and south) has been published (NACD & DAIRU, 2003). Nearly 9,000 people were surveyed in face-to-face interviews during the latter part of 2002 and in early 2003. From the viewpoint of the present work, the most interesting feature was that cannabis was the most widely used illegal drug. Just 18% of people in the south and just one percent less in Northern Ireland had used cannabis at some time in their lives. As might be expected the prevalence of use was much higher among young people. Around one in four people has used cannabis at some time in the age group 15-34 years, while only 3.5% of those in the 55-64 age-group had done so.

School and youth population: ESPAD (1999) published one of the largest youth population studies examining prevalence rates and related information for 15-16-year olds in 30 European countries. Ireland ranked as one of the top countries for cannabis use. Lifetime prevalence for cannabis use among adolescents in Ireland was 32% in 1999 (boys 35% and girls 29%). Use by Irish youth in the last 30 days was 15% and in the last 12 months was 26% (the measures of current use are only slightly lower than that for lifetime, presumably due to the young age cohort). Although these figures have decreased since 1995 (significantly for boys only), Ireland still ranks among the top countries for cannabis consumption in all three categories – lifetime, last 12 months, and last 30 days. Other countries with relatively high prevalence rates include the United Kingdom, France, Czech Republic, Italy, and Slovenia. Cyprus, Romania, Sweden, and the Faroe Islands had very low rates when compared to the rest of Europe. Data from this survey shows that the percentage of those who use marijuana/hashish in Ireland (32%) is double the average for all ESPAD countries (16%).

A review on youth drug surveys (both local and national) reveals lifetime prevalence rates vary between 12% and 32% (each study used a slightly different age group, but the range was between 9 and 18-years-of-age). The high percentages found in the ESPAD Report for Ireland were not seen elsewhere

(Moran et al., 2000). The Health Behaviours in School-Aged Children (HBSC) Study found much lower prevalence rates than was reported by the ESPAD Report (Kelleher et al., 2003). Over one-fifth (21.7%) of 15-16-year olds had used cannabis at some point in their lives according to the HBSC, compared to the ESPAD finding of 32%. Lifetime and current use (last thirty days) of cannabis increased steadily from age 11 to 17. Lifetime and current use of cannabis increased most dramatically between the 13-14-year and the 15-16-year age group, suggesting initiation to the drug occurs most frequently in this cohort, but the highest rates were found for the 17-year olds (current use 11%, lifetime use 28.5%). Current use among all study participants aged 9-17-years was 5.9% (reported by Moran et al., 2000).

Two points are worth mentioning. The first has to with the difference between the ESPAD estimate for 15-16-year olds and those in the HBSC study. There are a number of ways in which the data are not strictly comparable, particularly the fact that the ESPAD definition of age-cohort was strictly in terms of those born in the year 16 years before the study i.e. 1983. Another point worth mentioning is that the comparable figures for alcohol and tobacco are much greater than for cannabis. During the year prior to the study, 89% of Irish 15-16-year olds had drunk alcohol and 69% reported feeling drunk while about three quarters of these students had smoked cigarettes at some time (ESPAD study, 1999).

Frequency of Use

Moran et al. (2000) stress the importance of distinguishing between lifetime and current use of drugs. It is argued that recent or current use of a drug is a more telling indicator of frequency. Lifetime experience of a drug simply measures if a sample has ever used the drug in question, while recent use assesses drug experiences within the last year, last month, etc. Therefore, the lifetime measure may fluctuate very little from year to year, behaving as a poor indicator of trends within a population. Prevalence rates indicating lifetime use are nonetheless employed in this review because of their widespread availability and usefulness in making comparisons (International Scientific Conference on Cannabis, 2002). It is also important to distinguish between use/user and misuse/problem drug user. Problem drug user as defined by Bryan et al. (2000) is "a drug user who experiences social, psychological, physical or legal difficulties as a result of an excessive compulsion to continue taking drugs" (p.xii). *Use* refers to any aspect of the drug taking process, while misuse "…refers to the use of illegal substances in a manner that results in physical or mental harm or loss of social well-being for the individual, for other individuals, or for society at large" (p.xi).

Of those who use cannabis, most only do so occasionally. A minority are chronic users and experience difficulties. One out of ten users will become dependent on cannabis (reported by Degenhardt et al., 2000; Hall & Babor, 2000). Over one-fifth (21.4%) of young people aged 20-24 from the Nordic region reported lifetime use of cannabis, but almost 90% of those lifetime users had tried it only a few times (Poikolainen et al., 2001). Poulton et al. (2001) also stressed the important distinction between occasional use and dependence. Dependence, not occasional use, was associated with use of other drugs and legal problems relating to cannabis in this longitudinal study. They conclude "occasional use does not appear to present a serious problem, [but] cannabis dependence among users is a serious public health issue that warrants immediate action" (p544). An estimate for the proportion of people in Ireland dependent on cannabis was unavailable but Moran et al. (2000) report that the proportion of people presenting for treatment for cannabis use has been between 11% and 16% of those seeking treatment, since 1990.

(See chapter 1 for further discussion of cannabis dependence.)

Other Drugs Used in Combination with Product

Polydrug use is defined in the report of the Drug Misuse Research Division to the EMCDDA (Sinclair et al., 2001) as "the use of different substances and different combinations at different times" (p161). According to the National Drug Treatment Reporting System (NDTRS), the most common combination of two drugs used together on a daily basis was heroin and cannabis (NDTRS, 2002). Cannabis, heroin, and benzodiazepines was the second most common triage of drugs after heroin, methadone, and benzodiazepines (Sinclair et al., 2001). Of those seeking treatment, cannabis was also used in combination with MDMA (ecstasy) and alcohol, but to a much lesser extent.

When polydrug use was defined as "using two or more drugs in the same 24-hour period," among 41 'confirmed' polydrug users, cannabis and alcohol were reported as the most typical combination (36.5% of respondents). Keane (2001) concludes that there are gaps in the knowledge of polydrug use in an Irish context and calls for further investigation, namely to draw comparisons and make distinctions between "recreational" and "problematic" polydrug users.

Degenhardt et al. (2001) found that those who experienced cannabis dependence or abuse were more likely to abuse or to be dependent upon sedatives, stimulants, opiates, or alcohol. Even those who *used* cannabis were at greater risk for alcohol abuse and problems with other drugs. After controlling for confounding demographic and neuroticism factors, any type of cannabis user was more likely to use alcohol, tobacco, and other drugs (paraphrased, p325). The authors of the "Three Cities" study report that among regular cannabis users in Amsterdam and San Francisco, 9% and 8% respectively use cocaine and 9% and 6% respectively use ecstasy (Cohen et al., 2001). These polydrug users, however, were unlikely to engage in prolonged or heavy use of these drugs.

In a longitudinal study of German adolescents aged 14-17 years, 17.5% of cannabis users reported the use of other illicit drugs (not necessarily simultaneously), 9.4% admitted to the use of stimulants (including ecstasy), hallucinogens 6.1%, and cocaine 5.2%. These percentages increased if the participants were continuous users and more so if they experienced dependence. Students who did not report cannabis use rarely reported the use of other drugs (Perkonigg et al., 1999).

Cannabis Use and Subsequent Use of Other Drugs

One of the most controversial issues regarding cannabis concerns its role in the progression to use of other drugs. In the debates on decriminalisation and on the medicinal use of cannabis, it is often argued that use of cannabis increases youth's risk of initiating more dangerous drugs such as cocaine and heroin. This concern about the risk of progressing to more dangerous substances is a longstanding one and has been quite influential in drug policy in many countries (Morral et al., 2002).

Three key findings have played an important part in the acceptance of the idea that cannabis is involved in progression to other drugs. The first of these is the greater risk of hard drug use for adolescent cannabis users. This elevated risk is found in all countries where the issue has been studied and the risk factor has generally been high (Kandel, 2002). A related finding is that age of beginning to use cannabis is associated with the likelihood of subsequent use of hard drugs.

Another set of findings concerns the almost invariant order of adolescents' initiation to different drugs. It is very rare that hard drugs like heroin are used before cannabis (Fergusson & Horwood, 2000). The third set of findings centre on the frequency of cannabis consumption and the probability of using

drugs like heroin. A common finding is that the more frequent use of cannabis is associated with greater likelihood of use of hard drugs (Fergusson & Horwood, 2000).

The 'stepping stone' and 'gateway' hypotheses have been concerned with explaining these associations. The 'stepping stone' theory suggests that cannabis use 'causes' or leads unavoidably to the use of more serious drugs. However, there is no pharmacological evidence to suggest that the properties of cannabis would inevitably lead to a progression to other drugs (Corrigan, 1994; Rigter & van Laar, 2002). However, as noted above there is a strong statistical association between cannabis use during adolescence and subsequent use of other illicit drugs. On the other hand it is known that many young people try out cannabis and do not progress to either heavy use of cannabis or to other illegal substances (Rigter & van Laar, 2002).

The 'gateway' theory suggests that cannabis users may also use other drugs due to predisposing risk factors or experience. The gateway hypothesis acknowledges cannabis primes the user into taking other substances but that the mediating influences are not direct and also that more than one pathway may be involved. The gateway theory also acknowledges the role of legal substances (alcohol and tobacco) predisposing adolescents to using cannabis in the first place. Emerging evidence suggests that cannabinoids not only affect brain reward and withdrawal processes in exactly the same way as other addictive drugs but also that cross sensitisation with amphetamine and morphine can be induced when animals are repeatedly exposed to THC suggesting that long-term use of cannabis might enhance vulnerability to addictive substances in certain individuals (Tanda & Pontieri, 1997; Lamarque, Taghzouti & Simon, 2001).

One elaboration of the gateway hypothesis is that social disadvantage and low levels of parental attachment are associated with early cannabis use and that these factors are themselves influential in progression to other drugs (Rigter & van Laar, 2002). There are indications that this may be part of the story but not the complete picture. There is also some indication that genetic susceptibility to drugs may be at least a contributory factor in the progression from cannabis to other substances (Sher, 1991). An important environmental factor may be the social context in which cannabis is used and obtained. It may be that access to cannabis may reduce perceived barriers and inhibitions against the use of other drugs and the perceived access to such drugs (Bailey & Hubbard, 1990). Another factor that may be involved in progression is personality make-up. There is some indication that non-conforming adolescents may initially try out cannabis as part of a broader propensity to use drugs, i.e they may be more novelty-seeking or ready to take risks than their peers; they may have such positive experiences with cannabis that they start to underestimate the risk of other illicit drugs (Petraitis et al., 1995).

(See further discussion in chapter 4.)

There is a considerable body of evidence favouring at least some version of the 'gate-way' theory. Merrill et al. (1999) showed that although no causal effect was demonstrated, cigarette and alcohol use was associated with the likelihood of marijuana use and marijuana use was associated with the likelihood of other drug use, even after selected other risk and protective behaviours were considered among high school seniors in the US. Findings from New Zealand showed individuals using cannabis on more than 50 occasions a year had hazards of other illicit drug use that were 59 times higher than non-users. After adjustment for co-variate factors, including childhood factors, family factors and adolescent lifestyle factors, cannabis use remained strongly related to the onset of other forms of illicit drug use (Fergusson & Horwood, 2000).

Lynskey et al. (2003), in a study of Australian twins, found that those who used cannabis by age 17 years had odds of other drug use, alcohol dependence, and drug abuse/dependence that were 2.1 to 5.2 times higher than those of their twin who did not use cannabis before age 17 years. Controlling for known risk factors (early-onset alcohol or tobacco use, parental conflict/separation, childhood sexual abuse, conduct disorder, major depression, and social anxiety) had only negligible effects on these results. They conclude that associations between early cannabis use and later drug use and abuse/dependence cannot solely be explained by common predisposing genetic or shared environmental factors. The association may arise from the effects of the peer and social context within which cannabis is used and obtained – in particular, early access to and use of cannabis may reduce perceived barriers against the use of other illegal drugs and provide access to these drugs.

Wagner and Anthony's (2002) results indicated that users of tobacco and alcohol were more likely than non-users to have an opportunity to try marijuana and were more likely to actually use marijuana once an opportunity to do so had occurred. Opportunity to use cocaine was associated with prior marijuana smoking. Among young people with a cocaine opportunity, those who had used marijuana were more likely to use cocaine than were those with no history of marijuana use. Morral et al. (2002) reports that the observed association between cannabis and other drugs could instead be explained as the result of a common factor – drug-use propensity – influencing the probability of both cannabis and other drug use.

Geographical Distribution of Use

Lifetime prevalence rates of cannabis use are higher in urban locations (Moran et al., 2000) – 14.5% who have ever used cannabis reside in an urban area of Ireland while 9.9% who have ever used cannabis reside in a rural area of Ireland (Bryan et al., 2000).

As aforementioned, the ESPAD Report (1999) found that the countries with the most widespread use of cannabis among 15-16-year olds were Ireland, the United Kingdom, France, Czech Republic, Italy, and Slovenia. On the other hand, cannabis consumption was only found in 1%-2% of the populations of Cyprus, Romania, Faroe Islands, Finland, and Sweden. In Europe, the United Kingdom ranked first in lifetime use of cannabis, while France had the highest rate of use in the last 30 days. An interesting finding is that from 1995 to 1999, almost all countries experienced mounting prevalence rates, except for those with the highest rates, the United Kingdom and Ireland. Countries in which there was a pronounced increase included Poland, Czech Republic (putting it on par with the United Kingdom), Estonia, Italy, and Lithuania. In addition, nearly half of the ESPAD countries were experiencing an increase in the use of illicit drugs other than cannabis.

The use of cannabis is even more prominent in the USA and Australia (ESPAD, 1999; Hall & Babor, 2000). However, a longitudinal study of adolescents in Germany suggests that in at least some parts of Europe prevalence estimates are nearing those of the United States and Canada (Perkonigg et al., 1999).

Approximately 18% of the general population in the EU have tried cannabis at some time in their lives (Rigter & van Laar, 2002). Although comparisons between countries are hampered by different methodologies and populations, the available data suggests that cannabis use is less prevalent in the EU than in Australia or the USA (Table 4).

Table 4. Prevalence Rates of Cannabis Consumption in the General Population of Western Nations – Adapted from Data from the International Conference on Cannabis, 2002.

Country	Lifetime Use %	Last Year Use %
Australia	39	18
USA	34	8
Canada	29	7
England & Wales	27	9
Denmark	24	4
France	23	8
Belgium	21	?
Germany ('West')	21	6
Ireland	20	9
Spain	20	7
Netherlands	19	6
Switzerland	19	5
Greece	13	4
Sweden	13	1
Germany ('East')	11	5
Finland	10	3

The studies quoted show lifetime use among the general population to vary from 10% in Finland to 39% in Australia. Ireland appears approximately mid-way in the table with a prevalence rate of 20% for lifetime use in the general population. When data from the EMCDDA for 'young adults' (defined as respondents aged 15 to 35 or 40 years) is compared, Ireland, along with England and Wales, had the highest prevalence rate for recent (use in last year) cannabis consumption in the EU at 18% (EMCDDA, 2001).

Trends in Prevalence and Patterns of Use

Factors identified as predictors of cannabis use are being young, being white, having lower educational and occupational expectations, living in an urban area, not attending any religious services, living alone, having a father or a mother with advanced education (at least high school), being male and living with only one parent (International Scientific Conference on Cannabis, 2002).

There are indications that cannabis use in the European Union has doubled in the past 10 years. Approximately 20% (50 million people aged 15-64 years) have tried cannabis at least once (Hartnoll, 2002, paraphrased, p4). The rates of cannabis use among adolescents for the period 1995 to 1999 are converging among member states in the European Union. Cannabis prevalence rates among adolescents are stabilising or decreasing in historically higher-use countries and increasing in those with past low rates of use (ESPAD Report). Results showed that in Ireland lifetime use among

15-16-year olds had decreased from 39% in 1995 to 32% in 1999 (ESPAD, 1999). The ESPAD study also showed that over 90% of Irish 16-year olds who had used illicit drugs reported cannabis as their first drug. This was also true in the United Kingdom.

Characteristics and Behaviours of Users

Age and Gender of Users

Most studies on the demographics of cannabis use, abuse, and dependence indicate that consumption is more prevalent among males than females (International Scientific Conference on Cannabis, 2002; ESPAD, 1999; von Sydow et al., 2002; Brinkley et al., 1999; Coffey et al., 2002). However, there is some research that fails to find any gender differences of statistical significance. For instance, Hofler et al. (1999) targeted adolescents aged 14-17 whose cannabis experience was classified as 'one-time only,' 'repeated use,' and 'regular use,' focusing on the risk factors associated with the early stages. In this group, there was no significant gender difference. The authors attribute this finding to the relatively young age of the sample and their mild experience with the drug. Perkonigg et al. (1999) reported no significant difference between males and females even when indicators of abuse and dependence were included. Between baseline data and follow-up, the rates of both patterns of problematic use nearly doubled for both sexes. Still, most research indicates that patterns of cannabis consumption are more pronounced in males. Women demonstrate lower levels of use as well as less problems associated with use when compared with men, including having used any drug for fewer years, having fewer legal problems associated with drugs, and having spent less days in treatment for substance abuse (Westermeyer & Boedicker, 2000).

A review of Irish surveys confirm that this gender difference generalises to the lifetime, last-12-month and last-30-day prevalence rates of cannabis users aged 18-24, 25-34, 35-44, 45-54 and 55-64[1] (Moran et al., 2000). The data from the 1998 HBSC study of those aged less than 18 years shows that the lifetime, last-12-month and last-30-day prevalence rates for cannabis were higher for males compared to females for those aged 11-12, 13-14, 15-16 and 17 years (Moran et al., 2000).

The experience of cannabis is primarily a youth-based phenomenon. Based on a review of cannabis literature, the highest risk of use and initiation occurs between ages 14-18 and at age 16 begins the highest risk period of becoming dependent on the drug (Perkonigg et al., 1999). Cannabis has the lowest initiation age of any illicit drug. The mean age of onset is 12.5 years of age, according to Brinkley et al. (1999). Girls had a significantly older age of onset when compared with boys; girls on the average, began using at 12.7, compared with boys at 12.2 years of age. Cannabis consumption typically declines with age beginning in early adulthood. Use usually reaches its peak between the ages of 20 and 30 and then declines as one heads towards middle age. Indeed, the Health Promotion Agency in Northern Ireland found that 85.9% of adults aged 18-21 reported having taken cannabis at some point in their lives, compared with 83.5% of those aged 22-25 and 90.3% of those 26-30 years of age (Drugs Prevention.net, 2002).

In the Monitoring the Future Study, data collected in US schools revealed that the use of cannabis increases with age between 8th-, 10th-, and 12th- graders, reaching percentages of 20, 40, and almost 50, respectively (National Institute on Drug Abuse, 2002). The most convincing evidence of increased use in the youth population comes from population studies. Although there are a limited number of

1 While the lifetime and last-12-month prevalence rates show a gender difference in the 55-64 year age group, the last-30-day prevalence rate for males and females in this group converge at 0.5.

studies addressing the general population, those that exist find the youngest age group (varying age ranges of adolescents and young adults) have the highest rates of cannabis consumption (Kelleher et al., 2003; Moran et al., 2000) The Communication from the Commission to the Council and the European Parliament on a European Union Action Plan to Combat Drugs (1999) reports that between 1% and 8% of the total population and 20% of the younger population have at least experimented with cannabis.

Data from the 1998 HBSC survey in Ireland showed that lifetime, last-12-month and last-30-day prevalence rates increased steadily from the 11-12-year old to the 17-year old age group. The 1998 SLAN and KABI surveys of adults showed that prevalence rates (lifetime, last-12-months and last-30-days) decreased in each successive age group from 18-24 years to 55-64 years (Moran et al., 2000).

Social Groups Where Product Available/Used

Friends or those the user knows well are often cited as their means of obtaining the drug as well. "Friends" were consistently named as the primary social group in which adolescents experimented with or used cannabis. In the 'Three Cities Study', examining the behaviours of long-time drug users, eight out of ten were amongst friends the first time they used cannabis (Cohen et al., 2001). The International Conference on Cannabis (2002), reviewed literature revealing that in approximately 80% of cases, users' first experience of cannabis was initiated by friends or acquaintances. More than 75% of the students using drugs in 19 of the countries assessed in the ESPAD Report (1999) admitted receiving their first drug (typically cannabis) from friends or siblings, compared with less than 5% who reported getting it from a stranger. In a related study, of those Dublin pupils reporting cannabis use, 64% had said they obtained the drug from a friend and 62% reported that the cannabis was 'shared around a group of friends' (Brinkley et al., 1999). Similarly, along with curiosity, peers/friends' influence is an important factor leading towards cannabis use (Kuipers & Zwart, 1999; Brinkley et al., 1999).

Elder siblings may represent another social group with which adolescents use cannabis. However, the 1999 ESPAD Report finds that the cannabis prevalence rates of siblings of these users are quite low. Those countries with relatively higher rates of sibling drug users have corresponding high cannabis prevalence rates. For instance, cannabis users in Ireland reported that 17% of their siblings also use cannabis (compare with the average of 6% for all countries). This low percentage of sibling cannabis users provides evidence against older family members acting as a social group for consumption.

Risk Behaviours Associated with Use

The presence of psychoactive material in cannabis undoubtedly has an effect on the behaviour of an individual, but the extent to which this occurs has yet to be determined. Factors complicating this issue are individual differences and the tendency for cannabis to be used with other drugs, namely alcohol, making it difficult to isolate the effect of cannabis on behaviour.

Nelson (1993), in a review on cannabis, suggests that perceived violence associated with cannabis use is actually a manifestation of "panic reaction", a psychological effect of cannabis often confused with aggressive behaviour. He reports that their depressive state and lassitude makes cannabis users unlikely violent offenders. This mellowing effect has been disputed. In a New Zealand sample of young adults, the following contributed to their risk of committing violent offences: cannabis dependence, 28%; alcohol, 11%; and any form of schizophrenia, 10%. Any combination of two of these factors

greatly elevates the risk. However, it was a third factor, the presence of conduct disorder – not the use of cannabis – prior to an act of violence that was responsible for the increased risk of violence among those experiencing cannabis dependence. It is suggested by the study that factors associated with conduct disorder, such as delinquency, may spawn violence more so than the use of cannabis (Arsenault, 2000 reported by the International Conference on Cannabis, 2002). Gillet et al. (2001) also failed to predict violence and aggression by the use of cannabis. While alcohol, antidepressants, benzodiazepines, and cocaine appeared to induce violent reactions in users, the same causal relationship was not found for cannabis.

(Chapter 1 contains a more detailed discussion on cannabis and mental illness.)

Kouri et al. (1999) investigated the abstinence syndrome associated with chronic marijuana use and showed that chronic marijuana users displayed more aggressive behaviour on days three and seven of marijuana abstinence compared to controls and to their own pre-withdrawal data. These increases in aggressive responding returned to pre-withdrawal levels after 28 days and were paralleled by small, non-significant changes in depression and anxiety scores.

There has also been a significant association between the use of cannabis and other psychoactive drugs with risky sexual behaviour. Spanish adults aged 18-39 with higher frequencies of cannabis consumption were more likely to have multiple sexual partners compared with those using cannabis less often (Castilla et al., 1999). Sexual risk behaviour – sex with more than one partner and lack of regular condom use – tended to occur more frequently with those that were "high", thus increasing the chances of such unwanted effects as pregnancy and the transmission of an infectious disorder.

Special Concerns about Vulnerable Groups

There is a concern about the use of cannabis and abuse/dependence in the mentally-ill population, especially schizophrenics. As was discussed in Chapter 1, within the context of mental illness in general, there has yet to be a clear cause and effect relationship with the use and abuse/dependence of cannabis. The prevalence of cannabis use in the schizophrenic population is, however, well pronounced and there is support for cannabis acting as a risk factor for the disorder. There is also evidence that the use of cannabis aggravates some symptoms in patients with schizophrenia. In several studies reviewed by Johns (2001) positive symptoms, namely hallucinations and delusions, were exacerbated by cannabis consumption.

Another particularly vulnerable group to consider are unborn children of cannabis-consuming pregnant women, though research indicates adverse effects are minimal (Fergusson et al., 2002). Babies born to these mothers had significantly shorter birth lengths and smaller head circumferences than babies with non-using mothers. Small differences were also detected in birth weight, but these were shown to be insignificant. Cannabis use during pregnancy does not seem to put the unborn child at risk for perinatal death or in need of care; however, this study is limited by frequency of mothers' use of cannabis. The women in this study used cannabis once per week or less, suggesting that more severe effects may occur in babies born to heavier users.

Trends in Characteristics/Behaviours of Users

The following characteristics and behaviours have been found consistently in several studies to co-occur with cannabis use: lower socio-economic status; male gender; poor familial relationships

(particularly with the mother); mental illness; use of alcohol, tobacco and other illicit drugs; adoption of an anti-conventional lifestyle; poor school performance; substance-using friends; unemployment; easy availability of drugs; and residing in an urban area (Brinkley et al., 1999; Poikolainen, 2001; McGee, 2000; Lynskey & Hall, 2000; Morrell et al., 1998; von Sydow et al., 2002).

Some authors have suggested that sociodemographic, personality, and interpersonal factors associated with the regular use or abuse/dependence differ from those of individuals who have simply experimented with the drug. For instance, in a study of the early stages of cannabis consumption among German adolescents, typical characteristics spanning a wide range of users such as low self-esteem, poor competence, and peer drug use were confirmed, however, many other variables did not generalise to these experimental users (Hofler et al., 1999). The use of other illegal drugs, a history of conduct disorder, gender, education, and residence failed to predict first or occasional use of cannabis. Similarly, characteristics predicting progression from use, to abuse and dependence, include male gender, younger age, a disadvantaged socio-economic status, use of other illicit (but not licit) drugs, attitudes towards future drug use, and maternal affective problems (von Sydow et al., 2002).

The behaviours, and more importantly the characteristics, of cannabis users are simply listed here as those occurring most frequently in sample populations. The list is by no means conclusive nor would it predict with a high degree of accuracy those that will use cannabis. All levels of users come from many different backgrounds and to create a single profile of cannabis user (or any drug user) would be impossible. This is summed up by the following quote "*The* cannabis user does not exist" (Rigter & van Laar, 2002). To complicate matters further, Kuipers & Zwart (1999) discovered a recent trend in the characteristics of regular cannabis users in the Netherlands to resemble those of the non-using cannabis population. This is presumably a result of the continued normalisation of cannabis use in many areas (discussed elsewhere in this review), but nonetheless blurs the distinction between those who use drugs and those who do not.

A major source of information on the characteristics and behaviours of users comes from mental health research. McGee et al. (2000) addressed the question of which came first, the illness or the drug use. In a longitudinal study of New Zealanders aged 15-21, those youngest in the sample afflicted with mental illness were four times more likely than those without a disorder to use cannabis. However, as the sample aged, the prevalence rates of cannabis consumption increased as well; the presence of a mental disorder failed to be a predictor of substance use in the older age groups. The implication is that among younger people "the primary direction of risk lies from mental disorder to cannabis use rather than the reverse" (p500). Poikolainen et al. (2001) reaches the opposite conclusion in a study on the correlates of initiation to cannabis use. However, the former study deals with all levels of cannabis use, while the latter focuses primarily on those whose use does not exceed more than a few times.

There is no doubt of the central role that the environment plays in the lives of those who use cannabis, however, recent research has explored the possible impact of genetics on users. Kendler and Prescott (1998) assessed lifetime cannabis use, heavy use, abuse, and dependence among pairs of monozygotic and dizygotic twins. The hertitability results indicate that cannabis use is attributed to both genetic and environmental influences, but the authors suggest that heavy use, abuse and dependence symptoms of cannabis are solely a result of the individual's genetic make-up. A study in Australia of drug use escalation among monozygotic and dizygotic twins concluded that early cannabis use and later drug use and abuse/dependence cannot solely be explained by common predisposing genetic

or shared environmental factors and that the association may arise from the effects of the peer and social context in which cannabis is used and obtained (Lynskey et al., 2003).

Indicators of Health Consequences

Hospital Emergencies

There is little documentation of hospital emergencies related specifically to cannabis. Acute psychosis induced by cannabis is a direct cause for psychiatric admission. In Ireland, 3.6% of all admissions and 5.0% of first admissions to in-patient psychiatric hospitals were drug-related (Moran et al., 2000). The number of emergency admissions related to accidents associated with cannabis abuse is unknown in Ireland. – in the US marijuana was identified as a factor contributing to over 110,000 of the hospital emergencies in 2001 (National Institute on Drug Abuse, 2002).

Deaths (Direct and Indirect)

There have been no deaths as a direct result of cannabis use, such as through pulmonary disease or contracting an infection. It is for this reason that the European Monitoring Centre for Drugs and Drug Addiction has not yet defined cannabis in terms of its "problematic use" (Nelson, 1993; International Scientific Conference on Cannabis, 2002). There is, however, some evidence that suggests the indirect influence of cannabis on premature mortality.

Steentoft et al. (2001) determined the drugs involved in poisonings resulting in the deaths of drug addicts in Denmark, Norway, Sweden, Finland, and Iceland. The drugs present in the deceased were determined by autopsy and toxicological analysis. Heroin/morphine was the cause of death in the majority of the addicts, but in no case was cannabis reported as the main drug resulting in death. However, tetrahydrocannabinol was observed in many of the Danish (31%), Norwegian (25%), Swedish (19%), and Finnish (12%) cases. Rajs et al. (1992) reported data from the register of deaths related to illicit drug use in the Stockholm area. During the four-year period of 1987-1990, cannabis was found to be the only drug in postmortem samples in 24 cases; in 8 of these, cannabis was the only finding, while alcohol, alcohol and medicinal drugs, or only medicinal drugs was demonstrated together with cannabis in 10, 5 and 1 instances, respectively.

The House of Lords Report on cannabis (2000) reports that in an examination of the causes of drug-related deaths in England and Wales, cannabis appeared on death certificates 35 times throughout the years 1993 to 1996. However, the certificates list all drugs that were believed to cause death and it is common for several drugs to appear on one certificate. Cannabis was not mentioned in relation to direct or indirect causes of death in the Irish report to the EMCDDA (Sinclair et al., 2001).

Other areas where the role of cannabis as an indirect cause of death has been researched includes firearms and motor vehicle accidents. Among deaths due to drugs in New York City, cannabis, along with cocaine, opiates, and alcohol, were detected in nearly every case. In deaths by guns, cannabis-positive toxicology has actually fallen in the mid-1990s after an increase in the earlier part of the decade (Galea et al., 2002). Employing blood samples, cannabis was detected in 2.2% of the cases involving fatally-injured drivers, the fourth-most-common drug, after alcohol, cocaine, and opiates (del Rio et al., 2002). Postmortem results in Stockholm showed that deaths among the cannabis users

were unexpectedly violent compared to deaths among other drug addicts. The proportion of suicides, 10 out of 24, was particularly high. Among the 24 cannabis users, only one died from a non-violent cause, while the remaining 23 (96%) died as a result of violence, compared to a total of 26% of the entire number of 13,417 investigated postmortems during the same period. Eight of the 24 cannabis users died in accidents – two from alcohol intoxication, one from drowning and five from traffic accidents (3 as drivers of motor vehicles, and 2 as passengers with cannabis-influenced drivers) (Rajs et al., 1992).

Traffic Accidents

The Le Dain Commission (Canadian Government, 1970) gave consideration to the link between cannabis use and driving and concluded that there was reason to believe that the "short-term effects of cannabis increase the hazards of driving". The increasing concern across the EU Member States about the role drug use may play in traffic accidents was highlighted by a literature review conducted by the Drug Misuse Research Division of the Health Research Board for the European Monitoring Centre on Drugs and Drug Addiction (EMCDDA) which looked at the relationship between drug use, impaired driving and traffic accidents (Gemmell et al., 1999). Field studies demonstrated that cannabis was one of the most prevalent drugs discovered in fluid samples taken from drivers. Assessment of the causal role of cannabis was found to be complicated by the fact that alcohol was also present in the majority of cases. The review found that cannabis, when mixed with alcohol, is much more likely to be a risk factor than when consumed alone.

The research pertaining to cannabis and traffic accidents, as well as that of other health indicators found in this section nearly always cites polydrug use as the cause of various negative outcomes, typically alcohol used with one or more substances. However, cannabis usually heads the list of drugs that were found in combination. Fergusson and Horwood (2001) demonstrated a significant relationship between the frequency of cannabis use and traffic accidents as part of a longitudinal study in New Zealand. The likelihood that one was involved in a traffic accident increased with the amount of cannabis consumed. However, after controlling for confounding factors, such as risky/illegal driving behaviour and casual attitudes towards driving violations, the association between cannabis use and active traffic accidents became non-significant. A German study found that alcohol caused a significant deterioration in performance among infrequent cannabis users relative to regular users (Wright & Terry, 2002). These changes were mirrored by significant changes in self-reported scores for dizziness. Another study found that the effects of low doses of THC and alcohol on higher-level driving skills are minimal (Lamers & Ramaekers, 2001).

In a review on cannabis use and driving, it was found that epidemiological studies, such as the one mentioned above, are more likely to indicate a very limited role for cannabis-using drivers in motor vehicle accidents (International Scientific Conference on Cannabis, 2002). Experimental studies, on the other hand, typically find significant impairment in ability when cannabis is used. They suggest that the epidemiological studies are biased due to unreliable indicators (such as self-reports) and call for more, carefully-controlled studies.

One study that did use blood samples to determine level of intoxication found the presence of THC only was not related to driver culpability in either single-or multiple-car crashes (Longo et al., 2000). More striking is the comparison with the drug-free group, where a lower percentage of cannabis-using

drivers were deemed culpable for the crash. This difference, however, was not meaningful. Although alcohol and cannabis used together resulted in augmented culpability for drivers, the combination is not significantly greater than the sole effects of alcohol. Longo et al. caution that in extreme doses, not reached by any of the participants in their study, cannabis could result in increased culpability.

Nelson (1993) recognises the difficulty in determining the effects of cannabis on driving due to the coexistence of alcohol and THC in the analyses of drivers' blood. He implies that that the drug itself plays a relatively minor part in vehicle accidents, that it is more a matter of the context in which it is used "…problems caused by alcohol and cannabis in relation to motor vehicle accidents, in particular, are more due to the methods and circumstances of their use by a minority of individuals rather than the fact that these substances both cause, in the main, reversible perceptuo-motor deficits" (p2).

Hall & Babor (2000) take a more oppositional stance on the issue, claiming that cannabis "seems to make a small contribution *in its own right* to motor vehicle accidents", again expressing concern over the combined intoxicating effects of alcohol and cannabis (Gieringer 1998, cited in Hall & Babor). While it is noted that cannabis has adverse behavioural and cognitive effects that can impair driving ability, it is difficult to determine the extent of this influence on traffic accidents. Data from the US's Drug Abuse Warning System (DAWN) identified marijuana as a factor contributing to over 110,000 of the hospital emergencies in 2001 – 15% of the patients were between the ages of 12 and 17 (National Institute on Drug Abuse, 2002).

An experimental study by the UK Transport Research Laboratory demonstrated the practicability of assessing the effects of cannabis and alcohol on driving performance in controlled experimental clinical trials. It confirmed the results of previous studies which showed that drivers under the influence of cannabis are aware of their impairment, attempt to compensate by driving more cautiously, but are unable to compensate for the loss of capability in some psychomotor skills such as staying in lane on a bend (tracking), where their performance deteriorates. The study found that tracking performance deteriorated with increased dose level. In terms of road safety, the study showed a clear worsening of driver capability following the ingestion of cannabis or the ingestion of cannabis and alcohol together. The effects of alcohol (at a dose of just more than half the UK legal limit) and cannabis taken together were slightly greater than with cannabis alone (Sexton et al., 2002).

The link between drugs and driving has recently been a focus of policy in Ireland. As part of the Government's Strategy for Road Safety 1998-2002, the Medical Bureau of Road Safety (MBRS) carried out research on the epidemiology and trends in regard to driving under the influence of drugs (Drugnet Ireland, 2002). A study conducted for the MBRS by Flynn et al. (2001) analysed the 78 specimens tested for the presence of a drug during 2000. Of these, 34 blood specimens and 37 urine specimens were found to be positive; 23 specimens were positive for one drug class and 48 for more than one drug. 66% of the confirmed specimens contained two or more drugs, and 10% confirmed four or more drugs present. The most frequent drugs found were cannabis, amphetamines and benzodiazepines. The study found that results showed "excellent agreement for drug detection in the blood specimens analysed by the different methods, except for cannabinoids" (p.89). The authors concluded that methods for detecting cannabinoids in blood specimens were inadequate and would require further special attention.

The Le Dain Commission (Canadian Government, 1970) also highlighted the difficulties of devising a practical measure for detecting cannabis in the human body, comparable to the breathalyser used with regards to alcohol testing. Cannabis intoxication, the commission pointed out, "is still unrecognisable and undetectable". The commission recognised the need to develop a simple method for detecting the presence and concentration of THC or other active cannabinoids in the body. It was not optimistic of significant advances being made in this area in the immediate future.

Requests for Treatment/Counselling

The National Drug Treatment Reporting System (NDTRS) provides the most reliable and current data on those seeking treatment for cannabis use in Ireland. A bibliography of research and information on drug misuse and related issues in Ireland is also available (O'Brien et al., 2000). The Drug Misuse Research Division of the Health Research Board collects data on entries into in-patient and out-patient treatment facilities for each of the health boards. The information included here is taken from the 1996-2000 period for treatment contacts aged 15-39.

Cannabis is the primary drug for which people seek treatment[2] outside the Eastern Regional Health Authority area (NDTRS, 2002). Several health board areas experienced notable increases in cannabis misuse. For instance, in the Southern Health Board, of those seeking treatment, one-half were for cannabis problems in 1996, compared with two-thirds in 2000. Cannabis misuse increased from 33% in 1996 to 53% of those seeking treatment in 2000 in the Mid-Western Health Board, and from 44% in 1998 to 61% in 2000 in the North Eastern Health Board region. In the South Eastern Health Board region, however, cannabis misuse decreased from 70% (1996) to 58% (2000) of those seeking treatment. However, during that time the absolute number seeking treatment almost trebled from 92 to 247. Cannabis misuse in the North Western Health Board has remained fairly stable and there is a low number of those seeking treatment for any drug in the Western Health Board area (NDTRS, 2002).

Although requests for treatment are considered an accurate indicator of problematic drug use for most substances, a word of caution is needed here. The EMCDDA (1998) describes drug treatment data as effective in assessing needs and a valuable public health tool (paraphrased, NDTRS, 2002). Rigter & van Laar (2002) reports that most problematic cannabis users do not request any counselling. Hall & Babor (2000) deducted that few cannabis users seek treatment when compared with other dependent drug users simply because the ill effects of cannabis are not as intense as those produced by opiates and stimulants. Those presenting for treatment are rarely there for cannabis problems alone and are usually suffering from other substance disorders and/or a non-drug related mental disorder. For instance, in the Netherlands, one in three patients being treated primarily for cannabis troubles also experienced other drug problems, namely with alcohol and cocaine (Hall & Swift, 2000 quoted in the International Scientific Conference on Cannabis, 2002).

Admissions to in-patient psychiatric hospitals can also be examined with causation as an indicator of problematic drug use. Despite policies favouring non-residential community intervention for drug dependence, drug-related admissions are on the rise. First admissions with a drug-dependence diagnosis accounted for 10.6% of total admissions (percentage sum of all health boards). This proportion has increased steadily since 1995 (Sinclair et al., 2001). No data is available on the proportion of admissions that are related to cannabis misuse.

2 Treatment for illicit drug use only.

Other Health Indicators

The link between cannabis use and mental illness has already been considered in chapter 1. Suicide is a possible negative outcome that may result from serious psychiatric disorders and it is suggested that cannabis misuse may increase the risk. This issue is examined in chapter 3.

Context of Use

Risk Factors Linked to Circumstances and Rituals of Consumption

Although safer than injection, recent findings have brought to attention the effects of smoking cannabis on the respiratory system. According to the House of Lords Report (2000), smoking cannabis is a long-term health hazard, increasing the likelihood of developing bronchitis, asthma, and even squamous metaplasia of the respiratory tract, a pre-cancerous stage. This matter has been considered in detail in Chapter 1.

Aside from illicit drugs, dependence on alcohol is likely to co-occur with the use of cannabis. For instance, regular users of cannabis are more likely to be diagnosed with an alcohol disorder (abuse or dependence) and experience legal and social difficulties relating to their drinking (Booth & Kirchner, 2001). Even in the case of experimental and occasional users, where a relationship could not be found with illicit drugs, alcohol dependence was associated with cannabis use (Hofler et al., 1999).

In reference to non-drug related risk factors associated with use, a review on educational attainment and cannabis reveals that although use is associated with early school leaving and poor academic performance, it may be more related to the social context of use rather than previously cited explanations, such as "amotivational syndrome" (Lynskey & Hall, 2000). The authors suggest that use is linked with such factors as a nonconformist lifestyle and a delinquent and substance-using peer group.

(See chapter 3 for detailed discussion of effects on educational performance and motivation.)

Implications for the Non-using Population

Chapter 4 contains a detailed discussion of the sociological and criminological implications of cannabis use. The evidence linking cannabis use and crime is weak, however, it is an offence to possess cannabis. Cannabis offences account for 59% of all drug offences in Ireland and 64% of those in the UK (Sinclair et al., 2001; House of Lords Report on Cannabis, 2000). In Ireland, cannabis accounted for most drug offences in every region, including possession, supply/dealing, and obstruction. Cannabis offences have increased in both 1999 and 2000. In 1996, cannabis offences totalled 2,600 and in 2000, the number reached over 5,000.

Fourteen per cent of EU citizens have experienced problems in their communities relating to drugs, including witnessing drug-related scenes or being a victim of violence. Again, although the authors do not specify particular drugs, it is unlikely that a significant proportion of these cases were related to cannabis and were most likely attributed to harder drugs, such as heroin (Communication from the Commission to the Council and the European Parliament Union Action Plan to Combat Drugs, 1999).

Conclusions

The purpose of this chapter was to present information to assist in answering the question – is cannabis a public health risk? The evidence available is quite extensive and yet somewhat inconclusive. Some facts about cannabis use – for example its widespread use (a high proportion of people have tried it at least once), that use is more often intermittent, that the majority discontinue use after their twenties and that only relatively small proportions of people consume adverse levels of the product – may lead to the conclusion that the public health impact is small, in particular when compared to that of other licit and illicit drugs.

However, as seen above, the use of cannabis is increasing, particularly among adolescents and young adults. In addition, the complexity in establishing dose level is a difficulty and there is greater availability of higher THC concentration products and an increase in more risky administration methods. Although the health effects of cannabis use and misuse are not as serious as other drugs, the evidence presented suggests that there are undoubtedly health-related effects related to cannabis misuse, dependence and polydrug use. Added to these is the inescapable evidence that cannabis is a 'gateway' drug – regardless of why this is so.

A number of things are clear from the evidence presented in this review:

- Cannabis use is increasing and the epidemiological evidence suggests that 'there are a number of probable adverse health effects related to both acute intoxication and chronic ingestion that could potentially produce a substantial public health burden' (Hall & Babor, 2000);
- 'While occasional use does not appear to present a serious problem, cannabis dependence among users is a serious public health issue' (Poulton et al., 2001);
- 'An effective public health policy is more difficult to implement when a substance is more widely used and accepted' (Hall & Babor, 2000);
- 'The challenge from a public health perspective is to develop credible approaches to health promotion, harm-reduction and treatment in today's context, where cannabis is widely available and its use in recreational contexts is seen as banal across broad sections of mainstream youth' (Hartnoll, 2002).

Gaps in Knowledge

Future work in an Irish context should give particular attention to the following:

- There is a need to monitor cannabis use in both young people and the general population. The monitoring of use among young people should include both those in school and those who have left school early;
- Public attitudes and knowledge should be monitored at periodic intervals;
- The role of cannabis in traffic accidents in Ireland, either in combination with alcohol or alone, should be examined on an ongoing basis.

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Chapter Three

Psychological Consequences of Cannabis Use

Mark Morgan

Overview

This chapter reviews some of the major psychological consequences of cannabis use. In the first section, the effects on cognitive functioning are examined including field studies and controlled laboratory work. A second section examines the effects on self-harm with particular reference to suicide and perception of physical health. The motivational consequences of cannabis use are examined in the third part of this chapter and the association of cannabis use and education outcomes is considered in the fourth section. Matters to do with occupational performance are examined in the fifth section while the psycho-social consequences are set out in the sixth part. The final section of this chapter is concerned with the perception of risk associated with cannabis use.

Cannabis and Cognitive Performance

Because cannabis has acute effects on cognitive performance, there is a major concern that its use may result in cognitive impairment in the long-term. There is evidence that many people who have used cannabis frequently suffer from problems of memory and in problem solving (Stephens, Roffman & Curtin, 2000). The difficulty that emerges has to do with how such associations should be interpreted. It may be that the cognitive problems that are found in these cases may have preceded cannabis use or at least in some cases that they result from use of other substances. Below, the evidence is reviewed as follows: (i) cross-cultural studies, and (ii) controlled studies of cannabis use and cognitive impairment.

Cross-cultural Studies

Over 30 years ago the US National Institute of Drug Abuse funded three studies in Greece, Jamaica and Costa Rica to examine the chronic effects of cannabis use. In the Jamaican study Bowman & Pihl (1973) examined the effects on heavy daily cannabis users who had a minimum of ten years use and smoked an average of 23 joints a day. However, in comparison to controls who had no experience of cannabis, the study failed to find any major cognitive differences in either rural or urban samples. (There are some indications however, that the controls in this study were inadequate.)

The Greek study (Stefanis, Dornbush & Fink, 1977) compared daily cannabis users with a control group matched for age, gender, SES as well as alcohol use. The differences that emerged favoured the control group particularly on verbal IQ and on specific abilities within the IQ tests. It should be noted however, that the daily users were not required to stop use before testing so that it is not certain that the observed effects were due to acute as opposed to chronic effects of cannabis use.

The Costa Rican study involved a design that was fairly similar to the Greek study but included a follow-up study after ten years by which time the target group had been using cannabis for about 30 years (Page, Fletcher & True, 1988). The results indicated few differences except at the follow-up which showed that the target group performed less well on tests of sustained attention and short-term memory.

There has also been a number of studies of chronic cannabis users from India. In general, the pattern in these has been of cognitive problems among a substantial minority of people who have used

cannabis for a long time (Wig & Varma, 1977).

In general, it is fair to say that the cross-cultural studies have produced equivocal evidence of cognitive impairment resulting from long-term cannabis use. In many cases, such impairment has certainly been associated with use. What makes the finding somewhat difficult to interpret is that the users frequently differ in other respects like polydrug use, poor nutrition and poor medical care compared to the controls against whom they have been judged.

Controlled Studies of Cannabis Use and Cognitive Impairment

Studies carried out over the last 15 years have tended to use Western samples and have given a lot of attention to ensuring that control groups did not differ from cannabis users before they began use. In addition, a considerable focus has been on identifying the particular cognitive processes that may be affected.

A study by Block, Farnham, Braverman, Noyes, and Ghoneim (1990) in a longitudinal format examined the effects of long-term cannabis use on cognitive functions that were considered to be of major importance to school achievement. The researchers matched users and non-users on the basis of information collected on them in early high school, before they began serious use. The design of the study involved a comparison of 64 light users of cannabis with 80 heavy users and 72 controls. Heavy usage was defined as five times per week for at least six years. Prior to testing on a range of standardised tests, a period of abstinence of at least 24 hours was required. The results showed that heavy users did less well in tests of both mathematical and verbal skills.

Among the best known studies in this area are those of Solowij, who has examined long-term effects on a user's ability to exclude irrelevant stimuli when focusing attention on a test (Solowij, 1995). Solowij studied the attention processes of cannabis users, making use of both conventional performance measures and also brain event-related potential (ERP).

A major characteristic of this work is the care that Solowij has taken in ensuring that control groups are similar to the 'experimental' group. In an early study cannabis users were matched with non-users on a range of attributes including age, gender, years of education and pre-use estimated IQ scores. Furthermore, subjects were excluded if they had history of psychiatric illness, had used drugs other than cannabis or had high levels of alcohol consumption. In addition, the cannabis users were asked to abstain from cannabis and alcohol for 24 hours prior to testing and urine tests ensured that this was the case.

The task involved a selective attention task in which sequences of tones were presented through headphones while brain activity was recorded. Subjects were required to attend to a particular kind of sound in one of their ears and to respond by pressing a button. It emerged that the cannabis users performed significantly poorer than controls, with fewer correct detections, longer reaction times and more errors. The results suggested that cannabis users were less well able to process certain kinds of information and, specifically, to filter out information that was irrelevant.

Solowij (1998) examined the extent to which degree of impairment of attention could be linked with cannabis use. Thirty two cannabis users were divided into four groups based on frequency of use and duration of use. The results were not fully clear-cut. It emerged that the group who had smoked cannabis for a long time found it harder to ignore irrelevant stimuli – an impairment that was not,

however, related to frequency of use. In contrast speed of information processing was related to frequency of use but not to duration of use. The same author sought to examine the question of whether the change in ERP persisted after an extended abstinence from cannabis. For this study, the target group had been abstinent for two years. Her results showed that there was a partial recovery after former users had been abstinent for two years. In particular there was evidence that speed of information processing improved but the ability to ignore irrelevant stimuli remained impaired. Furthermore, the extent to which recovery occurred was not related to length of abstinence.

The most recent study by Solowij and her colleagues (Solowij et al., 2002) sought to examine the effects of duration of cannabis use on specific areas of cognitive functioning among users who were seeking treatment for cannabis dependence. The study involved 51 long-term users and an equal number of shorter-term users as well as controls. It was found that long-term users performed significantly less well than the other groups on tests of memory and attention. Furthermore, on verbal learning tests long-term users recalled fewer items than the other groups while the short-term users and the controls did not differ substantially from each other. The authors conclude that long-term heavy cannabis use results in impairment of memory and attention that endures beyond the period of intoxication and worsens with years of regular cannabis use.

Pope and Yurgulun-Todd (1996) examined the cognitive effects of heavy cannabis use among college students. Their comparison involved students who had been using cannabis for at least two years on a daily basis and light users who had used cannabis on not more than three days monthly. The authors used this design on the grounds that infrequent users would be more similar to heavy users on a range of confounding variables than would control students. While there were no major demographic differences between the groups on social and demographic variables, there were differences in verbal IQ and self-reported Scholastic Aptitude Tests (SAT). What was more interesting however, was that the groups differed on tests of digit span, auditory sequential processing and the Weschler memory scale as well as on tests that were specifically designed to measure attention. More significantly, these differences persisted when adjustments were made for the differences in Verbal IQ and self-reported SAT test scores, indicating effects of cannabis on memory and attention.

The recent longitudinal studies provide some of the most convincing evidence in this area. The study by Lyketsos, Garret, Liang and Anthony (1999) examined the effects of cannabis use on cognitive functioning among over 1300 adults more than 11 years after they had been assessed using the Mini Mental State Examination (MMSE). The scores among participants taken together declined by 1.2 points over the 11 years and this decline was highest among older participants. There was however, no relationship between cannabis use and decline in cognitive score and this lack of a relationship persisted even when controls were applied for age, gender and use of other drugs. It should be remembered that while the MMSE is an appropriate measure of gross cognitive functioning, it is not a measure of the subtle impairments that were referred to above as in the work of Solowij.

Another recent longitudinal study of the effects of cannabis on IQ is also worth noting. The recent study by Fried, Watkinson, James and Gray (2002), examined IQ scores in the early teens (10-12 years) with those age 18-20 years and compared the changed scores with frequency of cannabis use. The results showed that current use was significantly related with a decline in IQ over the ages studied. There was an average decrease of 4.1 points in heavy users compared to gains for light users, former users and non-users.

The authors concluded that heavy use had a negative effect on global IQ scores only if the subjects smoked 5 joints a week or more. A negative effect was not observed among people who had previously been heavy users but who no longer used the substance. They also concluded that while cannabis does not have a major effect on global intelligence, there might be an effect in cognitive domains such as memory and attention.

One interesting point that emerges in a number of studies concerns the reversibility of the effects of cannabis. A study by Pope, Gruber, Hudson, Huestis & Yurgelun-Todd (2001) administered a battery of tests to groups of current heavy users of cannabis, former heavy users and normal controls after 1, 7, and 28 days of abstinence from use. The test battery included measures of intellectual functioning, verbal fluency and sustained attention. Current heavy users scored significantly below controls on memory tasks before and up to 7 days abstinence. By 28 days however, there were virtually no differences between the three groups on the performance of the various tasks.

On the other hand, Bolla, Brown, Eldreth, Tate & Cadet (2002) found that decrements in performance persisted after 28 days. A group of heavy cannabis users showed poorer performance in five of 35 measures used (including memory, psychomotor speed and manual dexterity), even after abstinence. It also emerged that duration of cannabis use had little influence on the persistence of the negative cognitive effects. The reason for the difference between the studies by Pope and Bolla is not clear at this time.

Only a small amount of research attention seems to have been given to the idea that cannabis use may have beneficial effects on certain forms of cognitive functioning. The most likely features of functioning would be in the domain of creativity and aspects of cognition that interface with personal-motivational dimensions. One study that examined this was by Plucker & Dana (1998) who used the Creative Behaviour Inventory together with measures of substance use. The findings indicated that the relationship between various forms of substance use, including cannabis, and creativity (as measured in this study) were not significant.

A number of conclusions are appropriate regarding the effects of cannabis on cognitive functioning. Firstly, there is little evidence that cannabis produces severe impairment of broad cognitive functions, something which may relate to the failure to find gross structural changes in the brains of users. However, there is a considerable body of evidence that heavy cannabis use produces subtle cognitive impairments of memory, attention and the organisation of complex information. Thirdly there are indications that in many cases the impairment can be reversed with a prolonged period of abstinence.

Cannabis and Self-injurious Behaviour

Cannabis and Suicide

In deciding about the relationship between cannabis use and suicide, one of the major problems is in deciding whether the relationship is causal or can be explained by other factors. The study by Borges, Walters and Kessler (2000) in a cross-sectional study focusing on 'co-morbidity' found an association between self-reported suicide attempts and dependence on a number of drugs including cannabis as well as inhalants, alcohol and sedatives. What was interesting however, is that the association between cannabis and suicide attempts remained significant even when socio-demographic factors, other

psychiatric disorders and alcohol dependence were controlled. The odds ratio was 2.4 indicating that those using cannabis were between two and three times more likely to report such attempts than people not reporting cannabis use.

Beautrais, Joyce & Mulder (1999) looked at cases admitted to hospitals as a result of serious suicide attempts. The design of their study involved a comparison of over 300 cases admitted to hospital with over 1000 people selected randomly. This comparison indicated that the hospital group were about eight times more likely to have had a heavy involvement in cannabis use. Controlling for social disadvantage and having a history of depression reduced the association substantially but the odds ratio still remained at 2.00.

The study by Field, Diego & Sanders (2001) was concerned with factors associated with suicidal ideation. Those high school seniors who reported suicidal ideation were found to differ in a number of ways from those who did not on a number of variables including family, relationships, family depression, emotional well-being and substance use, including cannabis use. It is interesting that a regression analysis showed that emotional well-being predicted most of the variance in suicidal ideation while other factors, including drug use, added a modest level to the extent of the variance explained.

A number of studies have shown that cannabis use is related to other forms of risk-taking, which in turn are related to self-injurious behaviour. A study by Burge, Felts, Chenier & Parrillo (1995) found that substance use was related to a range of high risk behaviours including precocious sexual activity and suicidal ideation. It was particularly interesting that in this study cocaine use was especially strongly associated with severity of outcomes of suicide attempts while the relationships were somewhat weaker in the case of alcohol and cannabis use.

A study by Rodondi, Narring & Michaud (2000) found a relationship between drinking, cannabis use and having considered suicide in a sample of 2,500 young people in Switzerland. However, it should be noted that the relationship was not especially strong and the relationship of cannabis and alcohol use with other risky behaviours was much stronger than was the case with having thought about suicide.

One important point is that there are strong indications that in cases of suicide, cannabis use is often found to be associated with other forms of substance misuse. A study by Dhossche, Rich, Ghani & Isacsson (2001) examined postmortem toxicology records for over 300 suicides in Alabama, USA. Psycho-active substances were grouped into three broad categories: (i) alcohol, cocaine and cannabis; (ii) abusable prescription medications; and (iii) non-abused psycho-tropic medications. What was most interesting was the extent of overlap between the various categories. In more than two third of cases where cannabis and alcohol were found to be used, there was also evidence of the abuse of an abusable medication.

Cannabis and Perception of Physical Health

It is beyond the scope of the present chapter to consider the effects of cannabis on physical health – a topic that is given consideration in chapters 1 and 2. However, it is interesting to consider the relationship between cannabis use and perceptions and rating of health, since this links with the issue of how depression is affected by cannabis use. The evidence suggests that regular cannabis use is negatively related to perception of one's own state of physical health. In a study of factors influencing such ratings, Vingilis, Wade & Adlaf (1998) found that cannabis use was one of the factors that made a difference to such ratings in a study of students that included other variables like financial situation, academic achievement and self-esteem as well as demographic factors.

It is also of interest that a study by Winnail (1995) of American High School students found that physical activity was relatively lower among students who were frequent cannabis users. This might well be an important influence when the relationship between health and cannabis use is considered.

Motivational Consequences of Cannabis Use

Over 30 years ago, it emerged that chronic cannabis users in Jamaica, Egypt, the Caribbean and the US were considered by many people to be so apathetic, lethargic and unmotivated that they were considered to be suffering from an 'amotivational syndrome'. Subsequent studies however, have failed to find clear-cut evidence for this syndrome.

In an early study, Carter et al. (1980) compared 41 heavy users with a similar number of non-users matched on relevant characteristics like age, education and occupation. The results indicated that the users suffered from a variety of negative effects including having a less good employment record, being less likely to have been promoted and being more likely to be in debt. However, it is not clear whether the controls that were applied were sufficient to rule out other (psychological) differences that may have existed in addition to and prior to cannabis use.

One type of study that was traditionally very popular was a design that involved looking at the personality and motivational characteristics of users and non-users. For example, Crain, Ertel & Gorman (1975) examined three groups of college drug users (cannabis, amphetamines and barbiturates) with each group completing a personality inventory. Those who tended to use cannabis frequently were somewhat less anxious and less emotionally-stressed than the other groups. These results may have some implications for motivation especially the lower levels of anxiety.

The study by Miller & Plant (2002) was based on data from students in the UK ESPAD study. They examined the profile of students who had used cannabis at least 40 times in their lives, based on a cluster analysis. Three groups emerged, one of which was characterised by anti-social behaviour, another by a high level of unhappiness, and a third and largest group who believed that their environment was stable and predictable. There is little evidence in these findings that lack of motivation is particularly associated with cannabis use.

There is some interest in the association between cannabis use and self-efficacy judgments since such judgments are powerful predictors of readiness to tackle and cope with particular tasks (an essential component of motivation). One study along these lines (Sklar & Turner, 1999) was concerned with development of such a scale for people in treatment for a variety of addictions including cannabis

addiction. While they have produced a scale with good reliability and validity in assessing self-efficacy in high-risk situations, the absence of a suitable control group limits its value with regard to the question of motivational effects of cannabis.

Laboratory studies of the effects of cannabis on motivation continue to appear in the literature on a fairly regular basis. A recent study by Cherek, Lane & Dougherty (2002) checked the effects of cannabis use on effort expended when the amount to be earned decreased progressively. They found that the drug resulted in potency-related reductions in the number of responses, in time spent and in money earned – effects that they interpret as 'amotivational'.

The possibility that certain styles of motivation may be a factor in using cannabis (rather than the other way round) has been raised in a number of studies. A recent study by Wulfert et al., (2002) was concerned with delay of gratification among adolescents. As is typical in this kind of study, a choice is given between a small reward which can be obtained immediately and a larger one, some time later. It is generally thought that this capacity to delay gratification is a major factor in motivation for long-term goals like obtaining a college degree. From the perspective of the present work, it is interesting that the Wulfert et al. study found that certain behaviours were more likely to occur among adolescents who choose an immediate reward (did not delay gratification). These included a greater involvement with substance use generally and cannabis in particular. Thus it could be the case that cannabis use is associated with different motivational styles which in turn are associated with subsequent outcomes that are associated with loss of motivation.

Finally, there are some studies that indicate that cannabis can in some circumstances have positive effects on working, especially with hard physical work over a sustained period. The review by Hanak, Tecco and Pelc (2002) notes that in a small number of studies it has been found that cannabis can alleviate fatigue and thus increase productivity, notably a study of Ganja use in Jamaica by Rubin and Comitas (1975). However, a critique of this latter study by Nahas (1985) shows important methodological flaws and concludes that the acceptance by the authors of positive motivational effects is based more on philosophical premises than on objective evidence.

Cannabis Use and Educational Outcomes

In line with the view that bonding to school is weaker among cannabis users, several studies (in Ireland and abroad) have shown that cannabis use is associated with poor school performance including grades, attendance and likelihood of dropping out (Grube & Morgan, 1986; Fergusson, Lynskey & Horwood, 1995). As in the case of many correlates of cannabis use, a number of interpretations are possible. It may indeed be the case that cannabis use is a causal factor in poor school performance. Equally it could be argued that common factors influence both cannabis and poor school performance.

What is very striking is the strength of the association between cannabis use and factors associated with academic success. Sanders, Field and Diego (2001) studied the influence of substance use on academic expectations (which in several studies, including a number carried out in Ireland, has been shown to be strongly associated with achievement, Kellaghan et al., 1995). Interestingly substance use (particularly cannabis and cocaine use) accounted for more than half of the total variance in predicting academic expectations.

However, even a very strong association does not of itself ensure a causal relationship. Longitudinal studies offer the best prospect of resolving this issue. Newcomb & Bentler (1988) followed US high school students over 8 years to assess the impact of early drug use on educational outcome at age 19 years. Even when they had taken account of a variety of factors that affect leaving college (including educational disadvantage), they found that cannabis users specifically, and substance users more generally, were likely to abandon a college education.

One of the best-controlled studies is an American study by Garnier, Stein & Jacobs (1997), which examined a whole range of child and family variables in dropping out of high school, in a 19-year longitudinal study. What was especially interesting is that this study examined the effects of non-conventional family structures and values in interaction with other variables. Non-conventional values/family structures were measured through alternative achievement goals, self-reliant lifestyles, orientation towards immediate gratification, anti-authority and non-materialistic orientation.

What was particularly interesting is that while non-conventional lifestyles, which were sometimes associated with drug use by parents, could lead to cannabis use by children, which in turn increased the probability of dropping out, this was not the case where the non-conventional lifestyle was associated with strong belief in lifestyle values. In other words, the critical factor was not the lifestyle, as much as the extent to which families adhered to values around that lifestyle.

Thus, while in this and in several other studies, cannabis use was found to be associated with dropping out, this was more likely to happen when it occurred in the context of a lifestyle that was unconventional but where there were no deep feelings of adherence to that unconventionality. This is an important consideration since many criticisms of cannabis use focus not on the use of the substance per se but on the associated unconventional lifestyle.

Another high quality study by Ensminger, Lamkin & Jacobsen (1996) studied a range of child and adolescent influences on later school drop-out. These included social background, school behaviour and performance, and aggressiveness, as well as adolescent cannabis use. It is interesting that the pattern of results were somewhat different for males and females. However, for all young people adolescent supervision and cannabis use emerged as major predictors of drop-out.

In another American study, Tanner, Davies & O'Grady (1999) looked at the relationship between cannabis and other drug use at age 14-17 years on a variety of educational and other outcomes which were assessed at age 25-30 years. Among the outcomes that were assessed were whether high school was completed, progress to college and completion of college, as well as occupational status and employment status. As might be expected there was a substantial relationship between drug use and dropping out of school, failure to graduate from college, as well as unemployment. However, this relationship (though diminished) still persisted even after social background, cognitive capacity, and expectation of going to college were controlled.

One interesting point emerging in recent research is that cannabis use is involved in a large number of suspensions/expulsions from school. A review of the pattern and causes of expulsion by Shiraldi & Ziedenberg (2001) showed that over the last 20 years the number of expulsions from US schools had doubled. Those who were suspended or expelled were much more likely than their peers to use cannabis, alcohol and other drugs. It is also of interest to note that students suspended from school are likely to find themselves bereft of any form of further education, thus contributing to the relationship between poor educational achievement and cannabis use.

The recent study by Brook, Adams, Balka, & Johnson (2002) was concerned with the relationship between early cannabis use and educational and other variables, among two large samples of disadvantaged youth in the US. This longitudinal study included a range of variables associated with transition to young adulthood and sought to relate these to cannabis use five years earlier. The results indicated that early cannabis use was associated with having lower educational and occupational expectations, being suspended or expelled from school, as well some indicators of rebelliousness. These findings emerged with controls on relevant variables including gender, ethnicity and maternal education.

Conclusions Regarding Cannabis Use and Educational Outcomes

The association between cannabis use and poor educational outcomes, and especially early school leaving, is one of the strongest and most consistent in the international literature. While some of the relationship is almost certainly due to other factors, it is noteworthy that the association still remains even when controls are applied to a range of factors like social background and parental expectations and supervision.

The question still remains as to how the effect is mediated. As noted above there are some indications that cannabis can affect cognitive capacity (IQ and similar tests) but that this comes about only after intense and prolonged usage. It is doubtful if any of the studies included many young people whose level of use was such as to damage their cognitive skills. Another factor might be motivation and the evidence on the damaging effects of prolonged use of cannabis on motivational processes, which might include interest in school. However, what has been demonstrated about cannabis motivation again applies only to very heavy users and is unlikely to apply to the relatively low levels of use which has been shown to be associated with early school drop-out.

Cannabis Use and Occupational Performance

For people in the workforce it might be expected that for reasons to do with motivation or because of cognitive effects, cannabis users might be expected to do less well at work than those not using the substance. However, any finding in this area has to take into account the findings discussed above relating to the association between school performance and cannabis use.

A well-known study by Mensch & Kandel (1988) sought to establish the relationship between occupational status and substance use. Their results showed that there was only a modest relationship between substance use and occupational status, except in the case of cigarette smoking. Generally speaking there were only weak correlations between job satisfaction and cannabis use. However, it emerged that people in occupations that were lacking in variety and complexity were somewhat more likely to smoke cannabis during work. It should be stressed that this study is cross-sectional in nature and therefore the matter of cause and effect is impossible to untangle.

On the other hand some longitudinal studies offer more convincing evidence on the relationship between employment and cannabis use. A study by Newcomb & Bentler (1988) followed adolescents from high school into employment and young adulthood and were also able to control for educational differences and other characteristics which may have been associated with cannabis use. They found that cannabis users were more likely to have a lower income, greater job instability, and lower job

satisfaction. They have speculated that this difference may be due to cannabis users tending to be less conscientious, thorough and reliable.

One of the more substantial recent findings in this area is found in the work of Fergusson & Horwood (1997). This study showed that the rate of unemployment was about four times greater for those who had been regular cannabis users at age 16 years. When controls were applied for co-variates like social background and school performance, the association declined but still remained substantial.

Psycho-social Consequences of Cannabis Use

It is evident that use of cannabis is associated with a range of behaviours, beliefs and attitudes that are frequently regarded as deviant. One of the first studies in Ireland to illustrate this point was that of Grube & Morgan (1986) who found that those adolescents who had used cannabis were somewhat more likely to be involved in a range of behaviours that included having sworn or cursed, lied to teachers/parents, damaged property and stolen things.

Similarly there was evidence from the same study of relatively lesser social bonding by young people who use cannabis. Social bonding is conceptualised as consisting of three processes: attachment, commitment and involvement. Attachment refers to the effective bonds between an individual and an institution like school or Church. Commitment refers to the extent to which an individual believes the relationship with another is important or values an institution or its goals. Finally, involvement refers to the time or effort one expends within the context of a given relationship or social institution e.g. engaging in family or church activities.

Specifically, there is evidence from several studies that cannabis users are less likely to be bonded to school. In fact in many studies truancy from school is one of the strongest predictors of regular cannabis use (Lynskey & Hall, 2000). The evidence on a negative relationship between cannabis use and bonding to religion has also been consistently found (e.g., Grube & Morgan, 1986).

Cannabis Use and Anti-social Behaviour

The issue of the relationship between criminality and cannabis use is considered in chapter 4. However it is of interest to note that several surveys have shown a relationship between reports of anti-social behaviour and cannabis use. In the international literature Arsenault (2000) examined the effect of cannabis use on violent behaviour at age 21 years in a New Zealand cohort. The results indicated that even when controls were applied for demographic factors and for other disorders, about 28% of the risk of becoming a violent offender could be attributed to cannabis use. This was much stronger than either alcohol use or mental illness. One suggestion that emerges in this study is that the association with violence is mediated through users early and active involvement in the illegal drugs market.

Table 5 shows the association for Irish 16-year olds between cannabis use and various forms of anti-social behaviour in the ESPAD 1999 study (Hibell et al., 2001). To assist in interpretation the association with smoking and recent alcohol use is also shown.

A number of interesting points emerge from Table 5. Firstly, all of the correlations between the various forms of anti-social behaviour and the three forms of substance use considered are statistically significant. This is partly due to the large number of respondents in the ESPAD study (over 2,300 for

Ireland). In general the correlations are in the middle range rather than being high or low, indicating moderate level of association. Another interesting point is that the correlations are not very different for various forms of anti-social behaviour, e.g. stealing vs. violence.

From the perspective of the present study, the most important consideration is that the correlation between cannabis use and anti-social behaviour is generally stronger than is the case with cigarette smoking or drinking. This is the case for the various forms of anti-social behaviour with the exception of 'starting a fight'. In the case of the latter behaviour, there was a relatively stronger association with alcohol consumption than with either cigarette smoking or cannabis use – something that seems to make sense.

Table 5. ESPAD (1999): Association of Cannabis, Cigarette and Alcohol Use with Anti-social Behaviour

	Cigarette Smoking*	Alcohol**	Cannabis use***
Bullying	.12	.15	.16
Hurting someone	.17	.22	.27
Starting a fight (another group)	.26	.31	.30
Starting a fight (individual)	.20	.28	.23
Stole something (>about €12)	.23	.25	.31
Broken into a place to steal	.18	.19	.22
Damaged property	.21	.28	.39
Sold stolen goods	.19	.22	.29

* Measured as the number of cigarettes smoked daily in the previous month
** Measured as the number of times alcohol was consumed in the previous month
*** Measured as the number of times cannabis was used in the previous year
Note: All of the correlations shown above are statistically significant

Cannabis Use and Victimisation

It has often been suggested that factors that influence anti-social behaviour may also be a contributory factor with regard to being a victim of a crime. For these reasons a number of countries in the ESPAD study including Ireland included items with regard to victimisation that were parallel to those for anti-social behaviour.

It can be seen from Table 6 (page 90) that there is a pattern of generally weak, but positive, correlations between substance use, including cannabis, and various forms of victimisation. However, it is also noteworthy that the correlations are not as strong as is the case with the parallel forms of anti-social behaviour. Comparing cannabis with other substances (cigarettes and alcohol), there is a slight tendency for the correlations with victimisation to be slightly greater on average. This was not nearly as pronounced as in the case of anti-social behaviour.

Table 6. ESPAD (1999): Association of Cannabis, Cigarette and Alcohol Use with Victimisation

	Cigarette Smoking*	Alcohol**	Cannabis Use***
Being bullied	ns	ns	ns
Being hurt	.12	ns	.16
Being victim of a fight (group)	.21	.19	.28
Being victim of a fight (individual)	.16	.14	.16
Had something stolen (about €12)	.18	.10	.12
Had my house broken into for stealing	ns	ns	ns
Had my property damaged	ns	ns	ns
Had my property stolen or sold	.17	.17	.28

ns – not significant

* Measured as the number of cigarettes smoked daily in the previous month

** Measured as the number of times alcohol was consumed in the previous month

*** Measured as the number of times cannabis was used in the previous year

Note: All of the correlations shown above are statistically significant

Perceptions of the Risks of Cannabis Use

One of the challenges for prevention is that the immediate adverse effects of cannabis are not extreme. Furthermore, as shown above, many of the adverse long-term effects apply to heavy use over several years. The problem is that many adolescents have great difficulty in making decisions about the risks that may occur several years later. In a recent publication, Gruber & Pope (2002) have considered this issue and they draw attention to the difficulty of getting adolescents to understand that their behaviour may result in early school leaving, losing motivation or becoming depressed several years from now. The result is that many current approaches that are based on information are unlikely to be successful.

What is clear is that many young people do not see cannabis use as being dangerous. For example, a study by Poulton, Moffitt, Harrington, Milne & Caspi (2001) showed that young people in their twenties in New Zealand whether nonusers, occasional or heavy users of cannabis did not think that cannabis use had major negative consequences either in terms of getting caught, or negative social or health consequences.

The same general point emerges in the ESPAD study in 1995 and 1999 which inquired about the perceived dangers of various kinds of substance use among 16-year olds in Europe. What was particularly interesting about the ESPAD question is that it asked about the danger of occasional and frequent use of cannabis as well as for a variety of other substances. Table 7 summarises this information for a number of Northern European countries and includes, for comparison purposes, heavy smoking and binge drinking.

A number of interesting points emerge from Table 7. Firstly, the overall level of risk perceived in the case of occasional cannabis is quite modest in most countries. In Ireland for example, less than one

third of the sample of 16-year olds took the view that occasional cannabis use was a great risk. On the other hand, the general view was that regular cannabis use was a greater risk. In most countries about twice as many young people thought that 'regular' was a great risk compared to 'occasional' use.

Another point emerging is that fewer Irish 16-year olds see great risk in cannabis use compared to the European average (the same is broadly the case for the UK). This is true for both occasional and regular use. However, it should also be noted that in general the Irish sample perceived relatively less risk for all substance use with the exception of heavy smoking. It is important to note that there was a strong correlation between the level of perceived risk of a substance and actual use of that substance.

A final point that emerges from Table 7 is that for Irish adolescents, the perceived risk attached to regular cannabis use was roughly the same as for heavy smoking. In other words regular cannabis use was thought to have about the same risk as regular smoking of cigarettes. This is an interesting outcome given the results of the present review regarding the effects of cannabis use.

Table 7. ESPAD (1999): Perceived Risk of Substance Use

	Heavy Smoking	Binge Drinking	Occasional Cannabis	Regular Cannabis
Denmark	70	17	24	74
France	71	60	21	60
Ireland	67	18	32	63
UK	62	17	23	56
Sweden	69	44	44	89
Average (All)	65	38	43	78

Note: Table entries are percentages of students in each country who thought the behaviour in question was a 'great risk'. The average figure shown is for all 29 ESPAD countries

Conclusions

There are strong associations of cannabis use with a variety of outcomes and consequently the interpretation is difficult. However, there is a considerable body of evidence that heavy cannabis use produces subtle cognitive impairments of memory, attention and the organisation of complex information.

It has often been suggested that cannabis users appear to be apathetic, lethargic and unmotivated. The research shows that even in controlled studies, cannabis users suffered from a variety of negative effects including having a poorer employment record, being less likely to gain promotion and being more likely to be in debt. However, it is not clear whether the controls that are applied are sufficient to rule out other differences that may have existed in addition to and prior to cannabis use.

A strong association between cannabis use and poor educational outcomes, and especially early school leaving is one of the best-established findings in the literature on the consequences of cannabis use.

One important point emerging in recent research is that those who were suspended or expelled from school were found to be much more likely than their peers to use cannabis, alcohol and other drugs.

There is consistent evidence that young people attempting suicide are more likely to have a history of heavy cannabis use than are others. However, the precise role of cannabis per se is hard to pinpoint due in part to other substances, both legal and illegal, being found in these cases also.

Gaps in Knowledge

As in the other chapters, attention will be focused on gaps in knowledge that are especially relevant in the Irish context.

Future work should:

- Investigate relationships between cannabis use and suicides, and self-injurious behaviour;
- Establish the extent to which there is a relationship between physical health, well being and cannabis use;
- The need to look at cannabis use in studies of educational achievement as one of the factors in early school leaving and educational outcomes in Ireland;
- Examine existing school policies and practices with regard to cannabis;

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Chapter Four

Criminological and Sociological Consequences of Cannabis Use

Johnny Connolly

Overview

This chapter examines the major sociological and criminological consequences of cannabis use. In order to provide a context for this review, the legal situation with regard to cannabis in Ireland is described, especially the fact that over the last 25 years cannabis has been treated in a way that is different from other illegal substances. Some social consequences of the use of cannabis are examined including family problems, educational outcomes and marginalisation. Evidence regarding cannabis-related acquisitive crime and drug-related violence is evaluated. Features of the cannabis market are examined, particularly wholesale production and distribution, the involvement of organised crime and issues related to cannabis availability.

This chapter also considers social factors that increase the probability of harm and in this context revisits aspects of the gateway theory. Attention is drawn to the major value conflicts surrounding the use of the drug and the literature on the debate regarding the legal status of the drug.

Legislation of Cannabis in Ireland

Cannabis has always been treated differently under the Misuse of Drugs Act, 1977. Section 3 makes it an offence for a person to have a controlled drug in his possession. Section 27 of the Act as amended by Section 6 of the Criminal Justice Act, 1984 stipulates that where the substance is cannabis and the court is satisfied that the defendant possessed it for his or her own use the penalty should be a fine on the first offence up to a maximum of £300 (€380) on summary conviction and £500 (€634) on indictment. For a second offence, the maximum fines are £400 (€507) and £1000 (€1269) on indictment. For a third offence and on, the maximum fine for a summary conviction is a 12-month prison sentence, a £1,000 (€1,269) fine or both. For a conviction on indictment, the penalty is a 3-year prison sentence, a fine at the discretion of the court or both. The supply of drugs within a small circle of friends has been held to be a mitigating factor in sentencing while the presence of a commercial motive, even where friends are involved, has been seen as an aggravating factor (Charleton and McDermott, 1998).

The maximum penalty for the possession of any drug other than cannabis, on summary conviction, is 12 months' imprisonment, a £1000 (€1269) fine or both. For conviction on indictment, the maximum sentence is seven years' imprisonment, a discretionary fine or both.

The legal status of cannabis has come under increased scrutiny in recent years. The National Crime Forum, established by the Minister for Justice, Equality and Law Reform in 1998 heard arguments for and against decriminalisation of cannabis (Government of Ireland, 1998). Some contributors argued that the illegality of certain drugs gave rise to many of the problems associated with them.

The current legal situation was criticised on the basis that it brings young people into the criminal justice system, drawing the user into a law-breaking culture and exposing him or her to arrest and to contact with criminal elements. By placing the trade in the hands of criminal gangs who have a vested interest in maintaining high prices, it is argued that the users are encouraged to resort to crime to pay for their habit. There is also a concern that the glamour attached to criminals who make vast profits from drug dealing sets up a counter-culture which can be alluring to young people. It was also suggested to the Forum that decriminalisation would bring drugs within official control and regulation

and so facilitate quality control and facilitate the regulation of toxicity. Furthermore, it was argued that if drugs were available more openly in a controlled way, dealers who currently profit from its underground sale would have less incentive to recruit further users.

Those opposed to decriminalisation argued that such a move would send out the wrong signal, thus encouraging the use of drugs at a time when the need was to discourage it; that drug use would become more widespread in the absence of law enforcement measures. The forum highlighted the point that "the ineffectiveness of our efforts to control the abuse by young people of a legal drug such as alcohol boded ill for the control of the use of other drugs should they be legalised" (Government of Ireland, 1998, 78). It was also argued that a move towards legalisation would be contrary to international conventions to which Ireland is a signatory. It was also felt that, if substances prohibited in the rest of the EU were more available here, there might be a displacement to Ireland of drug problems elsewhere. It was argued that any move towards decriminalisation might most usefully be approached on an EU-wide basis.

It was emphasised to the National Crime Forum by opponents of cannabis decriminalisation that Irish public opinion was opposed to such a change. A nationwide survey of drug-related knowledge, attitudes and beliefs in Ireland found that the younger urban sector of society had a greater personal experience of cannabis and knew people who had taken cannabis (Bryan et al., 2000). However, approximately 77 per cent believed all drugs to be equally harmful to health and over half (54%) believed regular use of cannabis was just as dangerous to health as regular use of heroin. Over 40 per cent believed that one could become dependent on drugs after just one experience. Although, the authors point out, "this somewhat exaggerated sense of the effects of illegal drugs was less common among the young members of the (adult) population surveyed" (p.xiv). Regarding policy options, 24 per cent of respondents agreed that cannabis use should be decriminalised while 75 per cent of respondents were opposed to this.

A local door-to-door survey of opinion in a Dublin inner-city area which has endured severe problems associated with drug dealing and drug-related anti-social behaviour sought respondents' views on the issue of cannabis decriminalisation (Connolly, 2003). The study surveyed 44 local residents between August and December 2001. The majority of respondents who answered this question disagreed very strongly with suggested changes to the legal status of cannabis on the basis that they believed cannabis leads to harder drugs. Those who agreed with a change did so on the basis that it might help others in a medicinal way or because they feel it might assist in the prosecution of more serious drug use.

The change in the classification of cannabis in the United Kingdom in January 2004 has contributed to a renewed discussion as to its legal status in Ireland[3]. In rejecting suggestions that Irish law should be changed in this area, on 31st January, 2004, Noel Ahern TD, Minister of State with responsibility for the National Drugs Strategy stated that, "We're quite happy with how the law stands... In the UK, even after reclassification, in theory you can still get a tougher prison sentence than here, so in many ways they are more or less coming into line with how we are"[4].

3 For an analysis of the recent change in cannabis classification in the United Kingdom see Connolly J; Reclassification of cannabis in the UK Drugnet Ireland, Issue 10, March 2004.
4 Where the grass is greener The Irish Times 31st January 2004.

Social Consequences for the User

In this section the evidence is examined on the relationship between cannabis use and behavioural problems, education, employment and marginalisation.

Behavioural and Early Conduct Problems (See also chapter 3)

A Norwegian study sought to investigate the relationship between early conduct problems and early onset of cannabis use, with special emphasis on possible gender differences (Pedersen, 2000). The study consisted of a prospective longitudinal study of a national representative sample in their early teens. It found a strong association between early conduct problems and subsequent cannabis initiation. Serious conduct problems were found to have a moderate effect upon cannabis initiation in boys, whereas aggressive and covert conduct problems had strong effects in girls. The study did not control for personality traits associated with impulsiveness and sensation seeking. In seeking an explanation for the link between early development of conduct problems and drug use the author refers to a mechanism called 'cumulative continuity', where the "adolescent's interactional style leads him or her to select and create an environment that reinforces the behaviour in question" (Pedersen, 2000). The author hypothesises that conduct problems alienate the adolescent from ordinary youth groups, while fostering relations with more deviant youth.

Similarly, Spruit (2002) found that "factors such as unemployment, truancy, high levels of drinking and smoking, and sometimes behavioural disorders", may be a contributory factor in the case of heavy users of cannabis.

Education and Employment Problems

As shown in Chapter 3 cannabis use has been found to be associated with loss of motivation and poor educational achievement. In the studies of Lynskey & Hall (2000), it was shown that the association remains even when controls are applied for a range of co-variates and possible confounding factors. These authors suggest that the causal mechanisms may be the adoption of an unconventional lifestyle. For whatever reason, the link is quite strong. A prospective study in the US found that cannabis use negatively predicted college graduation (Brain et al., 2000). Another mediating factor may be the psychological problems that were shown to be associated with cannabis use. For example, Fergusson et al. (2002) found that cannabis use among 14-21-year old New Zealand youth was associated with a range of adjustment problems including depression and suicidal thoughts.

Drug laws can have an impact on educational prospects. For example, students convicted of cannabis possession offences in the US, are ineligible for federal student aid for university for a designated period of time. "Of the 9.8 million applicants for aid for the 2001-2002 school year, 43,436 were rejected for all or part of the year or risked automatic denial for not answering the question (relating to conviction for cannabis use)" (Associated Press, 2001). An Australian study found that, although a cannabis conviction had little impact on subsequent cannabis use, "a significant minority (of a group of 68 West Australians who had received a cannabis conviction) reported further problems with the law and problems with employment, accommodation, relationships and travel opportunities" (Lenton & Heale, 2000).

Marginalisation (See also Chapter 2)

It has been suggested that cannabis use leading to prosecution for such behaviour may contribute to marginalisation and alienation from societal norms (Hall, 2001).

Lenton and Heale (2000) found that offenders can perceive the law and its officers as heavy-handed, unjust and unfair and that research from a normative perspective has shown that such experiences can, under certain conditions, reinforce rule breaking, undermine respect for legal institutions, alienate offenders, and lead to a defiance of the law. Such findings are exacerbated in a context where cannabis use is seen as a 'normalised' aspect of behaviour. This concept will be discussed further below.

A study of the findings of the 2000 British Crime Survey (BCS) which considered the social costs associated with the impact of the policing of cannabis in England found that cannabis users were nearly twice as likely to report being approached by the police as non-users (May et al., 2002). There were marked differences in the satisfaction levels of cannabis-using and non-using BCS respondents. 57 per cent of non-cannabis users felt 'fairly treated' compared with 28 per cent of users. The authors concluded that although these findings did not amount to proof that the policing of cannabis damages relations between police and young people it did offer quite powerful circumstantial evidence to that effect.

Consequences on the Social Behaviour of the User

Below we consider a variety of consequences of cannabis use on the social behaviour of the user. These include disorderly conduct arising from use, acquisitive crime associated with use and specifically violence associated with cannabis use. This section also considers evidence on cannabis-related traffic offences.

Drug-related Disorderly Behaviour

A study conducted by the New York Academy of Medicine and published by the City of New York almost 60 years ago is still relevant (The La Guardia Report) (New York Academy of Medicine, 1944) in as much as it focused on issues that are still of central concern. The study sought to identify the relationship between cannabis, crime and juvenile delinquency. The committee conducting the study interviewed law enforcement officials and examined the records of a number of cannabis users who had come into conflict with the law.

Following an analysis of drug offender records, the report stated that "In the vast majority of cases…the earlier use of marijuana apparently did not predispose to crime, even that of using other drugs. Whether the first offenders charged with the use of marijuana go on to major crime is a matter of speculation. The expectancy of major crimes following the use of cannabis in New York County is small" (The La Guardia Report) (New York Academy of Medicine, 1944).

A subsequent UK committee of leading experts, the United Kingdom's Advisory Committee on Drug Dependence (The Wootton Committee) (Advisory Committee on Drug Dependence, 1968) focused specifically on cannabis. With regards to the alleged links between cannabis and crime the Wootton Committee (1968) noted that, "In the United Kingdom the taking of cannabis has not so far been

regarded, even by the severest critics, as a direct cause of serious crime". With regards to the alleged association between cannabis and criminal behaviour, a Canadian Government Commission of Inquiry into the Non-Medical Use of Drugs (The Le Dain Commission) (Canadian Government, 1970) reported that it was "unable to find scientific documentation of a criminogenic effect (of cannabis) in the international literature".

Obviously the link between cannabis and crime exists by virtue of the fact that it is a criminal offence to possess cannabis. This does not mean however that cannabis is a cause of crime. Criminal propensities may have existed before the onset of cannabis use. Studies in Britain and America show that about 50% of drug users committed criminal offences before they started taking drugs and 50% did not (Bean & Wilkinson, 1988). Given that not all cannabis users commit crimes other than those associated with possession, it can be argued that a more plausible explanation for links between morbidities might be that both are expressions of a deviant lifestyle (Bennett, 1998; Bennett and Sibbitt, 2000).

A great deal of research has focused on the search for an explanation for the linkage between cannabis use, crime and further more-serious illicit drug use. The idea that cannabis operates as a gateway to further drug use is a central theory used to illustrate these connections. The gateway theory will be discussed below (see also Chapter 2).

Drug-related Acquisitive Crime

With regards to the link between cannabis use and acquisitive crime, it has been difficult to identify, in the case of cannabis, those offences committed as a result of the use of the drug as distinct from those which would have been committed anyway. Thus it is difficult to identify a causal link between cannabis use and crime (Hough et al., 2001).

Some studies have suggested a relationship between cannabis use by juveniles and crime. An Australian review of the links between cannabis and crime suggests a strong relationship between cannabis use by juveniles and their participation in crime (Trimboll & Coumarelos, 1998). The study indicates that the reason for this relationship is that juveniles resort to property crime to fund their consumption of cannabis. Baker (1998) found that the odds of participation in property offences were almost five times greater for students who used cannabis frequently while Salmelainen (1995) found a relationship between heavy cannabis use and reporting the need to acquire money to buy drugs as the main reason for committing crime.

As Trimboll & Coumarelos (1998) point out, these findings do not conclusively show that all adolescents who are heavy cannabis users will inevitably become involved in crime, or if they are involved in crime that they will progress to more serious crime. There may be background factors that predispose them towards crime and also towards involvement with cannabis. A recent British review on this issue concluded that …. 'those who use illicit drugs are more likely than others to be involved in crime, and vice-versa. However, in general, there is no causal link between use of either ecstasy or cannabis and property crime' (Hough et al, 2001).

Drug-related Violence

Goldstein (1985) identifies three possible ways in which drugs and violent crime are related; the psychopharmacological, the economically-compulsive and the systemic. Although these can often overlap, they are useful for explanatory purposes as we seek to identify the link between cannabis and violent crime.

The psychopharmacological model suggests that individuals, as a result of drug use, may become excitable and irrational and may exhibit violent or disorderly behaviour. Such behaviour can lead to victimisation or other offences such as vandalism. There can also be a reverse effect here whereby the drug can have an ameliorating effect on behaviour and act as a crime-reduction agent. The economic model illustrates the populist view about the link between drugs and acquisitive crime, as discussed above. Crime is engaged in for the purpose of feeding the drug habit. Associated violence can occur during the commission of the crime as a result of the drug users' nervousness, intervention by bystanders or victim resistance. Systemic crime, which is associated with many forms of drug distribution networks, is viewed by Goldstein (1985) as the most common in terms of the drugs-violence nexus.

Early suggestions of a psychopharmacological link between cannabis use and violent crime have been largely discredited (Goldstein, 1985). Indeed, some studies have suggested that cannabis takes away aggressive impulses and operates as a calming influence on the user.

Despite this earlier consensus, there is evidence that heavy use of cannabis among juveniles is frequently associated with aggressive behaviour. This matter has been given detailed attention in Chapter 3 from an Irish perspective. Furthermore, a study by Friedman et al. (2001) found that frequency of cannabis use was associated with frequency of violent offences. There is also evidence that cannabis use increases the probability of being both the victim and the perpetrator of violent offences (Harrison et al., 2001). In addition, a number of Australian studies have found an association between the use of cannabis and participation in violent crime (Baker, 1998). This latter study found that cannabis use was a significant predictor of students' participation in assault and malicious damage, even when controls were applied for both developmental factors and the use of other drugs. The odds for participation in assault were more than two times greater for students who used cannabis frequently while the odds for participation in malicious damage were three times greater for frequent cannabis users.

However, another recent review which considered the link between cannabis and violence indicates a complex relationship between cannabis use and anti-social behaviour. 'Cannabis-dependent individuals …may become early and active participants in the illegal economy of drug markets, which may promote intimidation and violence' (Rigter & Van Laar, 2002). In other words the use of cannabis may involve association with deviant peers and dealers which in turn may result in a greater tendency towards violent and anti-social behaviour.

Drug-related Traffic Offences

In Ireland, the Road Traffic (amendment) Act, 1978 makes it an offence to drive a car, motor cycle, truck or pedal cycle 'while under the influence of an intoxicant to such an extent as to be incapable of having control of the vehicle. Intoxicants include alcohol and drugs and a combination of drugs and alcohol' (Corrigan, 2003).

In the international literature, the link between drug use and driving accidents and offences has become of increased concern to policy makers in recent years (Gemmell et al.,1999; Fergusson & Horwood, 2001; Lamers & Ramaekers, 2001; Tunbridge et al., 2001; Flynn et al., 2001; Ramaekers et al., 2002; Wright & Terry, 2002; Lenne et al., 2002; Sexton et al., 2002; Drugnet Ireland, 2002). This issue has already been discussed in chapter 2.

Attempts to develop adequate roadside testing procedures have severely constrained law enforcement efforts in this area. Ramaekers et al. (2002) conclude that "Currently available onsite tests of urine, saliva and sweat do not provide a foolproof indication of recent cannabis use. Saliva tests revealed many 'false negatives' and correctly identified only 18-25% of the THC positives in reference blood…Results from roadside drug tests may well provide good grounds for suspecting cannabis use in drivers, but need further confirmation by demonstrating the presence of THC in blood". Research conducted by Tunbridge et al. (2001) for the Transport Research Laboratory had highlighted the difficulties of establishing causation in this area.

The Runciman Committee (Ashton, 2000) also pointed to what it saw as the inadequacy of testing equipment and the poor standards of police training in drug-testing equipment. It went on to recommend that techniques to test drivers for drug-related impairment should be improved, and that all police officers responsible for testing should receive the necessary training.

A seminar organised by the Pompidou Group in April 1999 brought together public servants, researchers, practitioners, doctors and police officers from twenty-seven European countries and from the United States to consider the main areas in respect of road traffic and drugs (Council of Europe, 2000). These were the legal aspects including practical aspects of law enforcement and detection; prevalence, epidemiology and risk assessment and prevention and rehabilitation.

The primary conclusions which emerged from the seminar were that the distinction between licit and illicit substances in the context of road safety was not useful. It was felt that it was not their classification which matters, but the use to which substances are put; the real scale of the problem remains unknown, there was a lack of significant evidence of the effects on driving ability of the use of the substances concerned and that research needed to be expanded in this area.

A review of the existing legal situation regarding drug use and driving in European Union Member States found that all Member States had legal provisions for prohibiting driving under the influence of psychotropic substances besides alcohol in their traffic codes (Gemmell et al.,1999). However, the review found no specific criteria relating to the different types of drugs (licit or illicit) used, extent of drug use, or definition of an influence; no legal limits for drugs and no laws defining illegal blood limits of illicit drugs or medicine. The review found that there was insufficient evidence to define safe levels where drugs other than alcohol were concerned. Since 1994, European pharmaceutical package inserts have had to include statements concerning the potential deleterious effect of the drug on driving (ibid).

Within the European Union, there has been increased activity in both the legislative and the operational levels. In Austria, in its Road Traffic Act of 2001, a decision was made to exclude a provision on obligatory drug tests for drivers involved in accidents. In June 2001, a Finnish working group focused on this area proposed zero tolerance for drugs and driving. In Germany, a relatively new regulation provides for an extensive medico-psychological testing procedure in cases of

suspected cannabis use, to be paid for by the driving-licence holder who is placed under suspicion (Bollinger & Quensel, 2002).

Some traffic laws have evolved to provide for the revocation of driving licences in cases of cannabis possession. It has been argued that, "under the veil of traffic safety, harsh and repressive drug policies are being utilised to counteract legalisation tendencies" (Neumeyer, 2002). In Portugal and France in 2001, legislation was introduced to test individuals involved in road traffic accidents so as to conduct research on drugs and driving into the level and type of drug use among drivers and their contribution to accidents. This was to facilitate the design of a specific and effective legislation to address driving while under the influence of drugs. In March 2001, the UK Government introduced legislation regulating the testing and related procedures on individuals suspected of driving under the influence of illicit substances.

The Cannabis Market

For the purpose of simplicity, and in the absence of any specific research on the Irish drugs market, the cannabis market can be described as incorporating those involved in its production and importation, the "international market", those involved in its importation and distribution, described by Pearson and Hobbs (2001) as the "middle market" and then those involved in its distribution at a retail level, the "local market" (Lupton et al., 2002).

It should be noted that there may be a great deal of overlap between the network of individuals involved in the various layers or dimensions of the cannabis market.

Wholesale Production and Distribution

Cannabis is the most widely trafficked drug globally (UNODC, 2000). In 2000 approximately 4,500 metric tonnes of cannabis herb were seized, while approximately 4,000 metric tonnes were seized in 1999 (ibid). More than half of the cannabis herb seized worldwide was in North America and nearly a quarter in Southern Africa (much of it in South Africa).

The principal drug trafficking routes for cannabis herb are from Mexico and Colombia to the USA, although the UNODC reports that increasing levels of high quality production in North America are expected to diminish the importance of these routes. Some Colombian cannabis herb has already been re-directed to markets in Western Europe, where it competes with cannabis herb from Sub-Saharan Africa, South-East Asia, and, in recent years, from Albania. Also, domestically-grown hydroponic cannabis has gained importance in Europe. It is thought that the main route for cannabis resin into Europe (the principal form of the drug used in Ireland), is from Morocco via Spain to other countries in Western Europe, and from South-West Asia.

The cannabis resin in Ireland originates mainly from Morocco, while some smaller seizures are known to have originated in Pakistan, Afghanistan and Lebanon (Moran et al., 2001). In recent years some herbal cannabis seizures were known to have originated in South Africa. Most of the cannabis comes up through the Iberian peninsula to the south coast of Ireland. It is transported in freight trucks using cross-channel ferries, and on sea-going yachts. The Garda Síochána believes that most of the drugs seized in the country in recent years are for the home market. It is also speculated that Ireland, with its long coastline isolated in many areas, may be used as an access point for transit to the UK and Europe.

Involvement in Organised Crime

Most of the research conducted into organised crime and its involvement with drug trafficking has come from the USA (South, 1995; Dorn et al., 1992) although there is an increasing focus on such studies in Europe (Ruggiero & South, 1995). None of the studies consulted focused specifically on cannabis.

In Ireland, the Garda Síochána believes, however, that the distribution of drugs within the country is organised by networks of criminal gangs. In some cases these gangs involve members of the same family (Moran et al., 2001). This contention is supported by a relatively recent book by investigative journalist Paul Williams (2001), which focused on the gang involved in the murder of crime correspondent Veronica Guerin in 1996. This book suggests the significant involvement of both international and national organised crime networks in the Irish cannabis trade. It also suggests that the same gang was involved in the importation of cannabis, cocaine, firearms and ammunition. The book describes regular trips by gang members to the Netherlands to organise cannabis shipments. It suggests that a second level of gang members then sold the cannabis to a network of dealers in Ireland for onward local supply (Williams, 2001).

Violence in Connection with Production and Distribution

Although there is clear evidence of violence associated with the drug trade, in the absence of any adequate studies of Irish drug markets, it is impossible to state with any clarity the extent to which violence is associated specifically with the trade in cannabis. A number of popular crime books have been written by investigative journalists about prominent individuals or gangs involved with the drug trade in Ireland (Reynolds, 1998; Williams, 2001). The evidence from such literature, when considered along with newspaper and court reports does suggest that there is a significant amount of violence associated with the illegal trade in drugs. Also, it appears from media reports and drug seizures that there is some degree of overlap between trades in different drugs. For example, the gang discussed by Williams (2001) appears to have been involved in dealing cocaine as well as cannabis. It would be useful to have more reliable information as to the extent of overlap between the trade in cannabis and the trade in other drugs, where it exists.

In recent years, Ireland has witnessed an increase in gang-related murders. A study on homicides in Ireland suggested that between 1992 and 1996, fifteen homicides were connected to disputes concerning control over the supply of illicit drugs (Dooley, 2001). Although further investigation would be required to identify as to whether these murders had any specific relationship to the cannabis drug trade, the fact that there is some overlap within the trade in different drugs suggests a possible connection.

Studies by Connolly (2002, 2003) revealed high levels of drug-related crime and anti-social behaviour associated with drug dealing at the local or 'retail' market level in Dublin's inner city. This behaviour, which included muggings and other assaults, was associated with a particular location, known as a site of regular drug dealing. Although a local survey found that cannabis was regularly being used and sold at this location, the study did not investigate specific linkages between cannabis use and the crimes and nuisance associated with this location.

Money Laundering

The Criminal Justice (Proceeds of Crime) Act 1996 and the Criminal Assets Bureau Act 1996 provided for the seizure and confiscation of assets derived from the proceeds of drug trafficking and other offences including money laundering. Under the Criminal Assets Bureau Act 1996, the Criminal Assets Bureau (CAB) was established with powers to focus on illegally acquired assets of criminals involved in serious crime with a view to confiscating such assets. Although the annual reports of the CAB provide no detailed indication as to the extent or nature of its investigations in the drugs area (CAB Annual Reports, 1998-2001), it is worth pointing out that the CAB was established in the immediate aftermath of the murder of journalist Veronica Guerin by members of a gang involved in the trafficking of drugs, including cannabis. Media reports suggest that CAB has been particularly active in pursuing the assets illegally acquired by the gang involved in her murder as well as in other drug-related matters.

The Local Retail 'Market' and Cannabis Availability

Most research conducted on retail-level drug dealing is from the USA[5]. A recent UK study highlights the regional variations in drug markets in the UK (Pearson & Hobbs, 2001). The flexible and diffuse nature of the drug trade suggests that caution must be exercised before transferring findings from other jurisdictions onto the Irish situation.

No research studies have been conducted in Ireland in this area. The Garda Síochána National Drugs Unit believes that, in the last few years, the nature of the cannabis market seems to have changed to a larger distribution network, involving smaller amounts of the drug. That is, there are many more carriers, trafficking smaller amounts of cannabis (Sinclair et al., 2001). Survey research among those who have admitted to using cannabis and other similar studies do give some indication as to the nature of the retail market or, at least, the availability of cannabis at street level.

A US study which considered the period from 1975 to 1998, found that at least 82 per cent of high school seniors surveyed replied that they had found cannabis 'fairly easy' or 'very easy' to obtain. In 1999, 88.9 per cent of high school seniors said cannabis was 'fairly' or 'very easy' to obtain (Wodak & Moore, 2002 p50). The European School Survey Project on Alcohol and Other Drugs, which surveyed drug use among students in 30 European countries (Hibell et al., 2001) including a sample of 1,849 Irish fifth-year students, considered the question of drug markets and availability. Two-thirds or more of Irish students knew of some place they could easily buy cannabis (Pompidou Group, 2000). A "disco or a bar" was the most-commonly mentioned location, a "street, park etc." second, followed by "house of a dealer" and "school" (Pompidou Group, 2000 p131). 23 per cent of Irish students reported that cannabis was easily available in school while 78 per cent reported availability in any other place. With regards to the perceived availability of cannabis, 59 per cent of Irish students responded that cannabis was "very" or "fairly" easy to obtain. This was the highest finding of all countries, the average being 29 per cent across the countries in the study. The ESPAD survey also found that the majority of adolescents who had used any illicit drug in 1999 had obtained the drug for the first time from someone they knew quite well (Pompidou Group, 2000).

A study of 983 Irish second-year pupils in 16 schools in the Dublin metropolitan area found that the most common ways in which pupils obtained illicit substances, including cannabis, were from a friend, by it being passed around a group of friends, from a stranger or by buying it (Brinkley et al., 1999). Just 60 per cent said that they had been offered at least one illicit substance, cannabis being the most

5 For a review see Pearson, G. and Hobbs, D. (2001).

commonly offered. The places where students were most commonly offered illicit substances were on the street, at a rave or disco and at a friend's home.

A survey of 57 young people in Dublin's inner city found that the majority were acquainted with individuals who had ways and means of accessing illegal drugs although fewer were acquainted with known drug dealers. This was not seen as a barrier, however, to the procurement of illicit drugs as routine street encounters with friends and acquaintances were found to provide the most reliable and familiar access routes to respondents' drugs of choice (Mayock, 2000).

These findings are supported by a study conducted in Dublin's north inner city (Connolly, 2003). This study, which incorporated a local door-to-door survey of attitudes and perceptions about drug-related crime, found that 53 per cent of respondents had witnessed drugs being sold in the past year, while 24 per cent stated that they had witnessed cannabis being sold at a specific location (ibid).

A study conducted by the Garda Síochána research unit among second-level students in Waterford/ Kilkenny and Kerry Garda divisions found that cannabis was the first drug taken by 89 per cent of those who reported having used drugs. In 70 per cent of cases friends had supplied the drugs (Sarma et al., 2002).

No studies have been conducted into drug prices although the price of cannabis resin per gram appears to have remained relatively stable over the past number of years, at €13 per gram (Moran et al., 2001).

Social Factors that Increase the Probability of Harm

In terms of the risk of further harm from cannabis use, Clayton's (1992) definition of risk is useful. He defines a risk factor as "an individual attribute, individual characteristic, situational condition, or environmental context that increases the probability of drug use or abuse or a transition in level of involvement with drugs" (Clayton, 1992). Regular use of cannabis, such as daily use, exposes the user to greater risk of adverse health and psychological consequences (Hall & Solowij, 1998) (see Chapter 3). It is particularly important therefore to identify the factors that increase the probability of harm in relation to a drug which some argue has become a 'normalised' aspect of youth culture (Parker et al., 1998).

Brinkley et al. (1999) point out in relation to general drug use among young people that "….experimentation and a variable pattern of use and cessation have been found to be much more common than heavy or problematic use" (p3). Many studies reveal that many young people regulate their drug use patterns in accordance with perceptions of harm. A longitudinal study which described evolving patterns of drug use among young people in the North West of England, found that respondents made a sharp distinction between acceptable and unacceptable drugs with cannabis in the former category (Parker et al., 1998).

A survey sample of 2,641 UK school students aged 15-16 examined possible differences among heavy cannabis users (those who reported using cannabis 40 times or more) and in terms of patterns of illicit drug use within the group (Miller & Plant, 2002). The first group (but smallest in number) was largely distinguished by anti-social behaviour. A second group were identified as being clearly unhappy, with little support from parents and friends, high levels of depressed mood and low levels of self-esteem.

The third and largest group identified were 'ordinary' and had little to distinguish them apart from a belief that their environment was stable and predictable and that society's rules should be obeyed. The authors found that although clear relationships emerged between heavy cannabis use and heavy use of other substances, the 'ordinary' cluster of heavy cannabis users were less likely than the others to have used other illicit drugs. The authors conclude that teenage heavy cannabis users have different motivations and contexts for their usage and that they should not be seen as a homogenous group and many do not appear to use other illicit substances.

Normalisation of Cannabis Use

Parker et al. (1998) suggest that the normalisation of drug use among young people involves the "cultural incorporation of drugs, drug use and drug users into their everyday lives…(and) the acceptance of a wider range of substances as alternative choices for intoxication or a 'buzz', including alcohol, tobacco and cannabis quite routinely, and other drugs occasionally" (Parker et al., 1998).

With regard to 'normalisation', in countries with high prevalence rates for use of cannabis, the proportion saying that some, most, or all of their friends use the substance are expected to be high. The largest proportion who thought so are Italy (44%), the UK (34%), Slovenia (26%), Ireland (24%) and Denmark (23%) (Pompidou Group, 2000).

Mayock's (2000) Dublin inner city study found that the social and routine nature of cannabis use was a striking feature of young people's reports. Socialising with cannabis users was not perceived as a major problem for the majority of non-users and a large number expected to find themselves in the company of friends or acquaintances who used the drug. The study found that "For cannabis users, much of its appeal hinged on the sociability of the activity and the fact that it was not identified as a 'deviant' behaviour. In this context, cannabis use emerged as a standard and accepted feature of routine social events, certainly for users of the drug" (Mayock, 2000, p95). The author suggests that cannabis use was a 'normalised' behaviour and not one which met with outright or unqualified rejection. "While several respondents referred to the risks associated with prolonged and/or heavy use of cannabis, this practice, considered to be relatively uncommon, was not ranked as a necessarily problematic feature of use". The study also found that other drug use was not viewed with this casual acceptance.

In such a context it is important to identify those factors that increase the probability of harm associated with such use and why cannabis use might lead to offending behaviour or to further, more harmful, drug use. The 'gateway' theory has emerged as an important explanatory model in this respect.

Gateway Effects

Cannabis, along with tobacco and alcohol, are sometimes referred to as 'gateway' drugs, as research suggests a connection between the use of such drugs and further drug taking. There appears to be confusion in public debates on this matter with the gateway theory employed both by those who advocate the maintenance of strict cannabis prohibition and those opposed to it. The source of this confusion, it is suggested, lies in a widespread misunderstanding of the gateway theory and its probable association in the public mind with the earlier, 'stepping-stone' theory (see also chapter 2).

The 'stepping stone' theory held that the use of cannabis led inexorably to the use of more serious illicit substances. Nearly sixty years ago, the La Guardia Report (New York Academy of Medicine, 1944) in consideration of the 'stepping stone' theory concluded that "The use of marijuana does not lead to morphine or heroin or cocaine addiction and no effort is made to create a market for these narcotics by stimulating the practice of marijuana smoking".

The rejection of the idea that it was the properties of the substance that induced people to start using other illicit substances has led to the search for other explanations for the connections, hence the so-called 'gateway' theory. The 'gateway' theory stems from the premise that there are a number of risk factors and life pathways that predispose young people to use cannabis and that they overlap with the life pathways that predispose young people to use other illicit drugs[6].

Once cannabis use begins, there are two principal explanations for the way in which cannabis is then seen to act as a 'gateway' drug (Drugscope, 2001). Firstly, cannabis happens to be the most easily available to those predisposed to use illicit drugs so it is generally used before other illicit drugs (although alcohol and tobacco are consistently identified as the first 'gate' through which almost all illicit drug users pass). Secondly, due to the legal status of the drug, cannabis use brings the user into contact with people (who otherwise they may never have met) using or selling more harmful drugs, which they may then try (Drugscope, 2001). Here the link is explained with reference to the legal status and social controls surrounding cannabis (Drugscope, 2001).

With regards to the connection with other illicit drugs, drug takers who reported regular use of cannabis are more likely than intermittent users to experiment with a range of other illicit substances including inhalants, amphetamines, ecstasy, LSD and tranquillisers (Miller & Plant, 2002). Daily cannabis users are more likely to be male, less well educated, to use alcohol and tobacco regularly, and to use amphetamines, hallucinogens, psychostimulants, sedatives and opioids (Kandel & Davies, 1992).

Recent research has supported the 'gateway' theory (Nutt & Nash, 2002). Australian studies suggest that adolescents who use tobacco, alcohol and cannabis tend to progress through a sequence of drug use, adding new drugs as they progress through the sequence while, at the same time, increasing their involvement with current drugs (Trimboll & Coumarelos, 1998). Research also suggests that the earlier an adolescent starts using cannabis, tobacco and alcohol, and the more frequent the use, the greater the likelihood that the adolescent will use other illicit drugs (National Centre on Addiction and Substance Abuse, 1994). A 21-year longitudinal study of a birth cohort of New Zealand children found that cannabis consumption preceded the eventual use of other illicit drugs in all but three cases (Fergusson & Horwood, 2000).

A recent review of research into the 'gateway' effects of cannabis use concluded that although most cannabis users did not progress to other drugs, "it may be argued that cannabis *primes* the user into taking other illicit drugs, either through a physiological mechanism or through personality and social factors" (Rigter & Van Laar, 2002). The authors suggested that the factors which might explain the 'gateway' effect, were that cannabis users may be more novelty seeking or ready to take risks than their peers; they may have such positive experiences with cannabis that they start to underestimate the risk of other illicit drugs. Another hypothesis was that non-conforming adolescents who have a propensity to use other drugs may be selectively recruited into cannabis use and that, once this occurred, then social interaction with drug using peers and greater access to illegal markets might lead to the use of other illicit drugs.

6 A recent review of the cannabis 'gateway' effect suggests that a more useful focus of attention should be on the common factor – drug use propensity, which leads people to use illicit drugs in the first place (Moral et al., 2002).

Some factors that increase the probability of cannabis causing harmful effects are considered here including the age of beginning use, family problems and lifestyle and personality factors.

Early Onset of Cannabis Use

An 18-year longitudinal study of a New Zealand birth cohort examined the linkage between early onset (by age 16) of cannabis use and later psychosocial adjustment (Fergusson & Horwood, 1997). The study found that early use, and particularly frequent use, was associated with clear increases in risks of substance use, juvenile offending, mental health problems, school drop out and unemployment subsequent to sixteen. Those reporting using cannabis on 10 or more occasions by age 16 had rates of these outcomes between 2.1 and 19.6 times higher than the rates for those who did not use cannabis at age 16. One explanation provided for the linkage between early cannabis use and later psychosocial outcomes is that early onset cannabis use encourages users to adopt other behaviours which increase their risk of further substance use, offending and unemployment.

These authors argue that most of the elevated risk seen among cannabis users is likely to arise from factors that were antecedent to the decision to use cannabis, rather than as a consequence of cannabis use. However, early users, the study concludes, may be more vulnerable to later psychosocial problems as a result of the social context within which cannabis is used and obtained.

Family Problems

Studies have found that children from broken families, those who are dissatisfied with their parents, and those who were not supervised were more likely to use drugs (Ledoux et al., 2002). Having a parent with an alcohol problem was linked to earlier drug use among USA adolescents (Obot et al., 2001).

Lifestyle and Personality Factors

A National Household Survey conducted in Australia found that cannabis use was strongly related to the respondent's gender, age, tobacco-smoking and alcohol-drinking behaviour. 18 per cent of the males surveyed reported that they had used cannabis compared with only 8 per cent of the females (Trimboll & Coumarelos, 1998). Cannabis use was highest and most frequent among the younger age groups while another Australian study found that daily cannabis users tended to be male (Hall et al., 1994).

A study which examined the personal student background and college characteristics associated with cannabis use found that use was higher among students at non-commuter colleges and at colleges with pubs on campus (Bell et al.,1997). Student characteristics associated with marijuana use included being single, white, spending more time at parties and socialising with friends, and less time studying. Cannabis use was also found to be higher among students who participate in other high risk behaviours such as binge drinking, cigarette smoking and having multiple sexual partners, and among students who perceive parties as important, and religion and community service as not important (ibid). Another study identified early smoking and experimentation as risks for cannabis use (Ellickson et al., 2001). Miller and Plant (2002) found that heavy cannabis users as a whole were more likely to go out to discos, parties etc. than light users.

Major Value Conflicts Surrounding the Use of the Drug

Concerns with limiting the effects of cannabis, by implementing policies which bring about a separation in markets for cannabis from markets in other drugs, have combined with a number of other factors to bring about a debate on the legislative approach to cannabis. Demands for a review have come from individuals and from committees and organisations and have been debated over the past three decades. Attempts to change laws relating to cannabis have also met with consistent opposition and thus created a major value conflict in this area[7]. Indeed, the debate over cannabis law reform remains one of the most contested areas of international drug policy.

In the light of this debate, many jurisdictions have introduced legislative reforms and/or modified cannabis law enforcement practices. Within the European Union a greater convergence in cannabis laws and in their prosecution can be identified (European Monitoring Centre on Drugs and Drug Addiction – European Legal Database on Drugs, 2001, 2002a, 2002b). There has been a trend since 2001 where most EU member states have proposed or enacted legal changes directed at distinguishing more clearly drug users from other drug law offenders and at distinguishing cannabis from other illicit substances (ibid). As a consequence, the International Narcotics Control Board has strongly criticised some European States for legal reforms in this area, accusing them of "undermining the principle of the international drug control treaties" (International Narcotics Control Board Press Release). The Board states that the Dutch 'coffee shops' contravene the 1961 convention and regards the draft legislation in Switzerland as "a move towards the legalisation of the drug which would contravene the international drug control conventions" (International Narcotics Control Board, 2003).

It is beyond the scope of this publication to consider this debate and the impact of these reforms in detail. However, some of the relevant contributions are as follows:

- Bammer et al. (2002) describe the effects of the Australia initiative the 'Cannabis Expiation Notice', as does Ashton (2000);
- Drummond (2002) questions the economic arguments for legalisation of cannabis;
- Inciardi (2002) argues that legalisation of cannabis might well increase level of demand for the substance;
- Studies by Kilmer (2002) and Reuband (1995) suggest that countries with more liberal cannabis laws do not necessarily have higher cannabis prevalence rates and that levels of law enforcement appear to have no effect on cannabis use;
- Korf (2002) addresses the question of the effects of 'coffee shops' on cannabis use in the Netherlands;
- May et al. (2002) consider the possible impact of cannabis declassification in the United Kingdom;
- Murphy (2002) criticises the prohibitionist ideology of Irish approaches to cannabis regulation;
- Wodak & Moore (2002) have carried out a cost-benefit analysis of current laws and concluded that costs outweigh benefits;

7 For a fuller account of the various arguments see Wodak, A. et al. (2002); Inciardi, J. (2002); Levinthal, C. (2002); Gray, J. (2001); MacCoun, R. and Reuter, P. (2001).

- A study by Flynn (2000) concludes that measures designed to deter cannabis use have not been effective. Corrigan (2001) rejects Flynn's arguments on the basis of the lack of comparability of the data and the assumption that use of cannabis is benign;
- Gray's (2001) publication is concerned with 'why our drug laws have failed';
- Fahrenkrug (2000) has examined the effect of the normalisation of cannabis use in Switzerland;
- Pacula et al. (2000) suggest that the impact of fines may have an impact on possession of cannabis among adults but the evidence is mixed for adolescents. However, Farrelly et al. (2001) suggest that higher fines and a higher probability of arrest for possession of cannabis decreases the probability of use among adolescents;
- Horstink Von Meyenfeldt (1996) describes the context of the introduction of and the operation of the 'coffee shops' in the Netherlands;
- Marks (1994) argues that the financial costs of cannabis law enforcement outweighs the cost of its adverse effects.

Medicinal Cannabis and the Law

In the USA 11 jurisdictions have voted to permit the use of cannabis for medical purposes (Wodak & Moore, 2002). A recent article suggests that those who use cannabis for medical purposes under sanction of US state law may still face the threat of federal prosecution under the Controlled Substances Act (Newbern, 2000).

Canada has introduced regulations allowing patients to apply for the medical use of cannabis although users are required to carry identity cards[8].

The main EU legislation on medicinal cannabis and derivatives is in the sphere of medicines and legislation. The EU legal framework regarding medicinal products for human use was codified by a Directive in 2001 (2001/83/EC). EU member states are at different stages in terms of trials, manufacture, distribution and prescription of cannabinoids for therapeutic purposes (European Monitoring Centre on Drugs and Drug Addiction – European Legal Database on Drugs, 2002b). Clinical studies are being undertaken in Germany, Netherlands, Finland, and the UK, with Belgium, France and Spain considering the matter. In Belgium, a Royal Decree of July 2001 established the legal framework for clinical trials. Finland is carrying out studies on the effectiveness of cannabinoids on glaucoma. In France, clinical trials with Marinol were due to start in September 2002.

In Germany, the law states that cannabis could be used only on the basis of authorisation for scientific or other purposes which are in the public interest. In May 1999, 60 patients participated in a trial with cannabis extract, to continue over three years.

In Italy, in early 2002, the regions of Lombardy, Umbria and Tuscany requested the national government and parliament to regulate the medicinal use of cannabis and its derivatives. A court ruling in Venice on 13 March 2002 declared that the constitutional right to health could not be limited by Italy's ban on cannabis use in the case in question. The judge ruled that the patient's use of cannabis to alleviate symptoms of terminal lung cancer should be tolerated, and the relevant medical authorities should obtain the drug abroad and provide it to the patient free of charge.

8 British Medical Journal (2001) 'Canadian doctors brace themselves as cannabis becomes legal'. Aug 11; 323 (7308): 302; 'Canada legalises the medical use of cannabis British Medical Journal (2001) Jul 14' 323 (7304): 68; 'Medical marijuana users in Canada must carry identification cards'. Lancet (2001) Jul 21; 358 (9277): 220.

The only country in the EU to establish a national agency, as required by the 1961 Single Convention on Narcotics Drugs, for the monopoly on wholesale and stock is the Netherlands. The Dutch Bureau of Medicinal Cannabis was established in September 2002. In the Netherlands, an amendment to the Opium Act in 1999 allowed clinical trials with cannabis and prescriptions.

Doctors in Norway can apply to the National Board of Health and to the Norwegian Medicines Agency for exemption to perform a controlled trial, although such applications are unknown. Also, doctors can apply for an exemption to use certain drugs in treatment if needed. Again, such exemptions are seldom applied for.

The United Kingdom, although it has licensed the growing of cannabis for medicine, has not established an agency. In the UK, cannabis can only be licensed for cultivation for the purpose of research or other special purposes. The UK government has licensed a private company, GW Pharmaceuticals, to grow cannabis and carry out clinical trials of a sub-lingual spray containing cannabis extract. These trials are due to be completed in 2004. Also, doctors can prescribe medicine based on cannabis or cannabis extracts to patients under licence from the Home Office.

The British Home Secretary, in a submission to the Runciman Committee (Ashton, 2000) stated that, should the medical testing being carried out by GW Pharmaceuticals prove successful, he would recommend to the Medical Control Agency that it should authorise use of cannabis for medical purposes. That committee recommended that, in the event of the successful completion of clinical trials and a positive evaluation by the Medicines Control Agency, the law should be changed so as to "permit the use of cannabis-based medicines".

In Ireland, in October 2002, the Minister for Health and Children announced in Dáil Éireann that the Irish Medicines Board, under the Control of Clinical Trials Act 1987 and 1990, had granted permission to a UK-based pharmaceutical company to conduct a clinical research trial at a hospital in Ireland "to determine the effectiveness of a cannabis-based medicinal extract in controlling cancer-related pain" (Drugnet Ireland, 2002). The Minister further reported that his Department had subsequently granted licences to the hospital to import, be in possession of, prescribe, supply and administer the cannabis-based extract.

Reform in this area is not without its critics. It has been argued that legalising cannabis for medicinal purposes is a 'back-door' method of legalising it for recreational purposes. However, although a number of trials appear to be showing the therapeutic benefits of cannabis, a common finding is that smoking cannabis is seen to be one of the least reliable methods of administration for therapeutic purposes, as it has a poor dosage control and a high number of pollutants (European Legal Database on Drugs, 2002b).

Conclusions

The cannabis debate has intensified in recent years with a large number of publications encouraging debate as to the merits of different approaches (Wodak et al., 2002). Strang et al. (2000) bemoan the absence of careful, objective scrutiny of the available data in policy formation. This is hampered, they suggest, "by the lack of large scale survey data in countries which have and have not changed their cannabis policies, and the lack of research on the effects of the law as it is applied rather than as expressed in statute" (ibid). The authors call for a more rational consideration of public policies

towards cannabis use by adolescents and young adults in light of the major increase in cannabis use over the past few decades.

Kilmer (2002) argues that in order to learn more about the relationship between the law and drug use in Europe, more attention needed to be given to measuring enforcement "rather than to labelling regimes as 'liberal' or 'decriminalised' or 'de-penalised' and then comparing their prevalence rates to their regimes" (p104). Most studies do not control for the level of enforcement of such laws. Little is known about the influence of the actual enforcement of such laws in Europe.

Gaps in Knowledge

A major gap in knowledge which has been highlighted in this study relates to the absence of a significant body of research in Ireland on drug markets and drug-related crime. Similarly, from the perspective of enforcement, actual arrests are not reported in the official statistics in Ireland, thus it is difficult to obtain a clear picture of the enforcement of cannabis laws here. Another major gap has to do with the actual penalties applied in the courts for possession, dealing and for trafficking offences[9].

9 For a more detailed consideration of the weaknesses associated with the available criminal justice data and an analysis of Irish drug-related research see Connolly (2004).

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Strang, J., Witton, J. and Hall, W. (2000). 'Education and Debate: Improving the quality of the cannabis debate – defining the different domains.' *British Medical Journal* 30: Jan 2000.

Trimboll, L. and Coumarelos, C. (1998). *Cannnabis and Crime: Treatment programmes for Adolescent Cannabis Use.* Source: http: //www.lawlink.nsw.gov.au/bocsar1

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Appendix I
National Advisory Committee on Drugs

Cannabis Overview – Tender Brief

Background

The National Advisory Committee on Drugs (NACD) was established in July 2000 to advise the Government in relation to the prevalence, prevention, treatment/ rehabilitation and consequences of problem drug use in Ireland, based on the analysis of research findings and information. The Committee is overseeing the delivery of a three-year work programme on the extent, nature, causes and effects of drug use in Ireland. The Committee comprises representatives nominated from relevant agencies and sectors, both statutory and non-statutory. The Committee operates under the aegis of the Department of Tourism, Sport and Recreation[10] and reports to the Minister of State responsible for the National Drugs Strategy. Further information can be obtained from the Department's website www.irlgov.ie/tourism-sport.

Commission

Prepare an overview on one or more of the following areas relating to up-to-date scientific information on Cannabis drugs which would highlight gaps in our knowledge. The areas to be covered are:

1. Pharmacotoxicological information;
2. Psychological effects on cognition, mood and mental functioning;
3. Sociological/criminological information;
4. Public Health risks: epidemiological information, physical health, mental health and dependence, performance impairment.

It is **not** expected that the reviewer(s) would base their report(s) on an evaluation of the original medico/scientific/sociological or criminological literature on Cannabis drugs, but that they would focus on the many recent international reviews, some of which are listed in Appendix 1 of the tender brief. These would need to be brought up to date by a consideration of information published since 1999.

It **is** expected that the format of the report(s) would be based on the detailed headings (attached to tender brief) set out in each of the Technical Annexes A,B,C and D of the EMCDDA's "Guidelines on Risk Assessment of New Synthetic Drugs" (ISBN - 92-9168-061-3, website http://www.emcdda.org) appropriately modified for use with Cannabis drugs of natural origin.

The NACD, at its absolute discretion, may award a contract for the complete study (parts 1-4) or for each separate component. You are therefore invited to tender for the contract to prepare the report as a whole or to tender for each component separately. The report and each of its parts must also highlight gaps in knowledge particularly as they relate to the use of Cannabis drugs in Ireland.

The report should also highlight any limitations of the evidence or bias inherent in using certain methodologies. It is important to specify where there is general agreement or disagreement with regard to the evidence.

You are not expected to give views or opinions other than those of a scientific nature based on the evidence reviewed.

Duration of Project

We expect to receive a complete and final report 3 months from the award of the contract.

Requirements

Tenderers must submit a written proposal detailing the following:

Research methodology to be employed and justification of outputs;
Project management from conception to completion with clear milestones;
Personnel involved, their credentials, use of consultants and track record; and Description of administrative and technical costs.

Evaluation of the submissions be will based on the following criteria:

Research methodology

Understanding of the project;
Understanding of the work involved;
Feasibility of the approach suggested.

Project management

Ability to deliver key outputs on time;
Clarity in description of milestones;
Credibility of personnel and consultants involved;
Track record.

Value for money

Description of cost;
Justification for proposed costs;
Best use of resources.

The standard contract terms and conditions are available from the office. The total budget available for this project is in the region of €30,000.

Closing date: 4pm Thursday 16th May 2002

You will be required to sign an FOI declaration and you must include an up-to-date tax clearance certificate with your submission.

Tenders should be addressed to:

Secretary
NACD
3rd Floor, Shelbourne House
Shelbourne Road
Ballsbridge, Dublin 4

Tel: (01) 677 0760/765; Fax: (01) 667 0828;

Email: info@nacd.ie; Web: www.nacd.ie

NOTE: TENDER RETURNS SHOULD BE MARKED: Ref: Ten/Cannabis.

Appendix 1 with Tender Document:

Scientific Information on Cannabis

Some Recent Reviews

1. Marijuana and Medicine: Assessing the science base.
   Institute of Medicine. Washington DC 1999.
   National Academy Press.

2. Marijuana: The Forbidden Medicine.
   Grinspoon, L. and Bakalar, J. B.
   Yale University Press.
   New Haven Ct. 1997.

3. World Health Organisation: Cannabis: A Health Perspective and Research Agenda, 1997.

4. House of Lords Science and Technology Committee 9th Report.
   Cannabis: The Scientific and Medical Evidence.
   HMSO London.

5. Addiction Research Foundation. The Health Effects of Cannabis.
   Toronto 1999.

6. Zimmer L., Morgan J. Marijuana Myths, Marijuana Facts: A Review of the Scientific Evidence.
   The Lindesmith Centre, New York 1997.

7. British Journal of Psychiatry. Vol. 178, February 2001.

8. Solowij N. Cannabis and Cognitive Functioning.
   Cambridge University Press,
   Cambridge 1998.

9. Addiction. Editorials (various)
   on e.g. Reproductive Toxicity;
   Mutagenicity and Carcinogenicity;
   Respiratory Symptoms;
   Dependence;
   Assessing the Public Health Burden.

10. Report presented to the International Scientific Conference on Cannabis at the initiative of the Ministers' of Public Health of Belgium, France, Germany, The Netherlands and Switzerland, led by Rodin Foundation and the Ministry of Public Health, Belgium.

Appendix 2 with Tender Document

Technical Annex A

Pharmacotoxicological Evidence

A1. Chemical, pharmaceutical information

A1.1. Chemical description (including methods of synthesis, precursors, impurities if known, type and level)
A1.2. Legitimate uses of the product
A1.3. Pharmaceutical form (i.e. powder, capsules, tablets, liquids, injectables, cigarettes. Any distinctive markings, logos, etc. to be noted)
A1.4. Route of administration and dosage (e.g. oral, inhalation, intravenous, etc.)

A2. Toxicology and pharmacology in animals

A2.1. Pre-clinical safety data
- A2.1.1. Single-dose toxicity
- A2.1.2. Repeated-dose toxicity
- A2.1.3. Reproduction function
- A2.1.4. Embryo-foetal and perinatal toxicity
- A2.1.5. Mutagenic and carcinogenic potential

A2.2. Pharmacodynamics

- A2.2.1. In vitro tests (data from enzyme, receptor-binding, immunomodulatory and hormonal tests)

- A2.2.2. In vivo tests
  - Effects on central nervous system
  - Effects on cardiovascular system
  - Effects on respiratory system
  - Effects on gastrointestinal system
  - Effects on liver, kidneys, genito-urinary system
  - Behavioural studies

- A2.2.3. Pharmacokinetics in animals
  - Absorption
  - Distribution
  - Metabolism (including major metabolising enzymes and metabolites)
  - Excretion (including elimination half-life)
  - Pharmacokinetic interactions

A3. Human pharmacology

A3.1. Laboratory studies in volunteers
- A3.1.1. Effects on cognition and behaviour
- A3.1.2. Cardiovascular effects
- A3.1.3. Respiratory effects
- A3.1.4. Gastrointestinal effects
- A3.1.5. Effects on liver, kidneys, genito-urinary system
- A3.1.6. Effects on immune system
- A3.1.7. Interactions with other drugs and medicines
- A3.1.8. Effects on ability to drive and use machinery
- A3.1.9. Effects of overdose

A3.2. Pharmacokinetics in humans
- A3.2.1. Absorption
- A3.2.2. Distribution
- A3.2.3. Metabolism (including major metabolising enzymes and metabolites)
- A3.2.4. Excretion (including elimination half-life)
- A3.2.5. Pharmacokinetic interactions

A4. Clinical experience

A4.1. Studies on street users

A4.2. Dependence potential in humans
- A4.2.1. Tolerance
- A4.2.2. Abstinence symptoms
- A4.2.3. Drug-seeking behaviour

A4.3. Clinical safety

Technical Annex B

Psychological Risk Assessment (cognition, mood and mental functioning)

B1. Acute effects

B1.1. Effects on cognitive functioning (neuropsychological assessment)
B1.2. Effects on intelligence (multifactorial intelligence tests)
B1.3. Effects on emotional status, behavioural patterns and personality (psychological instruments, rating scales)
B1.4. Effects on psychopathological status/psychiatric comorbidity (psychological and psychiatric assessment)

B2. Chronic effects

B2.1. Effects on cognitive functioning (neuropsychological assessment)
B2.2. Effects on intelligence (multifactorial intelligence tests)
B2.3. Effects on emotional status, behavioural patterns and personality (psychological instruments, rating scales)
B2.4. Effects on psychopathological status/psychiatric comorbidity (psychological and psychiatric assessment)

B3. Psychological effects of drug-using careers

B4. Psychological factors that increase the probability of harm (e.g., mood and anxiety conditions leading to self-medication, sensation seeking)

Technical Annex C

Sociological/Criminological Evidence

C1. Social consequences for the user

C1.1. Primary relations and/or family problems
C1.2. Education and employment problems
C1.3. Marginalisation

C2. Consequences on the social behaviour of the user

C2.1. Drug-related disorderly conduct
C2.2. Drug-related acquisitive crime
C2.3. Drug-related violence
C2.4. Drug-related traffic offences

C3. Other social consequences

C3.1. Presence or absence of major value conflicts surrounding the use of the drug
C3.2. Implications for social institutions (school, labour, recreational, etc.) and community services

C4. Wholesale production and distribution

C4.1. Violence in connection with wholesale production and distribution
C4.2. Money-laundering aspects
C4.3. Involvement of (international) organised crime

C5. The retail market

C5.1. Non-commercial 'private' consumption market among users
C5.2. Semi-public subcultural consumption market (discos, etc.)
C5.3. Existence and characteristics of street markets
C5.4. Violence, public order and nuisance implications of the retail market
C5.5. Entrepreneurial criminal suppliers

C6. Social factors that increase the probability of harm

Technical Annex D

Public Health Risks: Epidemiological Evidence

D1. Availability and quality of product on the market

D1.1. Availability at consumer level (extent/quantities)
D1.2. Sources (at consumer level)
D1.3. Trends in availability
D1.4. Average dose and degree of variability
D1.5. Purity levels and presence of adulterants
D1.6. Other active ingredients
D1.7. Typical prices and range

D2. Knowledge, perceptions and availability of information

D2.1. Availability of scientific information on product
D2.2. Availability of information on effects of product
D2.3. Level of awareness of product amongst drug consumers in general
D2.4. Level of knowledge of product, effects and perceptions among consumers of product
D2.5. General population

D3. Prevalence and patterns of use

D3.1. Extent of use of product
D3.2. Frequency of use
D3.3. Route(s) of administration
D3.4. Other drugs in combination with product
D3.5. Geographical distribution of use
D3.6. Trends in prevalence and patterns of use

D4. Characteristics and behaviour of users

D4.1. Age and gender of users
D4.2. Social groups where product available/used
D4.3. Risk behaviours associated with use
D4.4. Special concerns about vulnerable groups
D4.5. Trends in characteristics/behaviours of users

D5. Indicators of health consequences

D5.1. Hospital emergencies
D5.2. Deaths (direct and indirect)
D5.3. Traffic accidents
D5.4. Requests for treatment/counselling
D5.5. Other health indicators

D6. Context of use

D6.1. Risk factors linked to circumstances and rituals of consumption

D7. Implications for the non-using population

Appendix II

Members of the Consequences Sub Committee of NACD as of June 2004

Chairperson

Ms Anna Quigley, Citywide

Members

Dr Mary Ellen Mc Cann, Voluntary Drug Treatment Network

Dr Hamish Sinclair, DMRD
Supt Finbarr O'Brien, Garda National Drug Unit
Dr Derval Howley, NDST
Dr Eamon Keenan, Consultant Psychiatrist
Dr Desmond Corrigan, School of Pharmacy, Trinity College
Mr Barry O'Connor, Dept of Justice, Equality and Law Reform
Mr John Kelly, Dept of Community, Rural and Gaeltacht Affairs
Mr Tony Geoghegan, IAAAC

Appendix III
NACD Membership as of June 2004

Chairperson
Dr Des Corrigan, School of Pharmacy, Trinity College

Vice Chairperson
Dr Mary Ellen McCann, Voluntary Drug Treatment Network

Members
Dr Joe Barry, Eastern Regional Health Authority
Mr Willie Collins, Southern Health Board
Mr Tony Geoghegan, Irish Association of Alcohol & Addiction Counsellors
Dr Derval Howley, National Drugs Strategy Team
Dr Eamon Keenan, Consultant Psychiatrist Eastern Regional Health Authority
Mr David Moloney, Department of Health & Children
Supt Barry O'Brien, Garda National Drugs Unit
Mr Liam O'Brien, Community Sector
Mr Barry O'Connor, Department of Justice, Equality & Law Reform
Dr Máirín O' Sullivan, Department of Education & Science
Ms Anna Quigley, Community Sector
Dr Hamish Sinclair, Drug Misuse Research Division, Health Research Board
Ms Kathleen Stack, Drugs Strategy Unit, Department of Community, Rural & Gaeltacht Affairs

Chairpersons of the sub-committees

Consequences	Ms Anna Quigley
Early Warning/Emerging Trends	Mr David Moloney
Prevalence	Dr Des Corrigan
Prevention	Dr Mary Ellen McCann
Treatment	Dr Eamon Keenan