

Drinking and Marijuana

KEY POINTS

- Marijuana is the third most prevalent psychoactive substance consumed around the world, after alcohol and tobacco, according to the United Nations Office on Drugs and Crime.
- Over recent years, there have been various efforts to decriminalize or legalize the medical and even the recreational use of marijuana, which has implications for substance abuse and health outcomes, including harmful drinking.
- Like other psychoactive substances, prolonged use of marijuana over time is associated with dependence and has potentially serious implications for the mental health status of young people.
- The relationship between alcohol consumption and marijuana use has been debated, although its exact nature is still relatively unexplored. One of the main issues relates to whether or not alcohol and marijuana are substituted for one another or are used as complements. This is difficult to research since marijuana is illegal in most countries and has only recently been legalized in some countries / states.
- Policy decisions around marijuana should take into account emerging evidence on its effects, but also its relationship with other substances. Similarly, alcohol policies, particularly where marijuana is more easily accessible, should also address potential interactions.

TERMS AND CONCEPTS

Marijuana is derived from the Indian hemp plant *Marijuana sativa*. The main active ingredient of marijuana is Δ -9 tetrahydrocannabinol (THC), which has a relaxing and mildly euphoric effect.

Legalization entails the total removal of legal penalty for specified drug use, possession, or sale, whereas **decriminalization** entails the relaxation of legal penalty for offenses, such as the ruling out of incarceration or the omission of offenses from a criminal record.

Substitution occurs when two substances are used interchangeably, and changing the availability of one (e.g., through regulation or deregulation) changes demand for the other in the opposite direction. Therefore, if marijuana and alcohol are substitutes, legalizing marijuana (thereby increasing its availability) would reduce the consumption of alcohol.

TERMS AND CONCEPTS (CONTINUED)

Complementarity assumes that two substances are used together, and thus changes in the availability of one is likely to drive the use of the other in the same direction. In the case of alcohol and marijuana, this hypothesis suggests that the two are used together to heighten desired effects or to manage undesirable effects. Therefore, if marijuana and alcohol are complements, legalizing marijuana would increase its consumption and also the consumption of alcohol.

BACKGROUND

Marijuana is the third most prevalent psychoactive substance consumed around the world, after alcohol and tobacco, according to the United Nations Office on Drugs and Crime [2].

- According to the World Health Organization, 3.8 percent of the world's population consumes marijuana [2].

As with other psychoactive substances, prolonged and regular use of marijuana can lead to dependence or addiction.

- According to the U.S. National Institute on Drug Abuse (NIDA) [3], nine percent of individuals who use marijuana will become dependent [4, 5].
- Seventeen percent of those who begin regular marijuana use in adolescence are likely to become dependent, and the number increases to 25 - 50 percent among daily users [6, 7].

In the majority of countries around the world, marijuana is a controlled and illegal substance. However, over recent years, some jurisdictions, including countries, have legalized or decriminalized the medical, and in some cases even the recreational use of marijuana.

- In the Netherlands, marijuana has been legalized in certain settings and decriminalized in others.
- Similarly, 3 territories in Australia (Australian Capital Territory, South Australia, and the Northern Territory) have decriminalized offenses involving small amounts of marijuana, although its use, possession, and sale remain officially illegal across the country.
- In the United States, 21 states and the District of Columbia have legalized the use of medical marijuana. Although it remains illegal under federal law and in most states, private recreational use of marijuana has been legalized in the states of Alaska, Colorado, Oregon, and Washington. In the District of Columbia possession is legal for individuals over 21 years of age, although sales and taxation of marijuana remain illegal.
- In December 2013, Uruguay became the first country to fully legalize the possession, sale, distribution, and cultivation of marijuana with some restrictions on quantity, user age, and setting.

Legalization and decriminalization of marijuana are likely to have an impact on perceptions around its use, which are already changing.

- In the United States, for example, levels of disapproval of marijuana use have been declining among all age groups in tandem with decriminalization and legalization. Whether changing attitudes are the direct result of legal changes or have given impetus for them (or a combination of both) is difficult to ascertain [8, 9].

The influence of the media in shaping public opinion on marijuana has also been highlighted.

- One study from the United States, suggests a causal link between media coverage and opinion of marijuana among adolescents. According to this study, negative media coverage of marijuana was correlated with subsequent increases in adolescent abstinence and disapproval of marijuana [10].

Marijuana use and alcohol consumption

Marijuana use is most common in North America, Western Europe, and in Australia and New Zealand, and least common in Asia [11-13]¹.

- In the United States, there has been a modest increase in marijuana use in recent years [14].
- There is evidence that in Western and Central Europe the use of marijuana has been stable or has even declined over recent years [13].
- In Asia, a recent increase in marijuana use has been reported, although concrete data in support of this claim are lacking [13].
- Reports from Australia show stable levels of marijuana use over recent years [12].
- Information available on marijuana use in Africa is limited [13].

Among adolescents in the United States and Europe, marijuana is the most commonly used illicit substance, and rates of adolescent use have remained stable over the past decade [15-17]

- Levels of marijuana use are higher among adolescents in the U.S. than among their European counterparts, even though alcohol and tobacco consumption among teens is lower in the U.S. than in Europe. [16, 18, 19].
- In the U.S. and in Europe, alcohol consumption and marijuana use are both more prevalent among boys than girls, but while this gender gap is closing for alcohol, it persists for marijuana use [16, 18].

Research on the relationship between socioeconomic status (SES) and consumption levels for both marijuana and alcohol has been mixed.

- Some studies have suggested that adolescence is a time of relative health equity in terms of substance use, with no clear pattern of associations between SES and current alcohol or marijuana use. This may be due to the growing importance of peer influence during adolescence as opposed to family influence [20].
- However, there is also some evidence to suggest that children who grow up with a lower socioeconomic background are more likely to engage in drug use, primarily marijuana use, in adulthood than their counterparts of higher SES [21]. By contrast, there is little evidence for a correlation between lower childhood SES and subsequent alcohol use [21, 22].
- Among adults, a number of indicators of SES are correlated with both drinking and marijuana use. For instance, adults are less likely to drink heavily or to use marijuana if they have higher levels of education, are professionals, and have no recent history of unemployment [23].

SUMMARY OF THE EVIDENCE

Mechanisms of action

The psychoactive effects of marijuana occur through the action of active ingredient tetrahydrocannabinol (THC) on the cannabinoid system.

- THC acts through two types of cannabinoid receptors, CB₁ and CB₂ that are part of the body's endogenous cannabinoid system. These receptors are found in different tissues and organs of the body, and account for the various effects of marijuana.
- High densities of CB₁ receptors are found in areas of the brain associated with motor activity, motor coordination, short-term memory, cognition, appetite, and sedation. The mood enhancing effects of marijuana are also mediated through the CB₁ receptor, as is the negative dysphoric response some individuals experience [24]. This type of receptor is also present in the lungs, liver, and kidneys.
- CB₂ receptors are found in immune cells and the lymphatic system involved in immune function and inflammation [25], explaining marijuana's potential usefulness for pain management [26].

1. In Africa a lack of quantitative information prevents accurate estimates of marijuana use [13]. United Nations Office on Drugs and Crime (UNODC). (2015). *World Drug Report 2015*. Vienna: Author. Retrieved from https://www.unodc.org/documents/wdr2015/World_Drug_Report_2015.pdf

The mechanism and kinetics of action of THC are different from those of ethanol. Depending on the mode of ingestion and potency of the particular marijuana strain, THC enters the blood stream within seconds or minutes. Its effects on the brain are observed immediately.

- While ethanol and its metabolites are cleared from the body by the liver within hours of ingestion, depending on the quantity of alcohol consumed, THC levels reach a peak in the first 1-2 hours, but remain detectable in the body for weeks [27, 28].
- Unlike ethanol, THC accumulates in fatty tissues, reaching its peak concentrations within 4-5 days after inhalation [29].

Health outcomes

There is ample evidence of the association between alcohol consumption and both positive and negative health outcomes, modulated by the level and pattern of consumption, and a range of additional factors [30-33] (Also see [IARD Health Reviews](#)).

Both beneficial and detrimental outcomes have also been described for marijuana use [6, 25, 34-40], and are summarized in Table 1.

The combination of marijuana with other substances (e.g., alcohol, nicotine, sedatives, hallucinogens) may enhance either its sedative or euphorogenic effects. Such combinations are associated with separate risks and may increase complications [35].

- While chronic smoking of marijuana has been shown to be a risk factor for various lung conditions, including chronic bronchitis and chronic obstructive pulmonary disease (COPD) [41], there is also a synergistic effect on lung conditions of smoking of marijuana and tobacco [42].
- Marijuana also contains some carcinogens, but further research is needed on the relationship between marijuana use and lung cancer [43].

The health effects of marijuana on young people are particularly problematic because of critical neurological development that occurs during adolescence.

- Adverse neurocognitive effects and psychosocial outcomes of marijuana use have been described, although there is some disagreement about these findings. Studies have shown structural and functional alterations in the brains of adolescents following chronic marijuana use [45]. Early initiation of marijuana use is correlated with poor cognitive performance [46], likeliness to engage in risky behaviors, and a lower orientation towards achievement in their late 20s (e.g., reading level, math level, and attention span) [49].
- A longitudinal study of a cohort from New Zealand showed a neuropsychological decline, with lower IQ, into middle age among individuals using marijuana from childhood and adolescence [47]. Cessation of marijuana use did not reverse these deficits.
- A review of longitudinal studies has described a consistent association between adolescent marijuana use and lower educational attainment and use of other drugs [48].
- Impairments to critical thinking and memory while using marijuana have been described, as well as lingering effects resulting from delayed clearance of THC and its metabolites from the brain [50].

There has been some discussion of whether these negative psychosocial outcomes are the direct effect of marijuana use on neuropsychological functioning, or whether they may be social rather than biological in nature, or the result of other, independent variables that have not been adequately controlled in research studies [48].

There is now a well-established relationship between marijuana use in adolescents and mental illness.

- Research into the association with schizophrenia has shown an association with earlier onset among adolescents using marijuana [51, 52].
- However, in adolescents not diagnosed with schizophrenia, marijuana use is correlated with cognitive decline, while this is not the case among adolescent schizophrenics [53]. In fact, some studies find that among adolescent schizophrenics, marijuana use is associated with improvements in cognition [52].

TABLE 1: HEALTH OUTCOMES ATTRIBUTED TO MARIJUANA

Adapted, where noted, from Greydanus, D. E., Hawver, E. K., Greydanus, M. M. [35] and [44]

Potential Benefits	Potential Adverse Effects
Remedy for: <ul style="list-style-type: none"> • Inflammation • Pain (including chronic and neuropathic pain) • Diarrhea (e.g., in Crohn's disease) 	Addiction <ul style="list-style-type: none"> • Physiologic • Psychological
Treatment of: <ul style="list-style-type: none"> • Dystonia • Multiple sclerosis • Rheumatoid arthritis • Glaucoma • Emesis due to chemotherapy • Treatment for epilepsy • Huntington's disease 	Withdrawal syndrome Tolerance (with heavy use) Neuropsychiatric disorders <ul style="list-style-type: none"> • Anxiety, hallucinations, violent behavior, depression, and fear • Linkage with schizophrenia • Precipitation of psychosis or depression
Improvements of excessive thinness (e.g., in AIDS patients)	Amotivation syndrome (loss of interest)
Management of inflammatory bowel disease	Flu-like reaction
Beneficial effect on atherosclerosis	Cough, bronchospasm, and bronchitis
Reduction of brain infarct size	Amenorrhea
Blockage of negative memories in PTSD	Immunologic dysfunction
Reduction of cardiac reperfusion injury	Increased risk of cardiovascular disease for middle aged users [44]
Adjuvant treatment for prostate carcinoma	Use of other illicit drugs [44]
	Increased risk of cognitive impairment and psychosis in adulthood for regular adolescent users [44]

Alcohol consumption and marijuana use: Substitution or complementarity?

Given the largely illegal nature and role of marijuana in most societies, the dynamics of consumption and relationship with other substances, such as alcohol, has not been well studied. One key question is whether the two substances are substitutes for one another or are complements (see Terms and Concepts).

The majority of the existing literature suggests that the two are substitutes; in other words greater access to marijuana is likely to reduce the consumption of alcohol, and vice versa [54-60].

- Results from natural experiments where restrictions were placed on alcohol availability generally support the substitution proposition [56, 61].
 - For example, a study of the impact of raising the legal purchase age limit for alcohol from 18 to 21 in the United States showed a 4.5 percent decrease in alcohol consumption and a 2.4 percent increase in marijuana consumption [56].
- Studies using longitudinal data on consumption, demand and / or price suggest that the decriminalization of marijuana is associated with a decrease in the consumption of alcohol, providing further evidence for substitution [55, 59, 62].
- A substitution relationship has also been supported by modeling studies [63].

However, there is also another, albeit smaller body of evidence that suggests a complementary relationship between alcohol and marijuana in which the increased availability of marijuana would be expected to lead to an increase in alcohol consumption [64, 65].

- Evidence invoked in support of this hypothesis is that the combined consumption of alcohol and marijuana is the most common form of poly-substance use in the U.S. [66].
- A similar study on European adolescents concluded that most young people who smoke marijuana do so in combination with alcohol [65].
- One U.S. study found that campus bans on alcohol are associated with a lower probability of both alcohol and marijuana use among university students [64].

A recent review of available research studies has shown that marijuana and alcohol can be both complements and substitutes.

- According to the author, longitudinal studies of young people support complementarity, while general population studies point to substitution. In addition, examination of subgroups reveals that the relationship may also differ across gender and race [67].

Marijuana and road traffic safety

The contribution of alcohol to road traffic crashes has been well described and is well understood, with regulations and prevention measures in place to reduce harmful outcomes around the world. However, research on marijuana-related crash risk is less robust than that on alcohol. Consequently, a consensus has yet to emerge for the road traffic crash risk associated with marijuana use.

The risk for road traffic crashes increases exponentially with alcohol consumption.

With regard to marijuana use, however, conclusions are less clear. A number of studies have reported that acute marijuana use is associated with a significantly increased crash risk.

- Three recent systematic reviews find that marijuana use is associated with a two-fold increase in crash risk compared to risk for drivers who have not been using marijuana [68-70].

Other studies have challenged the relationship between marijuana use and road traffic crashes, finding fault with the methodology of previous research.

- One recent review states that much of the literature on marijuana crash risk suffers from publication bias, and found that when publication bias was accounted for estimates of risk were decreased [71].
- Another recent study has suggested that crash risk disappears altogether once other factors are taken into account including age, gender, ethnicity, and alcohol concentration level [72].

Even if more research is needed on the relationship between marijuana use and road traffic crashes, it is well understood that marijuana use impairs motor function.

- A 2004 review by the U.S. National Highway Traffic Safety Administration (NHTSA) of the effects of marijuana in relation to road traffic safety offers a list of impairments that are closely related to the ability to drive a motor vehicle or undertake other similarly complex motor tasks: decreased car handling performance, increased reaction times, impaired time and distance estimation, inability to maintain headway, lateral travel, subjective sleepiness, motor incoordination, and impaired sustained vigilance [73].

There is some evidence that marijuana users may overcompensate for their perceived impairment, making an effort to improve performance. However, compensation appears to be less effective at higher doses, for longer periods of time, and for more complex or unpredictable tasks [73, 74].

Studies have shown that impairment associated with marijuana consumption increases significantly when marijuana use is combined with alcohol consumption [50, 70, 73-75].

It is important to note that there is no equivalent for marijuana to the blood alcohol content (BAC) scale used to measure impairment with regard to drink-driving [76]. While different BAC levels are well correlated with physiological effects and behavioral outcomes, no such definitions exist for marijuana, making it difficult to assess the relationship between use and risk for road traffic crashes.

METHODOLOGICAL CONSIDERATIONS

Systematic research on the epidemiology of marijuana use and various related health and social outcomes is still in its infancy. As in other areas of research a number of other factors can influence observed relationships. Some of these are methodological and should be taken into consideration when interpreting results.

Confounding:

Confounding variables can obscure the true nature of the relationships between drinking or marijuana and health outcomes.

- Smoking tobacco is an important confounding variable for relationships between health outcomes and both marijuana use and alcohol consumption, since tobacco is often consumed in tandem with alcohol and/or marijuana.
- Other potential confounders specific to marijuana include socioeconomic status, mental health, and personality traits.

Underreporting of Consumption:

Underreporting of consumption is a central concern of alcohol-related research. It is well established that survey respondents often underestimate their alcohol consumption. The magnitude of underreporting varies by respondent, context, and the approach used to measure consumption. As with alcohol, underreporting is also a concern in research on marijuana use, especially in jurisdictions where marijuana use is illegal and respondents may be reluctant to accurately report their consumption.

FINAL REMARKS

Given that marijuana use is illegal in most countries in the world and that its legal use has until recently been confined to specific subpopulations, for example, cancer patients, the full impact of marijuana use on health and social outcomes still needs to be fully described. Further research is required for a full understanding of patterns of marijuana use among different demographic groups, and its impact on health and societal outcomes.

The legalization of marijuana in some jurisdictions offers natural experiments for studying these relationships, as well as the interactions between marijuana use and alcohol consumption. The full societal impact of these changes still remains to be understood, as does the potential cross-policy impact of measures.

From a policy perspective, however, the legalization of marijuana poses a particular challenge. Given the potential for harm associated with marijuana use, a regulatory framework is needed to help prevent adverse outcomes. At a minimum, measures are required to safeguard young people by setting legal age limits for purchase and use. Given the effect of marijuana on motor function and skills required for driving, policies around blood THC concentration and thresholds for driving and other activities also need to be considered.

Attention should also be given to the development of mainstream prevention programs to address misuse and abuse of marijuana, its potentially differential effect on groups of users, and the need for targeted interventions and their integration with existing interventions, including those around alcohol.

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IARD
INTERNATIONAL ALLIANCE FOR
RESPONSIBLE DRINKING
action on alcohol and global health

The International Alliance for
Responsible Drinking (IARD)
The Jefferson Building
1225 19th Street NW, Suite 500
Washington, DC 20036

Phone: 1.202.986.1159
Fax: 1.202.986.2080
Email: info@iard.org
Web: www.iard.org