

## Marijuana and Youth – Research Brief

### Introduction

Public opinion and policy on marijuana in the United States is changing. In just three years, Colorado, Washington, Oregon and Alaska have legalized recreational marijuana. Several more states are considering legislation or ballot initiatives in 2016. Twenty-three states and the District of Columbia have legalized medical marijuana. Nineteen states and the District of Columbia have decriminalized small amounts of marijuana for recreational use. The federal government has shown leniency around enforcement of the federal law around marijuana by ordering U.S. attorneys to refrain from prosecuting states in federal legal issues involving marijuana. Public opinion has largely moved towards the belief that marijuana is harmless and favors reform of some sort.

Following the rest of the country, Connecticut has seen changes in our own landscape around marijuana. In 2011, CT decriminalized ½ ounce or less of marijuana for personal use. In 2012, CT legalized medical marijuana for adults over the age of 18 with certain health conditions. While recreational marijuana has not yet come to the state legislature for a vote, there is speculation that a bill may be raised in the near future. Public opinion follows that of the rest of the country, with a prevailing attitude, particularly among youth, that marijuana is harmless and misperception that it is legal. Data from the 2013 Connecticut School Health Survey, Youth Behavior Component shows that marijuana use has increased or remained at steady levels in recent years:

- 42.1% of youth report to have ever used marijuana in their life, up from 39.6% in 2011
- 7.0% of youth report to have used marijuana before the age of 13
- 26.0% of youth report to have used marijuana at least once in the last 30 days

It is without question that policy on marijuana within the United States will continue to be challenged, and that public opinion will continue to shift. It is of vital importance that prevention experts, legislators, and policy makers take the state's youth into consideration when enacting any policy or consider any prevention measures. Overwhelming evidence supports the idea that marijuana has a significant negative impact on the health and wellbeing of both young people and adults. The information that follows in this brief supports the idea that for youth, the negative effects of marijuana on physical, mental, and social development, particularly in the critical period of human development, is substantial. It is the opinion of The Governor's Prevention Partnership that marijuana for recreational use should remain illegal in the state of Connecticut.

### Evidence-Based Research on Marijuana & Youth

There is an immense volume of scientific research involving the effects of marijuana on humans stretching back almost 50 years. If we were to report on every piece of research the value of this document would be

lost. As a disclaimer, we note that The Partnership has no hidden motives or biases involving the findings of these research. We have reviewed and consolidated an extensive amount of the applicable research for the purpose of doing exactly what the research naturally intends to do; provide objective, observational findings and implications based solely on the evidence and validity of the experiments themselves. The Partnership possesses more archival data than is presented here. It is highly recommended to refer to the official literature articles to obtain more elaboration, support, and knowledge on any specific policy and health questions that may arise when determining a formal stance on any respective portion of the policy issue. Most, but not all of the research presented supports the idea that marijuana is harmful to youth because: 1) Marijuana has shown to contribute to abnormal alterations of the physical brain, 2) Marijuana has shown to negatively affect cognitive functioning and educational attainment, 3) Marijuana can contribute to depressive and addictive symptoms, and, 4) All these observations are strengthened by the age at which adolescents initiated use.

### *Research from a Neurological Perspective*

Smoking marijuana during the developmental period of the brain commonly referred to as the period of “neuromaturation” has been associated with structural brain abnormalities and a deprivation of white matter compared to healthy non-smoking individuals. This period of neuromaturation is not explicitly defined in years but has a consistent label of approximately 13-24 years in age. It is a period marked by development and functionality of areas of the brain that are directly linked to higher order functioning such as memory, strategic planning, decision making, executive function, and impulsive and inhibitory control. The key understanding from **all of** the research to follow is that the **age of onset**, or, the time at which an individual first ever smokes and continues to smoke marijuana has observed to have a significant negative impact on human health, especially the brain’s development. As you continue to absorb the research it will become evident how the evidence substantiates itself in this overlapping nature.

“Long-term, heavy use of marijuana has been linked to long-term changes in the structure of the brain, including the hippocampus, prefrontal cortex, and amygdala.” These areas of the brain are involved in memory, information processing, and other neurocognitive performances (Arria, Bugbee, O’Grady, & Vincent, 2015).

Within neurology, **fractional anisotropy levels** (FA levels) are a common measurement for assessing the integrity of white matter within the brain via brain scanning technology. Using this measurement along with a standardized measurement of **impulsivity** (how in control one is with both positive and negative trait factors of their impulsiveness), this study found two valuable associations:

- 1) When the marijuana smoking participants were divided into ‘those who started smoking regularly before age 16’ and ‘those who started smoking after age 16’, data analysis presented a significant correlation between the age of onset and FA levels within participants. Suggesting that earlier onset of marijuana use is associated with lower white matter integrity in the brain (Dahlgren, Gruber, Lukas, & Sagar, 2014).

A concurrent finding which strengthens the suggested association from #1 is that:

- 2) Self-reported impulsivity scores of only the marijuana smoking participants showed an inverse correlation with their FA levels. Meaning that those with lower FA levels reported higher standardized scores of impulsivity with “higher impulsivity scores significantly associated with lower FA in both the left and right genu of early onset smokers” (Dahlgren et al., 2014).

In summary, FA levels, which signify the quality of brain matter that contributes to higher order functioning in the human brain, were found to be significantly lower within individuals who started smoking marijuana prior to age 16. These same individuals concurrently self-reported higher impulsivity scores. Being highly impulsive is unbeneficial to self-control, healthy decision making, and points to high risk groups for general health behaviors. Together, this research supports the hypothesis of marijuana being a negative contribution to mental cognition and behaviors via white matter alterations in the brain.

Using a more comprehensive methodology in terms of brain scanning measurements, this last study observed structural abnormalities within a sample of 18-25 year olds within the regions of the brain that deal with reward/aversion control. These regions of the brain are considered to be the neurological epicenter of addictive behaviors. A valuable contribution from this study is the **trend-level** evidence that the brain alterations observed occurred on an **exposure-dependent** level; meaning the more joints smoked, the greater the morphological change observed (Blood et al., 2014).

### *Research from an Educational & Cognitive Perspective*

A fair portion of scientific research is incapable of claiming a cause and effect relationship. In the lens of marijuana and its health effects, this is certainly the case. There are always other variables that play a role and contribute to the end results and it is ideally the goal of research to rule out these variables through experiments or statistical analysis. In this section, each piece of literature factors in many other intermediate variables which could play a role in the health effects of marijuana. The obstacle of unknown and unforeseeable variables is an expected limitation in research but it can also, in this case, provide knowledge to other factors that marijuana may interact with or contribute to in the life of an adolescent. A brief example of this would be testing the relationship between marijuana dependency and depression to only afterwards observe that those who use marijuana were potentially more likely to use marijuana because of their predisposed depressive symptoms instead of demonstrating depressive symptoms because they smoked marijuana. The strength in understanding from this section and the rest to follow resides in the fact that each research took conceptual and statistical steps at isolating potential intermediate variables in order to strengthen the validity of the research, or, to suggest plausible explanations in their findings and provide support for future research.

The first study looked at marijuana use in college, grade point average (GPA), and the length of time it took to get to graduation and observed that: Within a population of over 1,000 students, a statistically significant relationship resulted in the rate of frequency of marijuana use having a negative association with the rate of change of GPA (Arria, 2015). If you imagined a line graph; those who increased their frequency of smoking marijuana over a period of time also experienced a direct decrease in their GPA's over time. Also, "Baseline marijuana use frequency during the first year of college had an enduring effect on delaying graduation several years later." The frequency at which a participant used marijuana at the start of college predicted the delay on their graduation years later (Arria, 2015).

Another study focusing on educational attainment utilized a longitudinal method of research where they followed a sample of youth aged 14-22 years old from 1979-2002 and looked at how both marijuana frequency (in a period of time, how often you smoked) and persistency (how long of a period of time you smoked at all) contributed to 'years of educational attainment achieved by mid-life'. The sample of this study may be a few generations old but the strength remains in the large representative sample of the population from which it was taken and the many known intermediate variables that were controlled for within the

research. After controlling for known variables associated with education attainment (gender, ethnicity, parent education, socioeconomic status, parent employment, subject employment, religion, marijuana trafficking, age of first marriage, age of first child birth, and geographical location) the study found that:

- 1) Those who used marijuana “very often”, but who did not persistently use over the course of their life, still reported lower educational attainment compared to those who “rarely or never used”
- 2) Those who used marijuana “very often” throughout the course of the study (23 years) reported even lower educational attainment compared to those who used only in adolescence
- 3) Participants who reported using marijuana through the length of the study (23 years) reported experiencing an average two-thirds of a year less educational attainment than nonusers even when the variable “frequency of use” was held constant (Ryan, 2010).

A similar longitudinal study chose to observe the reverse side of the issue involving marijuana and educational attainment. Instead of looking at how marijuana affects years of education, the research directed its focus on how marijuana use contributes to neuropsychological decline based on the premise of years of education. Years of education attained is a common covariate used to explain the link between marijuana use and neuropsychological decline and this study found within a large cohort of individuals from birth to age 38 “that cannabis associated neuropsychological decline did not occur solely because cannabis users completed fewer years of education” (Ambler et al., 2012).

A unique strength to this study was the ability for the research to observe the neuropsychological condition of the marijuana users within the sample **before** they ever used marijuana. By obtaining sample data on their neuropsychological state prior to marijuana use it provides support that premorbid neuropsychological deficit cannot always be a valid explanation for the relationship between consistent marijuana usage and later neuropsychological decline (Ambler et al., 2012).

Many studies have also found valuable observations differentiating marijuana with cognitive performance. For this study specifically, the research looked at how **age of onset** of marijuana smoking and **executive function** related to each other. (Within the official article multiple other studies are cited with having very similar findings but it is important to note the sample size of this research is small and thus a limitation to the generalizability of the results)

- 1) Individuals who started smoking marijuana regularly prior to the age of 16 performed significantly more poorly than healthy non-marijuana smoking controls on multiple measures of cognitive performance
- 2) Previous findings from citations #15, #26, and #48 (within the formal article) substantiate the current findings in this research which continues to suggest that earlier and regular onset of marijuana is associated with weakened inhibitory control
- 3) Within the sample: Early onset smokers smoked twice as often (frequency) and almost three times as much (magnitude) marijuana per week compared to their late onset counterparts
- 4) Significant task performance differences between early and late onset groups were observed even after controlling for frequency and magnitude of current marijuana use which suggests the importance of neuromaturation and the “critical period” (Dahlgren, Gruber, Kathryn, Lukas, & Racine, 2012).

The following research citation does not necessarily support the idea of marijuana effecting our cognitive performance. While also limited in sample size, this research observed that there were **no** significant cognitive differences between multiple different groups of individuals (abstinent adolescents with prior cannabis use disorder [CUD], adolescents with psychiatric disorders, and healthy controls). The value this study has is no less than the others provided. It demonstrates that research on marijuana, while structured and many times strongly valid within the paradigm, is still controversial in some aspects. It also demonstrates that The Governor's Prevention Partnership tries to remain as objective as possible. And finally, it highlights the importance of youth prevention and early intervention. The adverse side effects are both preventable and treatable the earlier they are stopped and the later on they are initiated (Bellis, Hooper, & Woolley, 2014).

### *Research from a Psychiatric Perspective*

Adding to the recursive nature of the literature, one study observed some fascinating data involving white matter and depression in adolescents. The primary findings from the study revealed that "Marijuana use and white matter volume were additive and interactive in predicting depressive symptoms among adolescents" (McQueeney, Medina, Nagel, Park, & Tapert, 2007). This means that the combined variables of the participant's marijuana usage and measured white matter volume statistically predicted their level of depressive symptoms. A key strength to this observation is that the sample of adolescents did **not** pass the criteria for past or current depressive disorder, therefore allowing the research to rule out these results as confounded by influences from mood disorders or psychiatric medications.

Additionally, it is commonly challenged among the relevant literature whether depressive symptoms and smaller white matter volume are an effect of increased marijuana usage or if those predisposed to depressive symptoms and white matter abnormalities are more prone to using marijuana. Regardless of which it is, the literature is consistent in one simple regard: regular marijuana users have been empirically observed to have heightened depressive symptoms compared to healthy controls.

In a previously mentioned study, a secondary finding was observed to correlate significantly, and to a moderate degree, with relapse within its sample group of CUD adolescents. The experiment utilized a wide range of neurocognitive batteries including areas of verbal and visual memory recall, attention, inhibition, reaction times, working memory, and executive function. From the data results of these tests the research found that "lower overall neurocognitive function was associated with younger age of onset of regular cannabis use and relapse within the 1 year follow-up" of the experiment (Bellis et al., 2014). From this we see a continued observational suggestion towards early intervention and suggestions towards high risk groups of marijuana users.

### *Research from a Perception-Based Perspective*

Perception of risk is a hot topic within marijuana legalization. It is by far one of the more prominent issues among our youth and the perception that marijuana is harmless is continuing to grow. National surveys such as Monitoring the Future and The National Survey on Drug Use and Health statistically reflect this growing trend. Amongst the more particular research the results are appearing to substantiate this issue.

One study took a racially diverse population of over 8,000 6<sup>th</sup> and 8<sup>th</sup> grade students from Southern California and observed that exposure to medical marijuana ads predicted significantly stronger 'intentions to use' marijuana, and, 'actually use' marijuana, one year later. The research also observed that marijuana use and intentions to use were predictive of exposure to medical marijuana ads. "Youth who reported marijuana

use were almost three times more likely to report seeing ads one year later” (D’Amico, Miles, & Tucker, 2015).

Similar to national surveys, the Utah Office of Education, Department of Health, and Department of Human services conducted their own biennial survey involving questions on prevention and drug use for grades 6, 8, 10, and 12. Analyses of this data from three of its larger school districts within Utah County in the years 2009, 2011, and 2013 found that “across school grades, students who viewed marijuana as not risky were 9 times more likely to have ever used marijuana”. This association strengthened even more when compared to individuals with past 30 day use alone (Merrill, 2015).

Analysis also found that “being male, non-white, Hispanic, not having a mother or father in the home, or living with a stepparent, were all factors associated with a significant increased perception that marijuana use has no risk” (Merrill, 2015).

An original longitudinal study took a look at how self-perceived reasons for using marijuana change over the course of an individual’s age. The research observed 32 sizeable cohorts of 18 to 30 year olds at different waves within the Monitoring The Future study from 1976 to 2007. They found that:

- 1) Individuals self-perceived reasons for using marijuana were shown to be effected by current age, with ‘to get high’ and ‘to relax’ significantly increasing with age
- 2) Those who reported past 30-day marijuana use at the age of 18 had nearly 5.5 times the odds of reporting using marijuana for the reason of ‘because they were hooked’ (Bachman et al., 2011).

Finding 2) strongly suggests that earlier substance use leads to later reasons to continue using and continues to substantiate, amongst all the aforementioned literature that continuing to prohibit recreational use is a health necessity.

### *Research from Colorado after Legalization – Early Evidence of the Impact of Legalization on Youth*

In the summer of 2015, 95 school resource officers and 188 school counselors surveyed from the Colorado public school system reported that adolescents between 8<sup>th</sup> and 12<sup>th</sup> grade primarily obtain marijuana from ‘friends who obtain it legally’ or ‘family members’.

In the summer of 2015, 90% of the 95 school resource officers surveyed from the Colorado public school system reported an increase in marijuana-related incidents. 69% of the 188 school counselors from the Colorado public school system also reported an increase in marijuana-related incidents (“The Legalization of Marijuana in Colorado: The Impact”, 2013).

## **Closing Statement**

The research is clear: marijuana has a negative impact on young people. Whether directly or through association, marijuana contributes negatively to the individualized health of youth and, by extension, to all of Connecticut. The development of healthy young people leads to the development of a healthy society. We have a responsibility to protect them, through laws and public policies that protect their health and wellbeing. Legalization of recreational marijuana in the state of CT would have a negative impact on our young people and by extension, on the future of our state. With the research on the negative impact of marijuana on youth, The Governor’s Prevention Partnership stands by its assertion that marijuana remain illegal for recreational use in the state of Connecticut.

## Appendix

### **Drafting Marijuana Policy: Topics of Regulation to Consider**

1. Rights of local jurisdictions
2. Ability for counties or zones to prohibit recreational marijuana (if they desire)
3. Amount of tax and period of taxation
4. Quantity of, proximity of, and location of recreational retail stores
5. Types/quantity of licenses allowed
6. Home growing (Yes, No, How much, etc.)
7. Age limit for being legal
8. Legal quantity allowed to be possessed on a person's body
9. Who oversees entire regulation
10. Who collects the taxes and other monetary gains
11. How are the monetary gains allocated
12. Where can marijuana legally be smoked
13. Retroactive expunction
14. How new policies interact with existing law
15. How new policies interact with medical marijuana laws
16. Driving Under the Influence of Intoxicants (DUII)
17. Clear definitions of all things related to marijuana (plant, edibles, vapes, THC, etc.)
18. Retail transaction limits
19. Registration of recreational users
20. Market integration
21. Packaging and labeling
22. Advertisement limitations
23. How to handle non-compliance with new policies
24. Official record keeping of how new laws effect the state
25. Potency limits

### **Current Resources on Marijuana**

1. Substance Abuse and Mental Health Services Administration
2. State Departments and Data (Health and Human Services, etc.)
3. Monitoring The Future (National Survey)
4. National Organization for the Reform of Marijuana Laws (NORML)
5. Marijuana Policy Project (MPP)
6. FBI Uniform Crime Reports (<https://www.fbi.gov/about-us/cjis/ucr/ucr>)
7. National Institute on Drug Abuse (NIDA)
8. Office of National Drug Control Policy
9. Center for Disease Control and Prevention
10. National Survey on Drug Use and Health (NSDUH)
11. Rocky Mountain High Intensity Drug Trafficking Areas
12. Drug Policy Alliance (DPA)
13. Washington State's marijuana information site implemented after legalization ([learnaboutmarijuanawa.org](http://learnaboutmarijuanawa.org))
14. American Association of Child and Adolescent Psychiatry
15. National Epidemiologic Survey on Alcohol and Related Conditions (NESARC)
16. Stay Safe Alaska
17. Alaska Memorandum re CLMS (included in archives)

## References

- Ambler, A., Caspi, A., Harrington, H., Houts, R., Keefe, R. S. E., McDonald, K., . . . Meier, M. H. (2012). Persistent cannabis users show neuropsychological decline from childhood to midlife. *Proceedings of the National Academy of Sciences of the United States of America*, *109*(40), E2657-E2664. [www.pnas.org/cgi/doi/10.1073/pnas.1206820109](http://www.pnas.org/cgi/doi/10.1073/pnas.1206820109)
- Arria, A. M., Bugbee, B. A., O'Grady, K. E., & Vincent, K. B. (2015). The academic consequences of marijuana use during college. *Psychology of Addictive Behaviors*. Advance online publication. <http://dx.doi.org/10.1037/adb0000108>
- Bachman, J. G., Johnston, L. D., Kloska, D. D., Maggs, J. L., O'Malley, P. M., Patrick, M. E., & Schulenberg, J. E. (2011). Age-related changes in reasons for using alcohol and marijuana from ages 18 to 30 in a national sample. *Psychology of Addictive Behaviors*, *25*(2), 330-339. DOI: 10.1037/a0022445
- Bellis, M. D. D., Hooper, S. R., & Woolley, D. (2014). Intellectual, neurocognitive, and academic achievement in abstinent adolescents with cannabis use disorder. *Psychopharmacology*, *231*, 1467-1477. DOI 10.1007/s00213-014-3463-z
- Blood, A. J., Breiter, H. C., Gilman, J. M., Kim, B. W., Kouwe, A. V. D., Kuster, J. K., . . . Makris, N. (2014). Cannabis use is quantitatively associated with nucleus accumbens and amygdala abnormalities in young adult recreational users. *The Journal of Neuroscience*, *34*(16), 5529-5538. DOI:10.1523/JNEUROSCI.4745-13.2014
- Connecticut Department of Public Health. (2013). Youth risk behavior survey. Connecticut School Health Survey. Retrieved from [http://www.ct.gov/dph/lib/dph/hisr/pdf/cshs\\_ycbc2013\\_report.pdf](http://www.ct.gov/dph/lib/dph/hisr/pdf/cshs_ycbc2013_report.pdf)
- D'Amico, E. J., Miles, J. N. V., & Tucker, J. S. (2015). Gateway to curiosity: Medical marijuana ads and intention to use during middle school. *Psychology of Addictive Behaviors*. Advance online publication. <http://dx.doi.org/10.1037/adb0000094>
- Dahlgren, M. K., Gruber, S. A., Kathryn, M., Lukas, S. E., & Racine, M. (2012). Age of onset of marijuana use and executive function. *Psychology of Addictive Behaviors*, *26*(3), 496-506. DOI: 10.1037/a0026269
- Dahlgren, M. K., Gruber, S. A., Lukas, S. E., & Sagar, K. A. (2014). Worth the wait: effects of age of onset of marijuana use on white matter and impulsivity. *Psychopharmacology*, *231*, 1455-1465. DOI 10.1007/s00213-013-3326-z
- Data on U.S. Public High Schools & Private High Schools. (2015). Compare connecticut high schools to the rest of the united states. Retrieved from: <http://high-schools.com/directory/ct/#school-comparison>
- McQueeney, T., Medina, K. L., Nagel, B. J., Park, A., & Tapert, S. F. (2007). Depressive symptoms in adolescents: associations with white matter volume and marijuana use. *Journal of Child Psychology and Psychiatry*, *48*(6), 592-600. doi:10.1111/j.1469-7610.2007.01728.x
- Merrill, R. M. (2015). Use of marijuana and changing risk perceptions. *American Journal of Health Behaviors*, *39*(3), 308-317. DOI: <http://dx.doi.org/10.5993/AJHB.39.3.3>
- Ryan, A. K. (2010). The lasting effects of marijuana use on educational attainment in midlife. *Substance Use & Misuse*, *45*(4), 554-597. DOI: 10.3109/10826080802490238
- Substance Abuse and Mental Health Services Administration (SAMHSA). *Results from the 2013 National Survey on Drug Use and Health: Summary of National Findings*. Rockville, MD: Substance Abuse and Mental Health Services Administration; 2014. HHS Publication No. (SMA) 14-4887. NSDUH Series H-49.
- The legalization of marijuana in colorado: The impact. (2013). *Rocky Mountain High Intensity Drug Trafficking Area*, *3*, 46-48. Retrieved from [www.rmhidta.org](http://www.rmhidta.org)