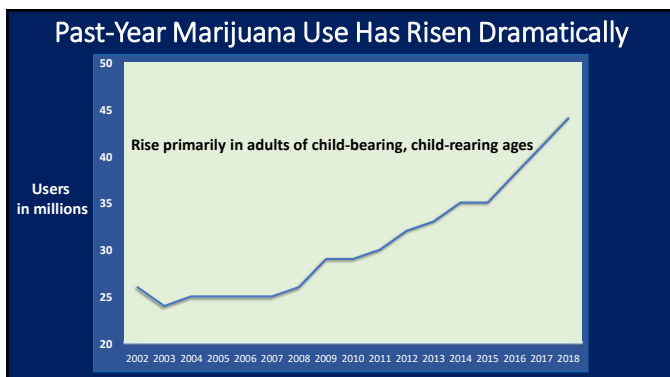


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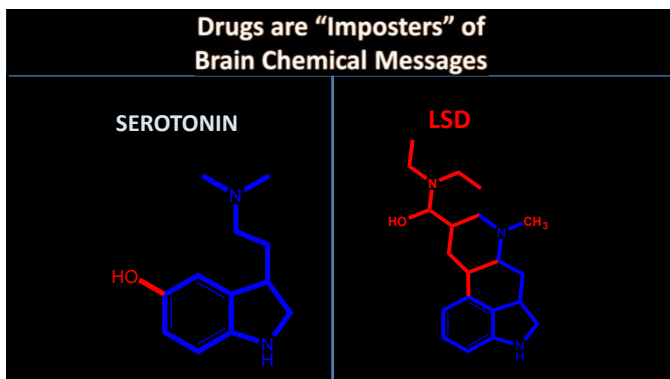
3

Introduction	
	Marijuana Biology
	Teen Marijuana Use: Risks Consequences
	High Frequency, High Potency Marijuana
	Can Marijuana Solve the Opioid Crisis?
	Parents and Offspring

4

Marijuana Biology


5



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What is THC?

Made by the brain



Anandamide

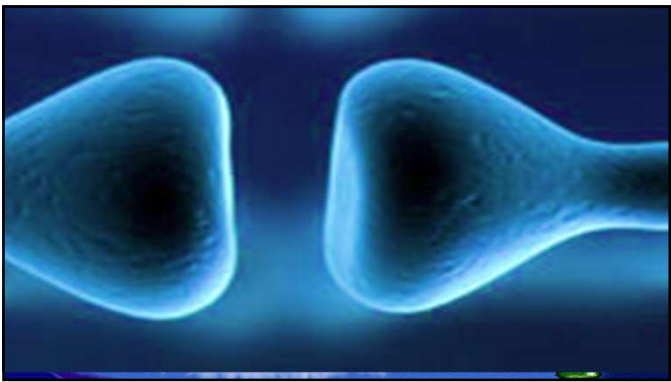
Made by marijuana



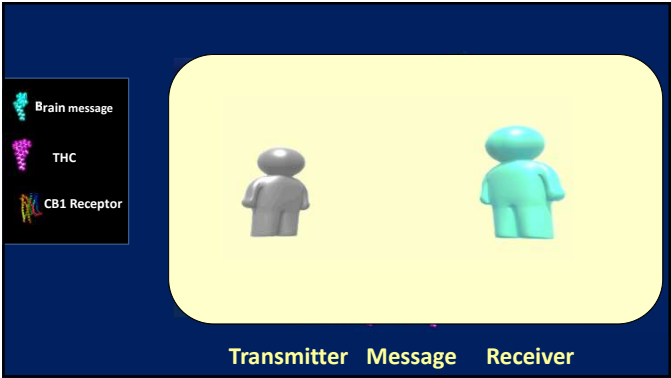
THC

Models from BK Madras, W Mascarella: Museum of Science, Boston Exhibit

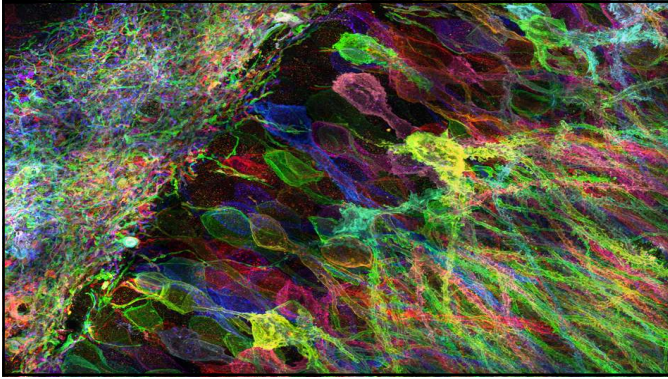
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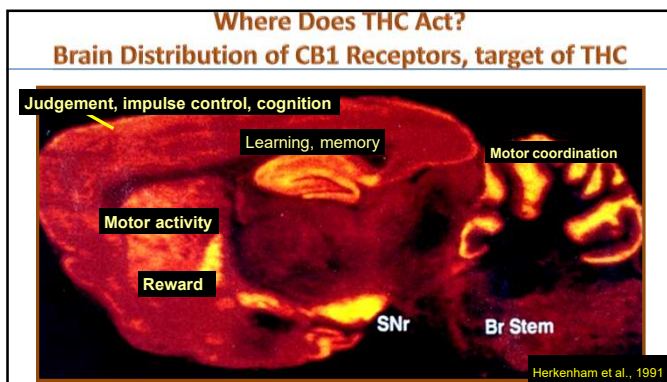
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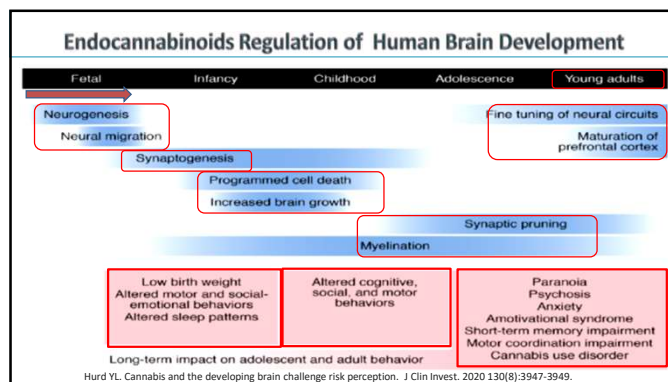


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The Developing Adolescent Brain

- Increases grey, white matter
- Prunes some connections
- Strengthens connections
- Changes function regionally

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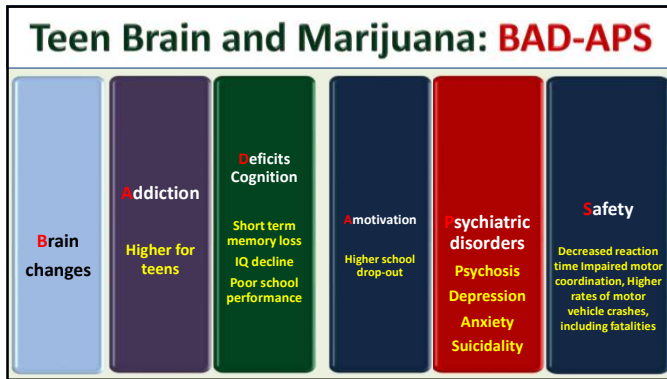
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Endocannabinoids Shape Brain Function Marijuana Affects these Brain Regions

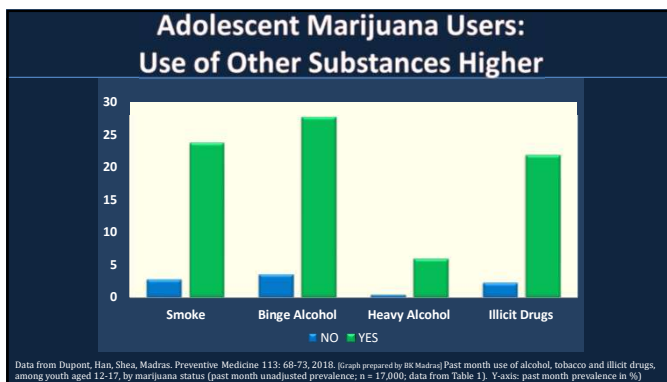
- THC accumulates in brain
- Released into bloodstream 5 days to weeks with heavy, regular use
- Neurodevelopmental effects can continue for weeks to months after use
- Marijuana affects development and maturation of circuits, grey white matter
- Impairs brain function

Cnaan RD, Crane NA, Mason RJ. An evidence based review of acute and long-term effects of cannabis use on executive cognitive functions. Journal of Addiction Medicine 2011;5:1-8. Pope HG Jr, et al. Early-onset cannabis use and cognitive deficits: what is the nature of the association? Drug Alcohol Depend. 2003 Apr 1;69(3):393-401. Pope and Vergara-Rodriguez (1996). Schwab et al. 2009, Fritzsche et al. 1999, Melnik and Hunt 2009, Parfex & Pennington, 2007 et al., 2002, Harvey et al. 2002, Soloway & Pech, 2010, Noveck et al. 2008, Barlow et al., 2010, Schweinsburg A.D., Brown S.A., Tapert S.F. The influence of marijuana use on neurocognitive functioning in adolescents. Curr Drug Abuse Rev 2008; 1: 99. Lisdahl K.M., Wright N.E., Medina-Sanchez C., Alparone R., Swalesberger S. Considering cannabis: the effects of regular cannabis use on neurocognition in adolescents and young adults. Curr Addict Rep 2014; 3: 144-56. Manza P, Yuan K, Shouri-Kajori E, Tomas D, Volkow NO. Brain structural changes in cannabis dependence: association with MAGI. published online ahead of print, 2019 Nov 6. Mol Psychiatry. 2019;10.1038/s41380-019-0577-z

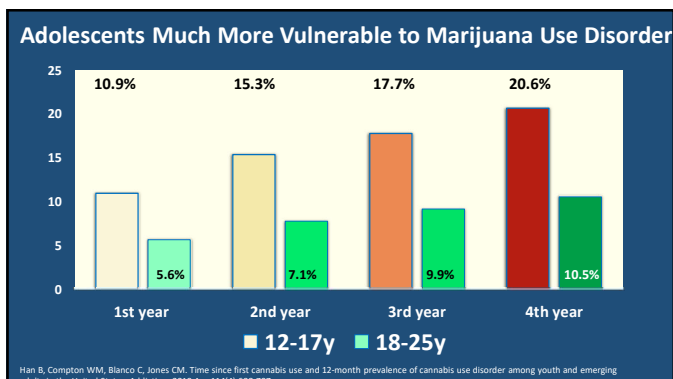
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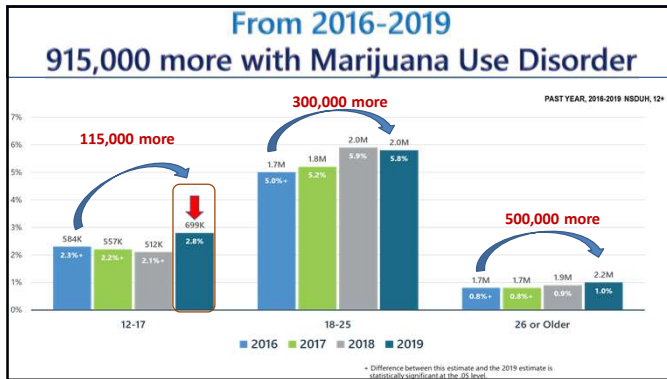
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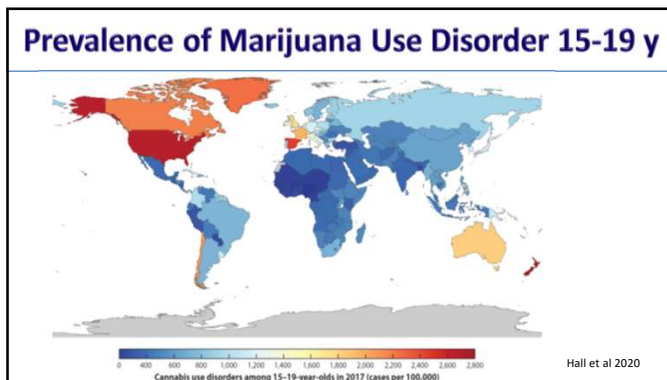
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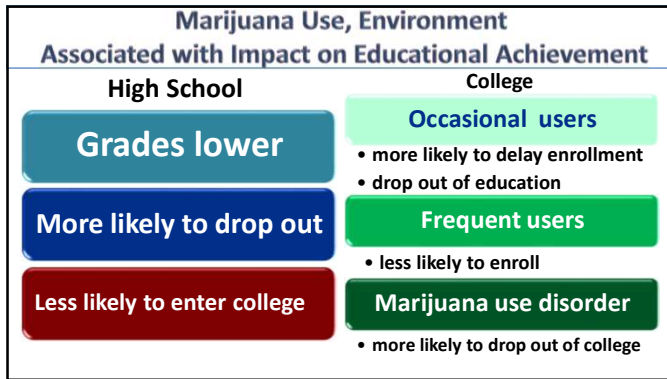
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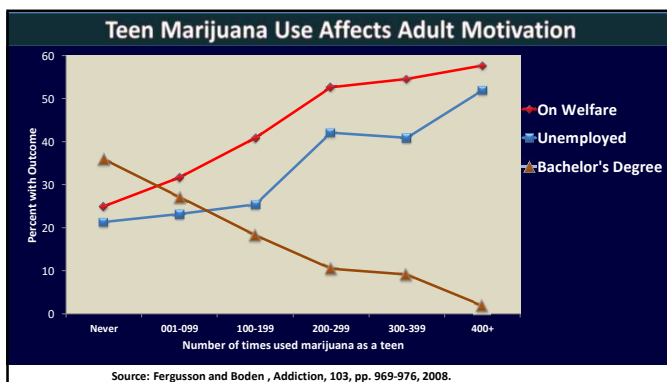
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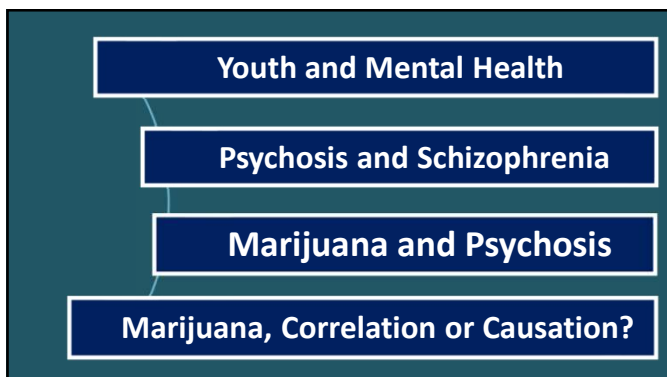
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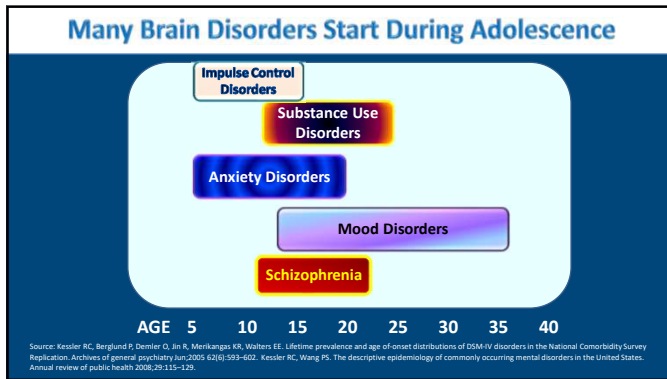
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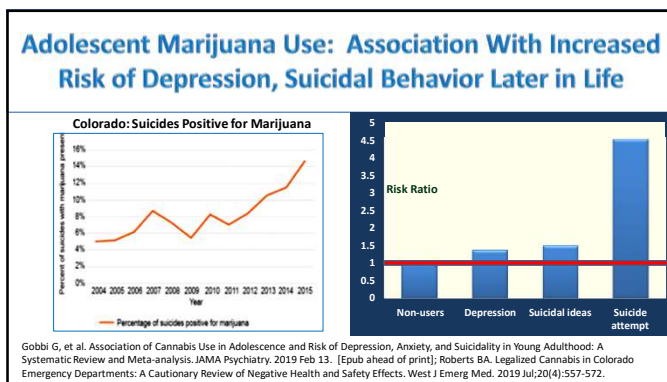
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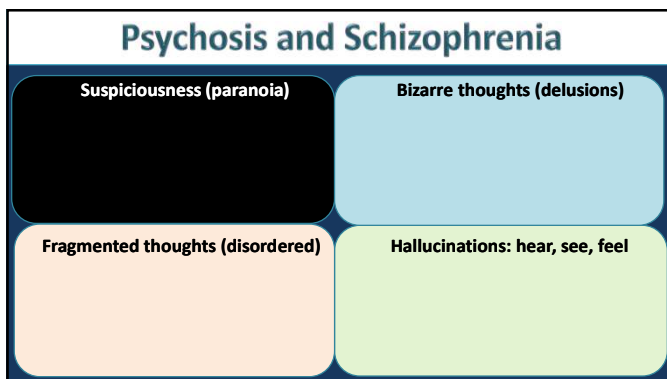
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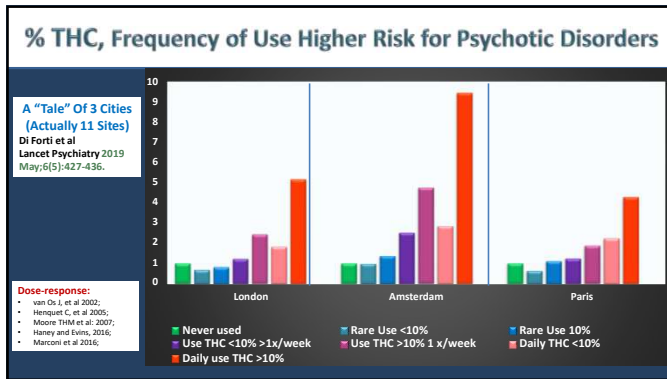
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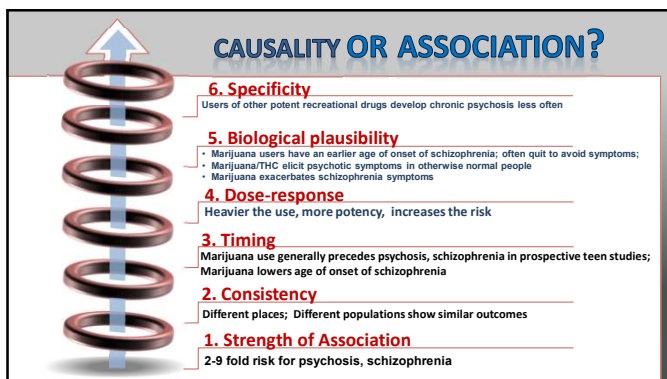


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Criteria for Causation	
Strength of Association	• larger the association, the more likely that it is causal
Consistency	• Consistent findings different places, different samples
Timing	• effect occurs after the cause
Dose-response	• Stronger dose, more frequent use, longer use, worse outcomes
Specificity	• Specific population with no other likely explanation
Biological plausibility	• A mechanism between cause-effect, if not limited presently

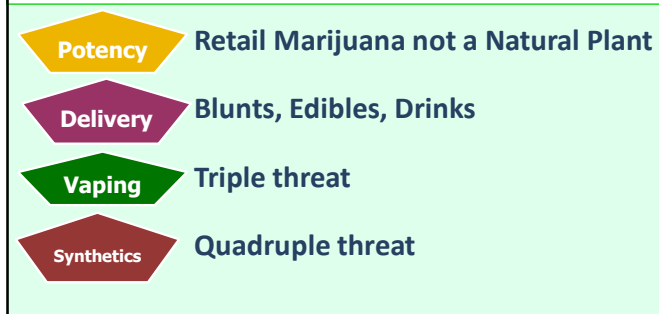
Hill, Austin Bradford (1965). "The Environment and Disease: Association or Causation?" *Proceedings of the Royal Society of Medicine*. 58 (5): 295–300.

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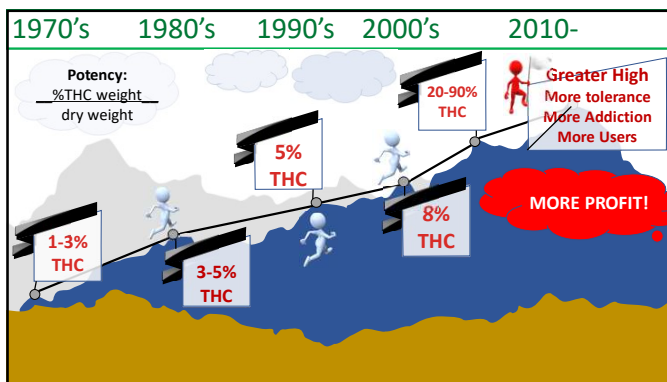


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What is New Marijuana?



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Why Does THC Potency Matter?

Higher potency, more drug effects, tolerance, addictive potential, others

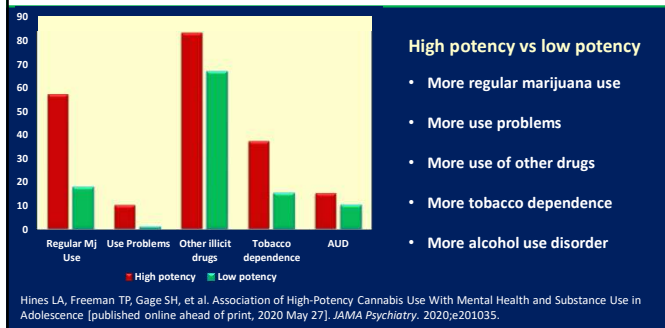
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The Reality

Sale of extracts rise	• +70% THC (21% of all sales in some states)
High potency	• preference of daily users (who account for most sales)
Cap %THC or tax %THC	• to reduce incentive, but no US state has adopted policy
Increased access to potent marijuana at low price	• likely to increase frequency of use
Profit-seeking legal industry	• Goal is to increase demand, users, frequent use

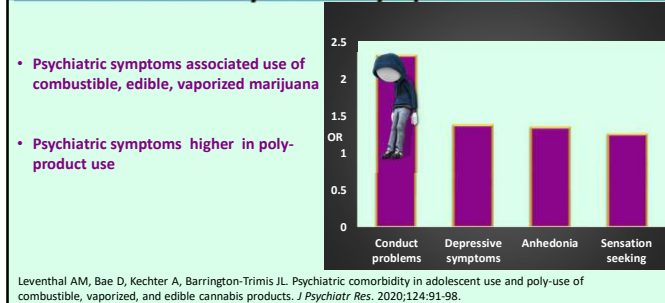
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High vs Low Potency Adolescent Marijuana Use

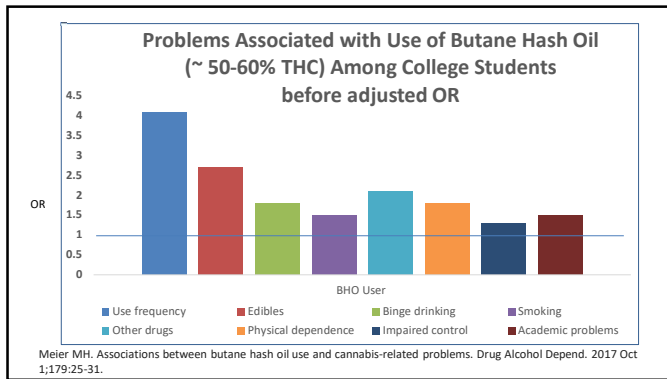


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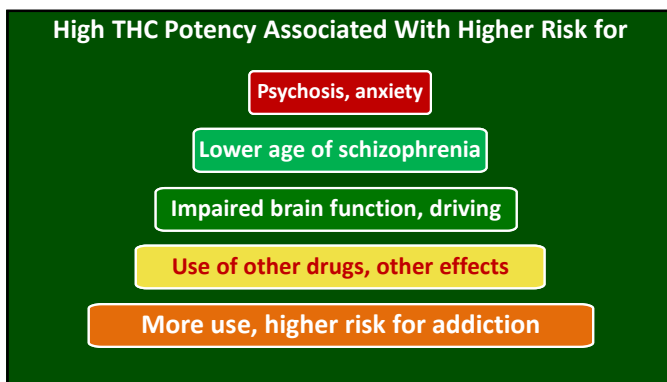
Edibles and Vaporized Marijuana Associated with Psychiatric Symptoms in Adolescents



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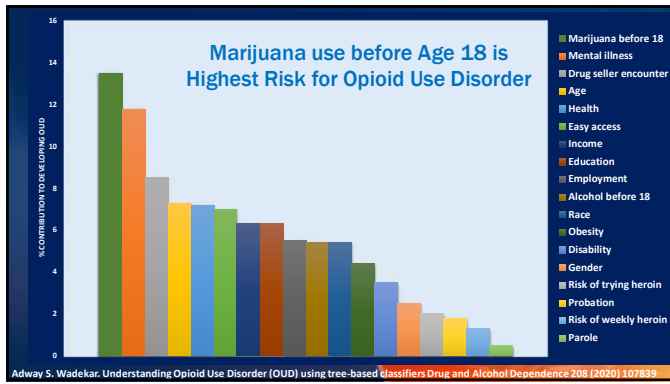


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Opioids, Overdoses, and Cannabis: Is Marijuana An Effective Therapeutic Response to the Opioid Abuse Epidemic?

PAUL J. LARKIN, JR. & BERTHA K. MADRAS, PhD
Georgetown Journal of Law and Public Policy, 2019

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Do Marijuana Users +/- Pain Use Opioids Less?	
USERS	Non-USERS
• Use more opioids than non-users	less likely to use opioids
• Misuse prescription opioids more than non-users	less likely to misuse Rx opioids
• More likely to develop Rx opioid use disorder	less likely to develop Rx OUD
• More likely to develop CUD	less likely

Degenhardt et al, 2015, Caputi et al, 2018, Olsson et al, 2017, Hasin et al 2020

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A Chasm Between Evidence and Beliefs

- **No high-quality evidence:** any form of marijuana in chronic pain
- **Adverse events may limit usefulness:** sedation, confusion, psychosis
- **At best, a few people with neuropathic pain** will benefit from long-term use

Shover CL, Vest NA, Chen D, et al. Association of State Policies Allowing Medical Cannabis for Opioid Use Disorder With Dispensary Marketing for This Indication. *JAMA Netw Open.* 2020;3(7):e2010001. Mücke M, Phillips T, Radbruch L, Petzke F, Häuser W. Cannabis-based medicines for chronic neuropathic pain in adults. *Cochrane Database Syst Rev.* 2018;3(3):CD012182. Published 2018 Mar 7.

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Summary

**Brain is maturing
until mid-20s to 30**

- THC unsafe for fetus, adolescent, young adult, especially potent marijuana

**High Potency Marijuana
Poses greater risk**

- no evidence it is necessary
- associated with more brain changes
- addiction, psychosis, hospitalizations

Marijuana and Opioids

- Evidence is weak that MJ reduces opioid use
- States put opioid users at risk by endorsing MJ

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Parents and their Offspring

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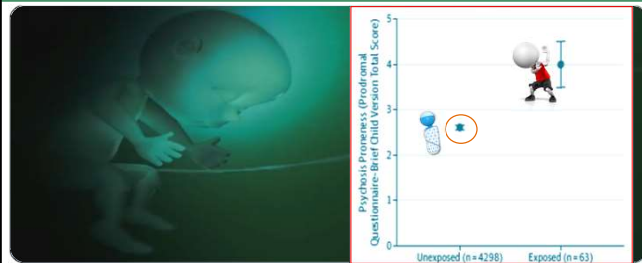
Prenatal Exposure to Marijuana: ABCD Study

9-11 y; n=11,489; 22 sites; 2016-2018; 5.7% (655) exposed prenatally

Paul SE, Hatoun A., Fine, JD Johnson EC, Hansen I, Karcher NR, Moreau AJ, Bondy E, Qu Y, Carter EB, Rogers CE, Agrawal A, BarchDM, Bogdan R. Prenatal cannabis exposure and childhood outcomes: Results from the Adolescent Brain and Cognitive Development Study ABCD. The author/funder has granted medRxiv a license to display the preprint in perpetuity. Dec. 19, 2019; doi: <https://doi.org/10.1101/2019.12.18.19015164>

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Prenatal Marijuana Exposure Associated With Psychosis Proneness During Childhood?



Jeremy D. Fine et al., Association of Prenatal marijuana Exposure With Psychosis Proneness Among Children in the Adolescent Brain Cognitive Development (ABCD) Study. JAMA Psychiatry. Published online March 27, 2019

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Prenatal Cannabis Exposure Increases Risk For Psychopathology, Reduced Cognition in Middle Childhood (11 489, 9.9 y, 5.7% exposed to cannabis)

- With increasing cannabis use among pregnant women,
- former U.S. Surgeon General Adams issued an advisory
- against marijuana use during pregnancy Aug 29th, 2019

• Psychotic-like experiences
• internalizing, externalizing

• **Reduced**
• **White and grey**
• **Matter Volume**

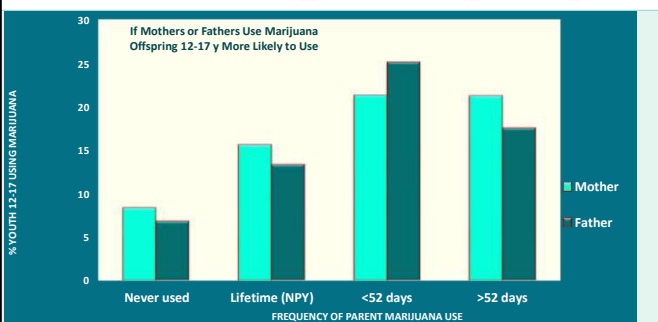


• **Attentional**
• **Thought**
• **Social**
• **Reduced cognition**
• **Social problems**

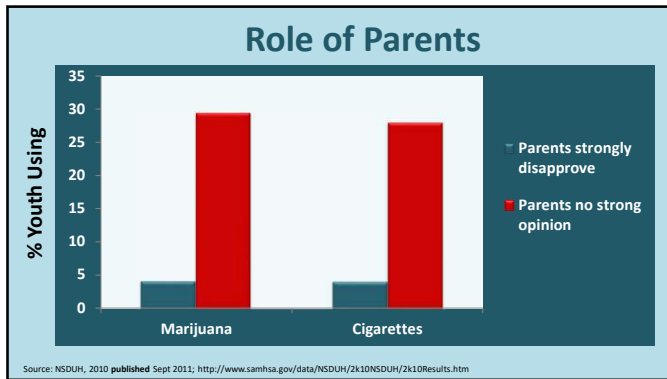
Paul SC, et al., Associations Between Prenatal Cannabis Exposure and Childhood Outcomes: Results From the ABCD Study. JAMA Psychiatry. 2020 Sep 23:e202902. doi: 10.1001/jamapsychiatry.2020.2902.

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Youth at Risk of High Potency Marijuana



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Learn Signs of Youth Drug Use

- Neglect school work
- Lose interest in extracurricular
- Change friends, groups, clothes, behavior
- Change sleep patterns, reduce sleep
- Increase in health issues, personal hygiene
- Decline in family relations
- Reduce openness and honesty

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What You
Can Do!

Promote
Prevention

Prevent multi-generational use

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What You Can Do! Promote Prevention

- Prevent Use Of All Drugs During Adolescence
- Challenge the Myth of New Marijuana as a “natural plant”
- Prevent Drug Use During Pregnancy
- Protect Safe Home Environment For Children
- Foster Parental Disapproval of Youth Marijuana
- Defend FDA Process For Drug Approval

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